Appendix A - Report MOWAT25-012

peterborough
Water Services

DRINKING WATER HANDBOOK FOR COUNCILLORS

October 2025

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This manual is based on the *Drinking Water Handbook for Public Officials* developed by the Michigan Section of the AWWA and the *Handbook of Public Water Supply in Ontario* by the Ontario Municipal Water Association.

1. Introduction

The purpose of this handbook is to provide Councillors for the City of Peterborough a general overview of all aspects in the delivery of safe drinking water for the customers of Peterborough. This handbook is a reference document to assist Councillors in providing due diligence and a standard of care in their role as the governing body for provision of municipal drinking water. As a member of Council, it is your duty to be informed, diligent and provide prudent oversight to the drinking water for the City of Peterborough.

1.1 Background on the Provision of Water in Peterborough

The original "Water Commission" was created in 1902 when the City bought the water pumping and distribution system from the private company that constructed the initial system in 1882. The Peterborough Utilities Commission (PUC) was formed in 1914 when the electric and water utilities formed under one commission. The gas utility was purchased by the City of Peterborough and transferred to the PUC in 1929. The PUC sold off the gas utility to Consumers Gas in 1959 and in 2000 the electric utility was restructured under the Ontario Business Corporation Act. The PUC (and its predecessor) is the oldest Canadian member of the American Water Works Association (joined AWWA in 1911). The Commission's office was initially located at Hunter and Bethune Streets. In 1924, a new office facility and electric sub-station was constructed at Aylmer and Sherbrooke Streets. The Commission constructed its current office on Ashburnham Drive, north of Lansdowne Street and moved in 1981. On April 1, 2025, The City of Peterborough dissolved the PUC and retained control of the drinking water system.

1.2 Background of the Peterborough Water System

The first pumphouse, dam and water distribution system was initially installed in 1882 to provide primarily fire protection for the community. The pumphouse was initially located at the Auburn dam site but with increasing water demands, a new wooden crib dam and pumphouse was constructed in 1893. The architecture of this building followed the style of the 1893 World Fair in Chicago. This building has recently been known as the "Old Monkey House". On May 24th, 2006 the Old Monkey House was renamed the Ross L. Dobbin Building to commemorate the founder of the zoo.

Ross L Dobbin Building

In 1909, the existing concrete dam and pumphouse was constructed downstream of the existing dam.

In 1921, construction commenced on the current Water Treatment Plant. Major expansions to the plant have occurred in 1952 (3

MGD expansion – basins 3 & 4), 1967 (Plant 2 constructed, filters 10 & 11) and 1995 (sedimentation tanks 5 & 6 added). Peterborough was the first Canadian city to install rapid sand filters (1922) and the second in Canada to install chlorine disinfection equipment (1916). In the fall of 2014, the construction of the new reservoir and contact tank began; and was completed in 2015. The second tank will provide redundancy and increase storage capacity. Rehabilitation of the Sherbrooke Elevated Tank and the High St Tank was completed in 2019 and 2021 respectively. This rehabilitation extends the useful life by 30 years.

1.3 Overview of the Municipal Water System

The source water for the City's drinking water is the Otonabee River. The present Water Treatment Plant has a treatment capacity of 104 million litres/day (also known as megalitres per day or ML/d). Approximately half of the City's drinking water is pumped from the power of the river using turbine-driven pumps. The remainder of the water is pumped using electric pumps. There is gas-fired and diesel standby power to run the entire Water Treatment Plant in case of a power outage.

The water distribution system consists of over 469 kilometers of water mains, 28,348 individual services and 2,501 hydrants. Underground reservoirs and elevated storage tanks provide an additional capacity of 48 million litres of drinking water in case of a large fire or high demand.

At current, the replacement cost of the entire water works is approximately $1.177B, with $787M in the water distribution system.

1.4 Water Source

The hydrologic cycle (figure 1) continuously replenishes and redistributes the water on earth through precipitation, runoff and percolation into the soil, and evaporation, condensation, and precipitation again. This continuing cycle makes adequate amounts of fresh water available in most parts of the world either as groundwater or surface water.

Public water systems are generally classified by their water source since it has considerable bearing on the quality of the water, the amount of water available, and the kind of treatment needed before distribution to the customer.

Groundwater sources fall into the general categories of wells, springs and infiltration galleries. A true groundwater is not typically subject to contamination by disease causing microorganisms, but contamination by synthetic chemicals may be possible. The water from most groundwater sources is of acceptable quality requiring minimal treatment (disinfection), but the quantity available for public water system use is often limited.

Surface water is available in most of the world from rivers and lakes. Large rivers are important sources of water for public water systems, but smaller streams can also be used as long as the flow is reliable. Although water from some lakes and rivers is quite clean, surface water must frequently be treated to remove sediment and disease-causing organisms before public use. When compared to groundwater, surface sources usually require a larger investment in treatment facilities and have higher operating costs. Peterborough falls into this category as its raw water source in the Otonabee River.

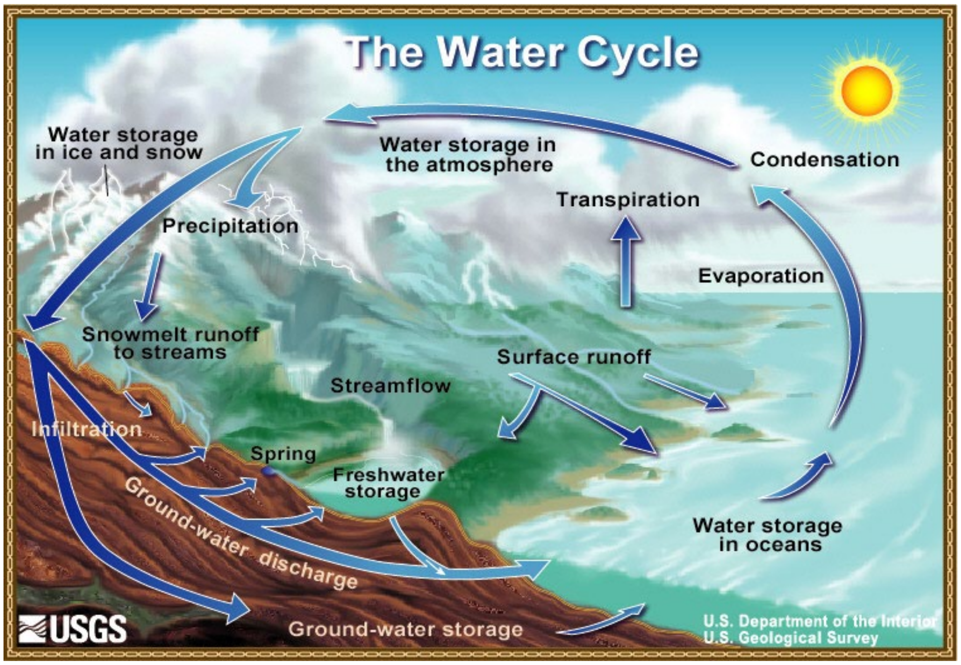


Figure 1: Hydrological Cycle

1.5 Water System Operating Considerations

Three aspects of public water supply operation that must be considered when managing and operating are *quantity, quality and system reliability*. A public water system must be capable of meeting all customer quantity demands under any conditions. Water use by customers generally falls into several categories.

1.5.1 Domestic Use

Domestic use is the consumption by private households and other living facilities and usually fluctuates by the time of day, day of the week and time of year. On a normal day, there is a moderately high water use in the early morning, much higher use in the evening and relatively low water use throughout the night. The highest domestic use causing the highest consumption for the year is during the summer months due to lawn watering. Average city water consumption can double during dry periods where substantial lawn watering occurs.

1.5.2 Commercial Use

Commercial use is the water used by stores, offices, and other businesses. A few businesses such as laundries and greenhouses use larger quantities of water, but most commercial customers use relatively little water.

1.5.3 Industrial Use

Industrial use is the water used by factories and industries. Many factories do not use water in manufacturing, only requiring water for drinking, sewage disposal and cleaning. These industries are referred to as “dry industries”. A few industries known as “wet industries” use large quantities of water for manufacturing process, cooling, cleaning or incorporation into the product that is being manufactured. Industries frequently have internal fire sprinkler systems, which require a water service adequate for drawing large quantities of water in the event of a fire. Individual use is usually consistent but varies with the number of shifts worked and days of the week the industry is in operation. In some cases, industries have wells or surface water sources for use in the plant processes and only use water from the public water system for drinking and sanitary purposes. Pepsi QTG, for example, draw from the river to supply water for standby fire fighting purposes.

1.5.4 Institutional Use

Institutional use is the water used by government institutions, schools, hospitals and churches. Like commercial customers, their water usage varies depending on the type of institution.

1.5.5 Fire Use

Fire use capability is the ability to furnish adequate amounts of water for fighting fires. The amount of water required for fire protection must be in addition to the daily domestic, commercial, industrial and institutional use. A reserve’s ability to furnish adequate amounts of water in the event of a fire is achieved by maintaining additional pumps or wells or reserving treated water in storage. Fire fighting can place a significant demand on the water supply system. Table 1 illustrates some large water demands from major fires in Peterborough.

Table 1: Historical data on water demands for major fires

Location	Date	Water Volume Used (litres)
Aylmer & Charlotte St.	December 1984	18,200,000
George Street	June 1992	9,100,000
Aylmer & Simcoe St.	February 1996	8,600,000 ±
Water & Hunter St.	February 1996	4,500,000 ±

The capacity to fight a fire at any given time has a significant effect on many capital costs such as pumping, storage and distribution piping. Having the proper firefighting capacity however, reduces insurance rates throughout the community.

Currently, a portion of the cost to provide fire service to the community is paid through taxes, collected as part of the City of Peterborough’s Fire Services budget.

2. Water Quality Monitoring

In order to assure that drinking water is safe, the water quality must be monitored through frequent and often continuous testing. Tests are performed on raw water at several stages in the treatment process, on plant effluent water, at a number of locations throughout the distribution system and during construction projects. The type and frequency of testing varies depending on test parameter and its criticality. There are 16 water-sampling locations across the city. Annually, over 20,000 water quality tests were performed on Peterborough's water.

There are various ways to monitor water quality. Key parameters at the water treatment plant, such as chlorine residual, turbidity, fluoride levels, water levels and water pressure are monitored *continuously* by use of online instruments linked to an alarm and data storage system (known as Supervisory Control and Data Acquisition or SCADA). Key points in the distribution system also have online analyzers to ensure adequate disinfection at the point of use by consumers. Other operational parameters are sampled periodically using a grab sample technique.

The water treatment plant has a laboratory that performs daily tests on operational parameters such as chlorine, turbidity, fluoride, pH and colour. Monthly tests are carried out to check iron, aluminum, hardness, alkalinity and silica levels. Any other test such as daily bacteriological tests and other periodic tests are done at an accredited laboratory, presently City of Peterborough Environmental Protection Laboratory. Each test is compared to maximum allowable levels of contaminants in water contained in the Drinking Water Quality Standards, O. Reg. 169/03.

The water customer is also a very important part of our water quality monitoring program. We have a 24-hour number the customer can call if they have concerns about water quality. Customer complaint records are kept to determine trends that may be of concern. In most cases, we respond in person to address the customer and sample the water if necessary. In cases where we are aware of disturbances in the system (such as crews flushing hydrants, etc.), we instruct the customer to run their taps for about 30 minutes until the water clears. If the problem persists, the customer is instructed to call us back and we will attend the location to investigate. Customer complaint records assist in establishing capital project priorities.

2.1 Bacteriological Sampling

All public water systems are required to collect water samples for analysis for the presence of coliform and E-coli. Bacteriological samples are collected three times per week in Peterborough. Samples must be carefully collected to avoid contamination and promptly transported or shipped to the laboratory for analysis. City of Peterborough Environmental Protection Laboratory, a Canadian Association for Environmental Analytical Laboratories (CAEAL) accredited lab, performs any tests that cannot be performed at the water treatment plant (for regulatory reasons) such as bacteriological samples.

2.2 Organic, Inorganic and Radiological Sampling

Water samples from water systems must be periodically collected and analyzed to detect the presence of various organic and inorganic chemicals and radionuclides listed in O. Reg. 169/03. Additional parameters may also be listed in the Certificate of Approval for the Water Treatment Plant. The required frequency of sampling varies depending on the compound and is listed in O. Reg. 170/03.

2.3 Adverse Water Incidences

Whenever a regulated operating authority or an accredited laboratory tests for a parameter and the result is beyond the maximum allowable concentration (MAC), the result is defined as *adverse*, triggering the following events. The operator must immediately notify the owner or its designate (if the operator is not the owner), Ontario's Spills Action Centre (SAC) and the local Medical Officer of Health. Corrective action must commence according to the parameter and result received.

If the laboratory performed the test that resulted in an adverse, the lab must immediately notify the operator, the Ontario's Spills Action Centre (SAC) and the local Medical Officer of Health.

The local Medical Officer of Health is responsible for public health and they are the only ones who can issue and rescind and boil water order or advisory. The water utility can issue drinking water advisory but the local Medical Officer of Health must rescind it.

3. Water Sources

3.1 Surface Water

It is relatively rare to have sufficient groundwater available to serve a large community from wells. As a result, most large cities have developed at locations where fresh surface water is available from lakes or rivers. In the instances where cities grow despite not having adequate groundwater or surface water available, it usually becomes necessary to pipe in water from a distant lake or river.

Lakes and rivers provide water of widely varying quality and quantity. As a rule, surface water has passed through forests, cultivated fields, animal grazing areas, industrial sites and cities. All the exposures to water runoff from the land and sewer discharges add contaminants that can cause undesirable tastes, odours and colour to the water, as well as harmful contaminants.

Specifically, river water quality and quantity usually varies from day to day and with the seasons of the year. Water quality in some rivers is much different in spring when snowmelt and rains carry silt and decaying vegetation from forest floors, fields and urban areas. Some rivers may be in flood stage in spring and flow at a very low rate in mid-summer.

3.1.1 Peterborough Source Water

The Otonabee River, the source of water for Peterborough, flows within a large watershed that includes the Kawartha Lake Region, covers a portion of the Haliburton Highlands and extends as far north as Algonquin Park. This diverse watershed traverses the Oak Ridges Moraine, Peterborough Drumlin Field, Canadian Shield and the Kawartha and Haliburton Lakes.

The Otonabee River originates in Lakefield at the outlet of Lake Katchewanooka and flows south to Rice Lake. The river flows through the municipalities of Selwyn, the City of Peterborough, Cavan-Millbrook-North Monaghan and Otonabee-South Monaghan. The Otonabee River, which is 45 km in length and has 25 tributaries including Jackson Creek, Meade Creek, Bears Creek, and Squirrel Creek. The Otonabee River drains an area of approximately 945 square kilometres.

The water is generally very consistent in quality, being a low turbidity, moderately coloured water. The water temperature can range from 0.5°C in the winter to 26°C in the summer. Due to the large number of dams upstream, the water is generally saturated with dissolved oxygen. Fortunately, few industrial or large municipal sewage systems are located upstream of the Peterborough Water Treatment Plant.

In Peterborough, the river splits to form the Trent Canal in the north end of the city. This canal handles all boat traffic, eliminating concerns from recreational use at the water intake.

3.1.2 Water Intake

The intake structure required to withdraw water from a surface source must be located so that it will collect the best possible water. At the same time, it must be protected from damage by vandalism, ice, and floods. In general, though, an intake at the surface will draw water of variable temperature and quality and may become clogged by floating debris.

The best quality water can usually be obtained near the bottom or at a relatively deep point in a river. The Peterborough plant has twin (for redundancy) intake pipes trenched into the bottom when they approach shore to protect them and the intake structure is slightly raised to avoid drawing in silt and sediment from the bottom.

The water drawn through the intake is deposited by gravity into an intake wet well located on shore. This structure helps equalize flow and provides a place for stones and debris to settle out so they will not damage pumps and treatment equipment.

In recent years, zebra mussels and other types of freshwater mollusks have invaded the Great Lakes and other surface waters in the Canada. The forecast is that they could eventually be present in most lakes and streams. These shellfish attach to underwater structures including water intakes and pipelines. When the mollusk dies, the shell is left attached. In order to deal with the problem of zebra mussel blocking the intake, water is slightly pre-chlorinated as it enters the intake pipe. Since their peak numbers in about 2000 the zebra mussels have cleaned the river water, causing less turbidity but allowing more sunlight to reach the riverbed. As such, there is more benthic (bottom-growing) algae growth than in the past.

Another issue for Peterborough’s water intake is anchor or frazil ice. On clear cold winter nights when the river is not frozen over, the water can super cool creating a suspended ice formation that can clog the intakes. When this occurs the intakes are generally shutdown and the water is supplied from the reservoirs and tanks. Normally, the ice problem dissipates late the next morning when the sun has a warming effect.

3.2 Ground Water

In most of Canada, water can be obtained by digging or drilling into the ground. Shallow holes will produce water in some places, while in others it may be necessary to drill hundreds of metres through earth and rock to reach water. However, the quality of water obtained from a well may not be desirable or even usable for drinking water without treatment. It is technically possible to treat just about any water to acceptable quality, but it may not be affordable.

Although groundwater can be found in most areas, the quantity is not always enough to meet all water supply needs. While the water available at some locations can supply individual home wells, it may not be enough to furnish the requirements of a public water system.

Peterborough does not use ground water since it has a reliable and easily accessible surface water source.

4. Water Treatment

It is necessary for public water systems using surface water sources to provide treatment of the water for the following reasons:

- To ensure that the water is safe from disease contamination
- To make the water aesthetically acceptable for use
- To minimize danger to public health from harmful chemicals

4.1 Water Contaminants

4.1.1 Disease Contamination

All surface water is at risk of contamination by bacteria and other microorganisms. *Pathogenic organism* is the term generally used to cover all organisms that may cause human sickness or death. Although most disease-causing organisms die quickly after being released to the environment in human or animal waste, there are some that can remain viable for a considerable period of time.

We monitor the drinking water for the entire family of coliform bacteria, which is commonly found in the environment. Coliform bacteria, itself, is not a health concern but it does indicate that there may be some contamination present. High coliform counts can also hinder detection other more harmful bacteria such as *Escherichia coli* (short formed *E. coli*).

Pathogenic organisms of particular concern today that may be transmitted in drinking water are viruses, E. coli bacteria, Cryptosporidium, Giardia Lamblia (beaver fever) cysts and Legionella.

Relatively simple inexpensive tests are available to detect the presence of coliform and E. coli bacteria. E. coli is considered the primary indicator of recent fecal contamination from wastes of humans and warm-blooded animals. All public water systems are required to regularly perform coliform and E. coli tests to provide assurance that the water has been adequately treated and the system has not become contaminated.

Unfortunately, there are no simple inexpensive tests to detect the presence of specific microorganisms such as viruses, Cryptosporidium and Giardia cysts. All surface water systems are required to use a treatment technique that will ensure adequate removal or inactivation of harmful organisms without the need for specific testing. Each surface water system must employ treatment consisting of disinfection or disinfection plus filtration in a manner known to safely remove and/or inactivate the most resistant pathogenic organisms.

4.1.2 Turbidity

Along with chlorine residuals, turbidity is one of the most important parameters we measure to determine treatment effectiveness. Turbidity is a measure of the cloudiness of the water caused by suspended matter. It is measured by determining the scattering of light through the water sample and is reported in units called *nephelometric turbidity units* (NTU). Most customers find visible turbidity in their drinking water unacceptable even if they were assured that it was safe to drink.

The presence of turbidity in drinking water also has public health significance. Turbidity can interfere with the disinfection process and can protect some microorganisms from the effects of the disinfectant. For this reason, filtered water from the WTP must meet a specific limit of 1.0 NTU. This allowable level is less than the amount visible to the naked eye, which is about 5 NTU. The filtered water from Peterborough's plant rarely exceeds 0.3 NTU.

4.1.3 Tastes and Odours

Relatively common problems with surface water sources are tastes, odours and, occasionally, unacceptable colour. These are usually due to natural causes such as decaying vegetation or plant and algae growth. The problems are usually seasonal and short-term and generally not harmful to human health. They may be offensive enough to cause customer complaints if the problem is not corrected.

Tastes and odours can also be caused by industrial chemicals. Although industries are now required to limit or eliminate unwanted discharges to waterways, it is possible to have contamination of a lake or river from a leak or spill, a broken pipeline, overturned tank truck, or chemicals dumped into a sewage system occur and not be removed by treatment. Some industrial chemicals such as phenol, are accentuated by chlorine and are offensive to consumers.

Tastes, odours and colour can often be reduced by conventional filtration treatment. If this fails, special treatment using carbon or other chemicals can usually make water quality acceptable. Peterborough relies primarily on the sedimentation and filtration stages of treatment to remove colour. Peterborough's treated water has a background earthy, swampy taste that is difficult to remove from the water inexpensively. Taste and odours are believed to be caused primarily by a natural-forming substance called geosmin which can be detected by sensitive persons at low parts per trillion concentrations. The only successful treatment for this is ozone or granular activated carbon adsorption both of which are expensive to install and operate. Peterborough has experimented with granular activated carbon on three filters to remove tastes and odours from the water.

4.1.4 Chemical Contaminants

Chemical contaminants considered harmful to human health are occasionally present in surface water sources. One of the most common is nitrate. Nitrate levels occasionally exceed standards at times of the year when there is heavy runoff from agricultural lands. Chemical leaks and spills can occur in almost any surface water source.

Specific tests to detect the presence of all chemicals that could contaminate a surface water source are not readily available. Vulnerable surface water systems are typically directed to routinely monitor for certain organic and inorganic contaminants.

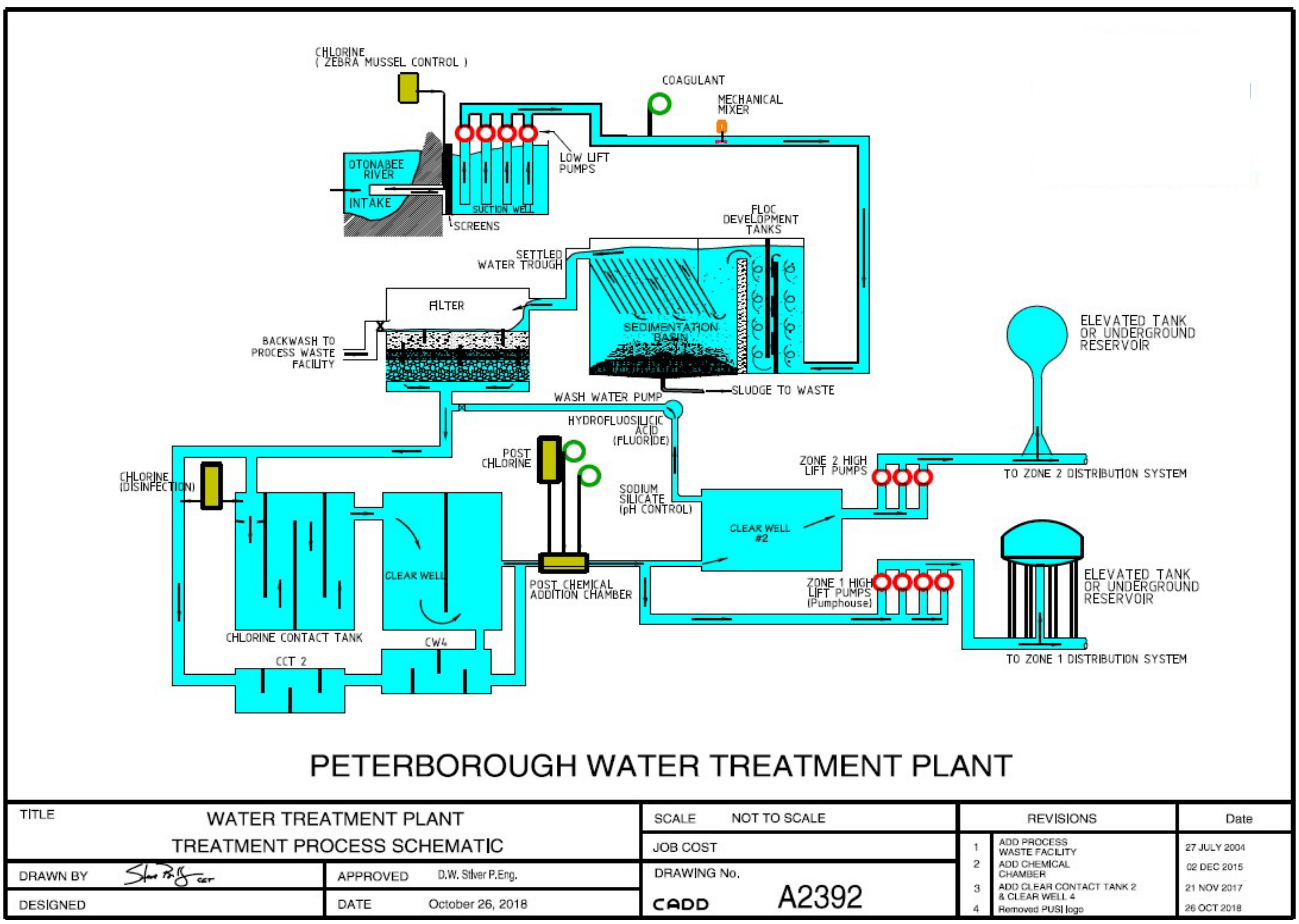
Some chemicals are fully or partially removed by conventional filtration treatment but many are not. When it is determined that chemical contamination levels are dangerous to public health and the water must be used, special water treatment for contaminant reduction is required.

Historically, tests for all chemical parameters in Peterborough's source and finished water have been well below the allowable provincial limits.

4.2 Water Treatment Process

Peterborough treats its water at a water treatment plant in the north end of the city on Water Street. The plant is rated to produce 104 million litres of treated water per day but can exceed that comfortably for short periods of time. Water is settled, filtered and disinfected to assure that it meets quality standards. This is a multi barrier treatment approach that involves several independent processes. Figure 2 shows a schematic diagram of the water treatment process at the Peterborough Water Treatment Plant.

Figure 2: Water Treatment Plant



4.2.1 Coagulation/Sedimentation/Flocculation

Once the low lift pumps have pumped the water out of the low lift wet-well, a coagulant is added. The coagulant, aluminum sulfide (alum), is mixed with the water using a mechanical mixer to distribute the coagulant throughout the water. The water then enters the flocculation tanks which is a slow mixing process that brings particles suspended in the water into contact with each other. This has the effect of forming larger particles of floc made up of fine particles that have adhered to each other. Once the floc has been allowed to grow, the water is then directed to large sedimentation basins where the water velocity is slowed allowing most of the suspended matter to fall to the bottom. Water exits near the top of the sedimentation basins and is then directed to the filter beds. The sludge that has accumulated at the bottom of the basins must be periodically removed using suction and is sent to the process waste facility for process waste treatment.

4.2.2 Filtration

Rapid sand filters are used to filter the water once the sedimentation process has settled out the larger particles. Rapid sand filters are constructed using sand of special grading and grain size so that the water will pass through rapidly. The sand is supported on layers of stone or porous plates in a concrete box and the filtered water is collected by a piping system at the bottom.

In Peterborough, a dual-media design of rapid sand filter is used. It has two layers; the top layer is anthracite or granular activated carbon, the bottom is sand. Anthracite has a slightly larger grain size than the sand allowing it to remove larger particles before they reach the sand layer. The water treatment plant is equipped with eleven dual-media filters, eight are sand/anthracite filters and the other three are granular activated carbon filters. Water typically passes through all the filters except when filters are in a backwash cycle.

When a rapid sand filter becomes plugged the filter media is cleaned by backwashing. In this process, the flow of the water is reversed and clean water is passed up from the bottom of the filter to wash the sediment to collection troughs at the top. There are three factors that determine the backwash frequency. Filter beds are backwashed every 48 hours when the turbidity level reaches 0.3 NTU or when the head loss (friction loss through the filter) is 2 metres, whichever happens first.

During the summer months filters that contain granular activated carbon (GAC) are used in addition to the anthracite/sand (duel media) filters which remove tastes and odours from the water. Adverse tastes and odours in water are more prevalent in the summer months because of increased biological activity and the warmer source water in the river.

4.2.3 Disinfection

Following flocculation, sedimentation and filtration the water must be disinfected. This process eliminates or inactivates disease-causing organisms in the water. Chlorine is the most commonly used disinfectant in Canada and the U.S. and is used to disinfect the water in Peterborough. The principal advantages of chlorine are that it is a very strong disinfectant and a persisting residual of chlorine continues disinfecting as the water passes through the distribution system. Chlorine is also moderately priced and relatively easy to use. Two forms of chlorine used for disinfection are liquid chlorine (sodium hypochlorite) and chlorine gas. Liquid chlorine is slightly more expensive that chlorine gas but does not present the same potential danger in case of a leak. Chlorine gas is used in Peterborough and the operators are very well trained in its handling. There is also a gas scrubber designed to scrub the chlorine from the air in case of a leak within the storage building.

Once the chlorine has been added to the water it passes through a large tank known as the chlorine contact tank giving the chlorine time to come in contact with the water and to kill any organisms that are present. The quantity of chlorine that is added to the water varies based on the time of the year and results from daily chlorine tests.

4.2.4 Other Treatment

Following the disinfection stage, fluoride and sodium silicate are added to the drinking water. Hydrofluosilicic acid (fluoride) is added to the water to reduce tooth decay as per requirements of the Medical Officer of Health. Most surface water sources have little or no naturally occurring fluoride so it is necessary to add the desired amount during the treatment process. The Medical Officer of Health decides to fluoridate the water. A plebiscite on December 4, 1972 was held and City of Peterborough By-Law 1973-1 was passed to fluoridate Peterborough's drinking water. The Canadian Dental Association still supports this practice today primarily in the protection of children's teeth, albeit the target level of fluoride have been reduced over the years.

Sodium Silicate is then added for pH control and prevents internal corrosion of the iron pipes in the water distribution system.

Before being pumped into the water distribution system, water is chlorinated again to assure that post-treatment chlorine levels will be acceptable throughout the distribution system.

4.3 Water Treatment Plant Operations

4.3.1 Water Treatment Plant Operators

The responsibilities of a water treatment plant operator can be grouped into the following general categories:

- Check, adjust, and operate equipment such as pumps, meters, analyzers and electrical systems
- Determine chemical dosages and keep chemical feed equipment charged with chemicals, adjusted and operating properly
- Perform routine maintenance and condition checks of equipment and make minor repairs
- Order and maintain a stock of parts, chemicals and supplies
- Maintain operating records and submit operating reports to the system owner or responsible person
- Perform tests and special analyses required for proper operational control

- Collect and submit samples required by the MECP at the proper time
- Keep informed of regulations affecting the water system
- Recommend to superiors any major repairs, replacements or improvements to the plant that should be made

In larger and more complex treatment systems it is necessary for the operator to spend more time performing the duties of operating and maintaining the production facilities. Surface water treatment plants usually require closer monitoring and have more operations that must be performed manually. An operator must be on duty while a surface water plant is in operation unless special monitoring and alarm equipment is installed. In Peterborough, the water treatment plant is staffed 24 hours per day, 7 days per week.

4.3.2 Plant Maintenance

It is particularly important that water treatment equipment be properly maintained to minimize failure. A pump or piece of treatment equipment that fails because of improper maintenance can be very costly and disruptive to customers. For this reason, maintenance of important pieces of equipment should be regularly performed as recommended by the manufacturer. This should be accompanied by frequent inspection and testing to anticipate failure or degenerating performance.

Major maintenance on equipment whether done by the water system or by contract is best done at a time of year when water use is low. This enables the system to meet normal operating demands while the equipment under repair is out of service.

4.3.3 Process Waste Treatment

It has been common practice for water systems to discharge their treatment process wastes back into the lake or river being used as a water source or any other available watercourse. Plants employing conventional treatment almost always discharge their filter backwash water and sedimentation basin sludge without treatment.

Although water treatment wastes are generally not toxic they cause discoloration of the water, may be detrimental to wildlife and might have an effect on biological life in a lake or river. This process waste is inserted into the sanitary sewer since 2017.

5. Water Distribution System Operations

5.1 Distribution System Components

The water distribution system is the combination of pipes, pumps, valves, fire hydrants, storage tanks and reservoirs that carry water from the water treatment plant and deliver it to customers. The city is divided into 4 pressure zones. These zones are based on elevation levels throughout the city. Zones that have a higher elevation require more pumping pressure capability to maintain adequate system pressures.

5.1.1 Water Mains

The piping in the distribution system should be large enough to meet maximum domestic and industrial use by customers, provide ample flow for fire protection and allow for anticipated future demand increases.

Since fire flow is almost always the largest demand, it usually determines the pipe sizes required in the system. The water mains are the large-diameter pipes that are normally buried in the public street right-of-way. There are two types of water mains, *distribution mains* and transmission or *trunk mains*.

The term transmission or trunk main designates larger sized pipelines installed to move large quantities of water from one point to another. For instance, a water system with a central treatment plant usually requires several transmission mains to supply principal use areas. Trunk mains for a small system may be only 200 mm or 300 mm in diameter, while large system pipes can be 1000 mm to 2000 mm in diameter. In Peterborough, trunk mains are generally considered to be any pipe greater than 300 mm in diameter. Trunk mains are normally more expensive to construct and accordingly are designed differently. There have fewer valves, hydrant connections and normally have no individual service connections. The distribution mains connect to the trunk mains at several locations.

Distribution mains move smaller amounts of water to specific areas. If one were to compare the water piping to roads, the trunk mains would be the freeways and the distribution mains would be the arterial streets. Individual water services and hydrants are connected to distribution mains. These mains are generally well valved so that a portion of the main may be isolated from the rest if a repair is necessary. By providing well-looped and valved mains, the customer will be inconvenienced less frequently when mains need to be taken out of service. Six-inch diameter mains installed in most residential areas are generally considered the minimum size that will provide adequate fire flow.

Most water main pipe is made of cast iron, ductile iron, reinforced concrete or plastic (PVC or polyethylene).

5.1.1.1 Cast Iron Pipe

Cast iron (CI) pipe has been used for water mains for many years. Peterborough has cast iron mains that are over 130 years old and still functioning. Older cast iron pipe had no lining and under some water conditions, moderate to severe tuberculation occurs in the pipe. Tuberculation involves the build up of rust in mounds on the pipe interior.

Tuberculation reduces the capacity of the pipe both because of constriction of the opening and the added roughness (friction) along the walls. When tuberculation seriously restricts flow the main must be mechanically cleaned or replaced. The interior of most cast iron pipe produced in recent years has been coated with a thin layer of cement to protect the pipe interior.

5.1.1.2 Ductile Iron Pipe

Ductile iron (DI) is the newer version of cast iron that is now in general use. The material appears about the same as cast iron but it has been treated so that the metal is somewhat flexible and less subject to breaking or cracking. The pipe wall thickness was reduced from that of cast iron due to the increased strength and flexibility. As such, the early unlined ductile iron was often prone to premature corrosion failure until cement lining was introduced.

5.1.1.3 Concrete Pressure Pipe

Lager trunk water mains are made of concrete pressure pipe (CPP). This material consists of a steel pipe (for water tightness) wrapped by a reinforcing wire (for strength) and covered with concrete (for corrosion resistance). CPP pipes are very strong, resistant to external forces and will not corrode like metal mains.

5.1.1.4 Polyvinyl Chloride Pipe

Polyvinyl chloride (PVC) water main pipe is a relatively new (introduced in Canada in the mid 1970's) plastic material that is produced in the same general sizes as cast iron pipe. PVC pipe is lightweight, easy to cut, competitively priced, resistant to corrosion and somewhat flexible. On the negative side, PVC is more easily crushed than metal pipe and is difficult to find if location records are not kept. Furthermore, PVC pipes have a tendency to break longitudinally as opposed to cast iron pipes, which break circumferentially making repairs more difficult. PVC is the most common pipe used in new distribution water main installations.

5.1.1.5 Other Water Main Material Types

Other materials used in Peterborough are asbestos cement, fiber-reinforced concrete, polyethylene and steel. These material types account for a very small percentage of the pipes in the water distribution system.

5.1.2 Valves

Valves are installed at intervals in water main piping so that segments of the distribution system can be shut off for maintenance or repair. Shut- off valves should be located close enough so that only a few homes or businesses will be without water while a main is being repaired. In Peterborough we design valve locations so that no more than 50 residences will be affected with a water shutdown. When valves are to be installed in a normal grid system in which mains are in all streets and run in every direction of the grid, it is recommended that three valves be installed at each four-way intersection.

Each valve should be installed with a valve box that extends to the ground surface and has a cap that can be removed so that a valve key can be used to operate the valve. Valves should, if possible, be located where the box is easily located and where damage by snowplows and other equipment is least likely.

In addition to shut-off valves, there are air release valves, vacuum breaker valves and pressure reducing/sustaining valves. Air valves are installed at high points to release air from pipes when filling the pipe. Vacuum breaker valves are used so that a negative pressure will not collapse the pipe when the pipe is being drained. Often the air release and vacuum valves are combined as part of their construction. Pressure reducing/sustaining valves are installed at specific locations such as a pumping station to automatically control the system pressure.

5.1.3 Hydrants

Because of the climate in Peterborough, dry-barrel hydrants must be used over wet barrel hydrants. Dry-barrel hydrants have the shutoff valve located at the bottom of the barrel and are operated by a long shaft extending down from the operating nut on the top of the hydrant. Dry-barrel hydrants also have a small drain hole at the bottom that allows water to drain from the barrel when the hydrant is shut off. This will drain the barrel of the hydrant after use to prevent freezing. In areas of high water table, the drain hole is plugged and the hydrant must be manually pumped out after each use.

Hydrant locations should be selected carefully. They should be readily visible and located near a paved surface where they will be accessible to fire-fighting equipment. They should also be placed where they are protected from damage by vehicles and are least liable to be covered by plowed snow. In Peterborough, hydrants are generally placed 300 mm from the property line on the same side of the street as the water main.

Bright paint protects hydrants from rusting and makes them easy for the fire department to find. Well-maintained hydrants also project a positive public image of the water system. In Peterborough, hydrants are painted every four years and the colour of the hydrants bonnet and caps represents its flow capacity. Blue represents the highest available flow, green and orange represent moderate flow and red represents the lowest flow. This is a requirement from the Ontario Fire Code.

5.1.4 Services

The small-diameter pipe used to carry water from the water main connection to the private plumbing system at the property line is referred to as a water service. A water service pipe may range from 20 mm (3/4 inch) in diameter for a home to 250 mm (10 inch) for an industry or large building.

Each water service usually has a buried valve called a *curb stop* inserted in the line at a point in the public street or alley right-of-way. The general curb stop location in Peterborough is on the lot line where the City's responsibility ends and the landowner's begins. The buried valve is fitted with a service box that extends to the surface and has a removable cap so a valve key may be inserted to operate the valve. The curb stop is primarily used to shut off the service if the building being served is vacant or repairs are needed. It is also a way of discontinuing service for nonpayment of the water bill.

5.1.5 Storage Facilities

5.1.5.1 Elevated Tanks

Elevated tanks are the most familiar because they are visible in prominent locations in most communities. Tanks are generally located on the highest ground that is available and acceptable to the residents.

An elevated tank normally "rides" on the water system and the elevation of the water in the tank determines the water pressure in the system. When the water level is near the top of the tank the supply of water is reduced or stopped before the tank overflows. When the water level falls to a predetermined point in the tank flow to the system is increased. These tanks function to cushion or moderate pressure fluctuations caused by pumping and provide valuable water storage in case of a fire, high demands or periods when the WTP must be shut down.

Peterborough currently has three elevated tanks. The largest and most predominant is the 4.5 ML High Street tank that was installed in 1957, Peterborough also has smaller elevated tanks on Sherbrooke Street and Milroy Drive.

5.1.5.2 Reservoirs

A water reservoir is generally a large tank in which treated water is stored under no pressure. Reservoirs are constructed of concrete or steel and may be aboveground, partially underground or completely buried. Water is admitted to a reservoir by a remotely operated valve during times when excess water is available such as in the middle of the night. Pumps are then operated to extract water from the reservoir and provide it to the distribution system as needed during the day or in an emergency. Occasionally, a water system has a high point of ground available where a reservoir can be constructed so that it will supply adequate pressure to the system without repumping.

The prime advantages of a reservoir are that it can be constructed to store relatively large quantities of water and can be completely buried where an aboveground structure would be objectionable to residents. When a reservoir is completely buried, the land above it is sometimes used for a park or recreational area. The prime disadvantage is the cost of power to operate the pumping equipment.

Peterborough has two underground reservoirs, one on Towerhill Road that has a capacity of 22.7 ML and one on Clonsilla Avenue that has a capacity of 18.2 ML. Because it is built on high land, the Towerhill Road reservoir does not require additional pumping.

5.1.6 Booster Pumping Facilities

The city is divided primarily into three pressure zones. The zone boundary lines are based on the ground elevation in different areas of the city. In order to maintain pressure within the zones, booster pumping stations are positioned at these boundary lines. Booster pumps are also used to pump water into elevated storage facilities.

5.2 Metering

All new customer accounts (residential and non-residential) require water meters and Automatic Meter Reading (AMR) devices. The meter and AMR devices shall be supplied at no cost to the customer for installation at their cost. For existing customers the meter and installation is normally provided free of charge.

5.2.1 Water Conservation

In the summer, lawn watering greatly increases water demand. As a result, Water services division started its water conservation program in 1990. This program has cut peak water use by an estimated 10% by restricting and monitoring lawn-watering times. The program allows even-numbered homes to water their lawns on even-numbered days of the month and odd-numbered houses to water their lawns on odd days of the month. The restrictions are in place annually from June 1st until August 31st. The program is advertised through bill stuffers, ads in newspapers, social media, the Riverview Park & Zoo road sign, and the City’s Conservation calendar.

5.3 Distribution System Operation and Maintenance

5.3.1 Record Keeping

The Water Services Division maintains an up-to-date mapping system and database containing information about every component of the water distribution system. It includes information such as measurements from each valve to aboveground features such as buildings, curbs and extended lot lines. Fire hydrants are also shown on the map with measurements for both the hydrant and the hydrant control valve. Watermain information includes size, type of material, depth and date of installation.

These records are stored in a Geographical Information System (GIS). The GIS is a combination of maps and database components that contain water distribution system data.

Water service information is also recorded as installations or repairs are made. A water service pipe with an inadequate location record can usually be located using an electronic pipe locator but the process takes longer than using good record information.

Water service information is maintained in the GIS database. A copy of these records is also stored on file cards indexed by street address. Important information that should be obtained and recorded before the pipe is covered in the trench are measurements locating the water main tap, the type and size of pipe, burial depth and measurements to the curb stop or meter pit.

Fire hydrants each have an identifying number and an individual record in the GIS database. Basic information that is stored includes the make and model, installation date, depth and location measurements, as well as the initial capacity determined by flow tests. Continuing records are kept of all maintenance and repair performed and the results of subsequent flow tests.

5.3.2 Maintenance Needs

Water distribution system equipment is often neglected since most of the valves and other equipment are buried and seldom used. Some of the problems that are caused by poor system maintenance include customer complaints of poor water quality or lack of pressure, difficulties in repairing water main leaks and inadequate or unreliable water availability for fighting fires.

Broken water mains and water services must usually be shut off and repaired as soon as possible after they are identified. A serious leak from a broken main can drop pressure in the whole system creating a potential for system contamination.

Although leaks cannot be anticipated, there are steps that can be taken to make sure the repair is accomplished as quickly and efficiently as possible. The first task in repairing a leak is generally to shut down the smallest possible section of main so as to inconvenience the least number of customers. In some circumstances, there may be six or more valves that must be operated to isolate one section of main. If valves cannot be located or are found to be inoperable, the repair crew must continue searching until an appropriate combination of valves is found. During this delay, time and water are being wasted plus a larger-than necessary number of customers may have to be without water while the repair is made. Conversely, the water system with good records and a valve check and operation program should be able to quickly locate and operate the correct valves to shut down the smallest possible section of main and progress with the repair.

5.3.3 Cross Connection Control Program

Water distribution systems can be negatively impacted by private plumbing systems particularly when water mains are depressurized for repair or where a private plumbing system has a pump to increase the internal pressure. There have been recorded instances throughout the world where water mains have been contaminated by cross connections and backflow occurrences. The Ontario Building Code (Part 7 – Plumbing) provides for backflow prevention devices on new construction and renovations. It does not, however, deal with the ongoing testing of these devices to ensure that they are working. It also does not deal with current deficiencies in existing buildings or situations where plumbing was revised without a permit.

A cross connection control (sometimes called backflow prevention) program is designed to survey existing higher risk buildings to discover cross connections and determine the level of risk and necessary protection. The program also includes development of a database of backflow prevention devices and their annual testing results. The program is a proactive approach to protect the municipal drinking water system from backflow occurrences.

6. Capital Program

As time passes, the condition of the water system naturally deteriorates. Water mains have an expected service life of approximately 70 to 100 years. As a result, the City must replace at least 1% of the pipe in the system every year to keep the condition of the distribution system at a sustainable level. In addition to water main replacement, the Water Services Division cleans and lines pipes with cement mortar to extend the life of a water main and improve water quality and flow capacity (see section 7.2). The estimated extended life of the cement-mortar lined pipe is 30 years.

6.1 Asset Management Plan

Water Services has developed an Asset Management Plan. The purpose of this Plan is to identify and describe current asset management (AM) programs for the City of Peterborough's Water services, which inform how the water assets will be managed to achieve service levels and Key Performance Indicators (KPI). Water assets include assets that relate to the collection, production, treatment, storage, supply, or distribution of drinking water. The plan is updated every year. New areas are added and the priority of repairs is changed. There are many factors that need to be considered when evaluating water mains for replacement or rehabilitation. Water mains that show an increasing failure rate or other signs of structural instability are flagged for replacement and areas with a high frequency of water quality complainants and reduced flow are targeted for rehabilitation. The full details of this plan are posted on the City's website.

6.2 Water Main Cleaning and Relining

Figure 3: Tuberculated water main and cement lined water main

Older cast iron and ductile iron water mains are susceptible to internal corrosion if they are not lined. Over time, rust tuberculations form in unlined cast iron and ductile iron water mains. This thick rust reduces water flow and can cause brown or red water complaints when there is higher than usual flow due to fire or flow testing.

In order to improve water quality and water flow, problematic pipes that are still structurally integral are cleaned and lined with cement mortar. This process involves passing a scraper through the pipe to remove the rust from the water main. Following the scrapping, a device that sprays the cement mortar onto the inner walls of the water main is passed through the pipe. Once the cement has hardened the main can be tested and put back into service.

6.3 System Renewal

Water Services has a goal to replace a minimum of 1% of the water mains in the system every year. In order to maintain service during water main replacement and repairs a temporary water main is often installed.

6.4 System Expansion

The final factor to consider for the capital program and the development of the 5-year capital construction plan is system expansion requirements. As new subdivisions are built and the water distribution system expands hydraulic requirements change. In order to accommodate for these new requirements water mains must be replaced with larger mains that have a greater water-carrying capacity.

7. Water Services Division Management

The Water Services division is managed under the Director, Environmental Services. Staffed by a Management Team for water treatment, distribution, maintenance, engineering and quality assurance.

7.1 Water Services Management Team

Director, Environmental Services	Lorne Dainard
Manager Water Utility	Michael Meyers
Manager, Water Treatment Plant	René Gagnon
Program Manager, Quality Assurance	Patricia Skopelianos
Operation Support Manager, Water Distribution	David Mahoney
Operation Support Manager, Water Quality	Glenn Fisher
Operation Support Manager, Maintenance	Ryan Sorensen

7.2 Municipal Drinking Water Licence

Under the SDWA, the City is required to be licensed under the Municipal Drinking Water Licensing Program. This licensing system contains the following five parts;

1. A drinking water works permit;
2. An approved Operational Plan, modeled after the Drinking Water Quality Management System;
3. The system is operated by an accredited operating authority;
4. Approved Financial Plan; and
5. Permit to Take Water has been issued.

7.3 Water System Classification and Operator Licensing

Each water treatment and distribution system is scored and classified according to their size and complexity. The operator's licensing system mirrors the facility classification so that more experienced and skilled operators are required to operate larger and more complex facilities.

There are four levels of facilities for both treatment and distribution. A Class 1 facility is small and relatively simple compared to the highest and most complex Class 4 system. Currently the Peterborough Water Treatment Plant is a Class 4 facility and the distribution system is Class 2. The lower Class 2 rating in the distribution system is a result of the Water Treatment Plant staff operating and maintaining the reservoirs, elevated storage tanks and booster pumping stations.

Water operators must renew their certification every three years. It will now be necessary for our operators to have a specified number of continuing education units (CEUs) in order to renew their certification. The CEUs are awarded for attending seminars and training courses. The continuing education requirement helps ensure that certified operators are keeping abreast of changing rules and technology. See table 2 for Licensing requirements in Ontario.

Table 2: Licence Requirements for Waterworks Operators in Ontario

	Education	Experience	Exam	Other
Operator-in-training	Grade 12 or equivalent	N/A	70% on operator-in-training exam	Cannot be in charge of a facility
Class 1	Grade 12 or equivalent	1 year of experience	70% on class 1 exam	
Class 2	Grade 12 or equivalent	3 years of experience	70% on class 2 exam	Must hold a class 1 license
Class 3	Grade 12 or equivalent + 2 years of additional education or training	4 years of experience with at least 2 years as “operator-in-charge”	70% on class 3 exam	Must hold a class 2 license
Class 4	Grade 12 or equivalent + 4 years of additional education or training	4 years of experience with at least 2 years as “operator-in-charge”	70% on class 4 exam	Must hold a class 3 license

7.4 Personnel

Technological changes are rapidly making the operation of public water systems easier and more complicated at the same time. Many repetitive tasks or monitoring functions can be performed by computer systems (known as SCADA or Supervisory Control and Data Acquisition systems) but the technological complexity increases demanding more expertise from operators and maintenance persons. Operators and workers must have the knowledge and abilities to deal with complicated electronics, more powerful machinery, new treatment methods and increasing/changing regulations.

7.4.1 Operator Training

Ontario has protocols for operator training; these requirements exceed those of most other municipal-level employees. Failure to receive the necessary training will result in an operator losing their operating license and will likely result in fines being levied to the employer. It is imperative that operating authorities ensure that operators receive the required training, as if operators lose their license they cannot be allowed to operate, thus putting a strain on other operators.

The training required includes training provided by Ministry of Environment, Conservation & Parks (MECP) accredited courses plus some in-house training. In the latter case, it is imperative that training records be maintained including a lesson objective, training method and a verification of training (testing).

There are two mandatory training courses required at different stages of an operator's licensing progression. Effective August 1, 2005, an Operator-in-Training must receive an entry-level training course approved by the MECP. In addition, every operator must receive another MECP-approved training course per license cycle (3 years) dealing with new technology and emerging issues in the water industry.

On-the-job training of new employees should be by a deliberate and conscious effort. Supervisors or experienced employees who are willing to share their knowledge should be designated as trainers and allowed the time necessary to do this work.

This training is expensive in terms of course fees, travel and lodging. In addition, while an employee is away on training, a replacement must be provided. Those with oversight responsibility must ensure that these training needs are met and properly funded.

7.5 Public Relations

Traditionally, managers of municipal and other publicly owned water systems generally devoted little time and effort to public relations. There were always so many other things to do that this is usually at the bottom of the priority list.

When a water system keeps a low profile the public rarely realizes the complexity of the operation, the problems that must be coped with and the product and service the system is providing. Many customers do not even know where the water comes from. As long as service is reliable, water quality is acceptable and there are no drastic changes in rates or policy, the public generally has little interest in the operation of the water system. This concept has worked in the past, but since the onset of Social Media and the requirement to have information realtime, customers' expectations for timely and accurate information is high.

7.5.1 Public Relation Techniques

A few things that the Water Services Division does to inform the public and maintain a good image, which do not require a lot of work or cost are listed below.

- Field staff, customer service personnel and media contacts have by far the greatest exposure to the public of all water system employees. These employees must ensure that all interactions with the public are dealt with in a professional and positive manner. A consistent and professional appearance of employees is important to customers and for our corporate image. The City issues uniforms to operators, this encourages workers to maintain a neat and professional appearance, that is easily recognized by the public and customers alike while conducting work.

- Keeping the public informed of water system work is paramount. The use of social media; automated calls to inform customers of planned outages and letters advising customers of potential issues, such as frozen pipes during cold winter months provides a wealth of information. Keeping the public informed will usually fend off a negative customer experience.

  The person who has the water unexpectedly turned off in the middle of a shower or the homeowner who has clothes in the washer when the water turns brown due to water main flushing has good reason to be irate. When these potential situations occur, we provide information to customers, prior to work commencing through social media and directly to the local media to advise the customer of any potential issues and how they should remedy these situations. Our social media platforms are monitored during business hours In years gone by the media was our only venue for conveying messages to the public, social media has now provided real time updates.

- Informing children about the local water system and water conservation can be gratifying and pay good dividends. This includes providing information and literature for teachers to use in their classes, arranging for a water system employee to speak to classes, class tours of the water plant and participation in the Peterborough Children's Water Festival. Not only will the children be better informed, but also they will take the information presented to them home and project a positive image of the water system to their parents.

- Buildings, trucks, backhoes, fire hydrants, elevated tanks and other water system equipment that is seen by the public be kept clean, well-painted and in good repair. Besides projecting a good image, there is usually a side benefit that employees take better care of equipment that is well maintained.

When major work or policy changes that will affect customers has been made, a special wide scale media release is developed. Examples are major construction projects that will cause inconvenience to the public, a change in water quality or a significant rate increase.

7.6 Financial Considerations

7.6.1 Billing

In Peterborough, customers receive a combined bill for water and sewer, starting in 2025 a stormwater management fee was also added to the water bill. The sewer surcharge is calculated as a percentage of the water charge, and the stormwater fee is based on residential property values This amount is determined by the City of Peterborough. Customers are billed on a bi-monthly basis.

7.6.2 Meter Reading

Water Services has an automatic meter reading (AMR) system which provides readings through communication with the City of Peterborough's smart street light nodes to a digital data repository. The AMR will provide "real time" hourly consumption and a monthly single register read for billing. A few customers who have chosen not to have an AMR enabled water meter in their home pay a monthly fee to have the meter read. This system provides a cost effective method of meter data collection and allows the City to provide information like leak detection or high water usage to customers through letters and automated phone calls. This feature has prevented many potential high water billing issues.

7.6.3 Water Rates

The Water Utility rate schedule is approved by the Commission and is published on the City of Peterborough website, through social media and in bill inserts. All current fees, charges and surcharges are outlines on the water Rate Schedule. Monthly water charges are based on the Basic Charge plus the Consumption Charge. The Basic Charge is a fixed charge that will appear on each metered customer's monthly invoice. This rate varies depending upon the size of the meter installed. Consumption charge is a volumetric charge for water consumed. Residences still on flat rate services are billed a monthly based on the Rate Schedule.

7.6.4 Development Charges

New developments in Peterborough must pay development charges to connect to the existing water system. The development charges are determined through a “Background Study” which is required to be completed every five years under the Development Charges Act. Development charges help pay for a small portion of the existing treatment, storage, pumping and trunk main infrastructure attributed to new development.

7.6.5 Frontage Charges

Another fee that must be paid when connecting to the water system is the frontage charge. This charge covers half the cost of the water main abutting the property requesting connection (the customer on the opposite side of the street would pay the remaining half of the cost of the water main). The charge is dependent on the frontage measure for the property. A corner property having frontage on more than one street has a certain exemption on the flankage. For non-abutting lots a non-abutting frontage charge is applied because the property receives the same level of service as an abutting lot.

In the case of subdivisions or larger developments where the developer installs the water main abutting and within their property there are no applicable frontage charges.

7.6.6 Service Charges

The service charge covers the cost to install the service pipe from the water main to the property line. For the majority of residential and small commercial services (20 mm size), there is a fixed cost to install the service pipe. Restoration costs are site specific and extra to the fixed rate. For non-residential services over 20 mm size, the charge is the actual cost to install the service.

8. Roles of a Councillor

8.1 General Responsibilities

The majority of the general operating authority and responsibilities of a water utility will fall under the *Municipal Act*, 2001, sections 78 to 93 and 194 to 202. Under provisions in the *Safe Drinking Water Act*, the owner of a municipal drinking water system must ensure the following:

1. That all water provided by the system to the point where the system is connected to a user's plumbing system meets the requirements of the prescribed drinking water quality standards.
2. That, at all times in which it is in service, the drinking water system,
   i. is operated in accordance with the requirements under the Safe Drinking Water Act,
   ii. is maintained in a fit state of repair, and
   iii. satisfies the requirements of the standards prescribed for the system or the class of systems to which the system belongs.
3. That the drinking water system is operated by persons having the training or expertise for their operating functions that is required by the regulations and the licence or approval issued or granted for the system under the *Safe Drinking Water Act*.
4. That all sampling, testing and monitoring requirements under the Safe Drinking Water Act that relate to the drinking water system are complied with.
5. That personnel at the drinking water system are under the supervision of persons having the prescribed qualifications.
6. That the persons who carry out functions in relation to the drinking water system comply with such reporting requirements as may be prescribed or that are required by the conditions in the licence or approval issued or granted for the system under the *Safe Water Drinking Act*.

8.2 Governance Issues

Councillors oversee the operations of all aspects of the water utility. They meet regularly to ensure the proper functioning of the utility. They are responsible for things such as the upkeep of the utility's public image, budget and safety. They are also responsible for ethical issues that tie into the water system.

8.3 Standard of Care

In his Walkerton Part II Report, Councillor O'Connor recommended "given that the safety of drinking water is essential for public health, those who discharge the oversight responsibilities of the municipality should be held to a statutory standard of care". Those held to a statutory standard of care, he said "should be required under the *Safe Drinking Water Act* to act honestly and in good faith with a view to the protection of the safety of the consumer and exercise the care, diligence and the skill that a reasonably prudent person would exercise in comparable circumstances."

Statutory standards of care already exist in other Ontario legislation. For example, both the *Environmental Protection Act* and *Ontario Water Resources Act* contain provisions in which every director and officer of a corporation has a duty to take all reasonable care to prevent the corporation from causing or permitting the discharge of a contaminant into the natural environment or waters. Every person who has this duty and who fails to carry out that duty is guilty of an offence.

Section 19 of the *Safe Drinking Water Act*, 2002 places a statutory standard of care on those who have oversight of municipal drinking water systems. The act states that each person with oversight responsibilities must ***"exercise the level of care, diligence and skill in respect of a municipal drinking water system that a reasonably prudent person would be expected to exercise in a similar situation."*** The *Act* further states that such persons must **"*act honestly, competently and with integrity, with a view to ensuring the protection and safety of the users of the municipal drinking water system."*** The penalties for individuals not exercising the required standard of care resulting in a drinking water hazard are severe. The first offence can result in a fine of $7,000,000 or imprisonment of up to five years.

Specific roles and responsibilities of persons with oversight responsibilities vary according to the size and complexity of the municipal drinking water system. It is not expected that municipal officials with general oversight responsibilities become experts on the operation of drinking water systems, rather that they have familiarity with the basic principles of operation and administration of public water supply. Further that they understand the characteristics of the systems over which they have responsibilities. In this regard, The Report of the Walkerton Inquiry Parts One and Two contain two consistent themes: be informed and exercise diligent oversight. Councillor O'Connor Wrote in the Part I Report: "In my view, it is reasonable to expect, as a minimum, that Councillors (and therefore also councilor's and Board directors) absorb enough knowledge, over time, to ask intelligent questions of senior management, to evaluate the performance of senior management and if issues or serious concern arise, to inform themselves of what is necessary to address those issues." It is important to note that a person may rely in good faith on a report of an engineer, lawyer, accountant or other person whose professional qualifications lend credibility to their advice. Being informed and exercising diligent oversight involves taking both proactive and reactive steps. In his Part I and Part II reports, Councillor O'Connor outlined several actions that municipal officials with oversight responsibilities could and should take, including:

- Being acquainted with drinking water legislation and regulations;
- Learning about drinking water safety and the operation of water works facilities;
- Familiarizing themselves with their municipal drinking water systems, including the physical condition of major infrastructure, the background and experience of their senior staff and approvals granted for ownership and operation of the facilities over which they provide oversight;
- Setting the overall policy direction for the municipal drinking water system;
- Clearly defining and understanding the roles and responsibilities of councilors, senior management and other municipal officials who exercise decision-making authority over the system;
- Hiring competent senior management and conducting regular performance appraisals;

- Asking for and receiving periodic and annual reports from senior management on the operation of the municipal drinking water system;
- Periodically auditing or evaluating the performance of the external operating authority if one has been contracted by the municipality to run the drinking water system;
- Reading and asking questions about any reports which identify declining water quality;
- Being satisfied that appropriate steps are taken to address any issues; and
- Seeking outside expertise when needed.

Taking these actions, in addition to ensuring that the municipal drinking water system meets the requirements of the *Safe Drinking Water Act*, 2002 and the regulations as well as any approvals/licenses and orders will help to satisfy the standard of care.

The Ministry had developed a Drinking Water Quality Management Standard (DWQMS) by which operating authorities will be measured by external audit and licensed to operate. The Owner's standard of care requirements and the owner's license to operate a water system will be dependent on using an accredited operating authority. The City of Peterborough is an accredited operating authority since 2025. The City Council will be kept up to date on the relevant aspects of the DWQMS through annual reports presented at Council meetings.

The DWQMS Operational Plan describes the responsibilities and authorities of the Owner of the drinking water system as follows:

- Approving the annual budget.
- Approving annual water rates.
- Establishing bylaws and policies

8.4 Check your Knowledge

Ask yourself these questions to check your current level of knowledge about the City of Peterborough drinking water system and oversight responsibilities.

- Have I had a tour of the Peterborough water treatment plant?
- Am I familiar with the Peterborough drinking water system?
    - The source water?
    - The physical condition of major infrastructure?
    - The background and experience of senior water division staff?
    - The approvals that have been granted for ownership and operation of the water system?
- Am I acquainted with the drinking water legislation and regulations?
- Do I know the basic information about drinking water safety and the operations of the water treatment plant?
- Do I understand the requirements to meet minimum standards for drinking water?
- Do I know how to set overall policy direction for the Peterborough drinking water system?

- Do I understand the different roles and responsibilities of those who have decision-making authority?
- Am I assured that competent senior management has been hired?
- What were the results of the last inspection? Are there areas for improvement?
- Am I aware of the risks currently facing our water source, water treatment plant and infrastructure?
- If there is an emergency with the drinking water system, what procedures are followed? How will I be notified? How is the public notified?
- Am I aware of the Utility's role in source water protection planning?
- How and when do I ask for annual reports on the drinking water system from senior staff?
- What should I look for in an annual report? What questions must it answer?
- What should I do if a report identified declining water quality?
- Do I know that appropriate steps are being taken to resolve any issues? Do I know when outside expertise is needed?
- Is the drinking water system periodically audited? When? How often?
- Do I know if our drinking water system is financially sustainable for the future? Are there financial plans in place?
- Am I familiar with the municipal drinking water licence and the key elements of the licence (e.g. drinking water works permit, operational plan, financial plan)?

Quiz is adapted from "Taking Care of your Drinking Water, a guide for member of Municipal Councils".

9. Regulatory Environment

9.1 Safe Drinking Water Act & Regulations

In December 2002, the Ontario Legislature passed the *Safe Drinking Water Act* (SWDA) in response to the recommendation of Mr. Justice O'Connor in the *Part 2 Report of the Walkerton Inquiry* that such legislation be enacted.

Together with related legislative, regulatory and policy initiatives, the SDWA will serve as an important component of Ontario's overall framework for protecting drinking water across the province.

The purpose of the *Safe Drinking Water Act* is to provide for the protection of human health and the prevention of drinking water health hazards through the control and regulation of drinking water systems and drinking water testing.

9.1.1 Ontario Drinking Water Quality Standards Regulation 169/03

Regulation 169/03 outlines Water Quality standards. It contains tables outlining the maximum allowable levels of contaminants in drinking water. Table3 shows Schedule 1, which contains microbiological standards under the regulation. There are two other Schedules within the regulation for chemical and radiological standards.

Table 3: O. Reg. 169/03 Schedule 1

Item	Microbiological Parameter	Standard (expressed as a maximum)
1	Escherichia coli (E. coli)	Not detectable
2	Total coliforms	Not detectable

9.1.2 Drinking Water Systems Regulation 170/03

Regulation 170/03 describes operational and administrative requirements and regulations associated with water systems operations. The Peterborough water utility is defined as a large municipal residential system under this regulation and must follow the following schedules under regulation170/03.

Schedule 1 – Treatment equipment
Schedule 4 – Relief from Schedule 1
Schedule 6 – Operational Checks, Sampling and Testing - General
Schedule 7 – Operational Checks
Schedule 10 – Microbiological Sampling and Testing
Schedule 13 – Chemical Sampling and Testing
Schedule 15.1 - Lead
Schedule 16 – Reporting Adverse Test Results and Other Problems
Schedule 17 – Corrective Action
Schedule 20 – Engineers' Reports
Schedule 22 – Summary Reports for Municipalities

Schedule 23 – Inorganic Parameters
Schedule 24 – Organic Parameters

Please refer to the regulation for details on these schedules.

9.1.3 Financial Plans Regulation 453/07

The purpose of this regulation is prescribing the requirement for a financial plan in order that a municipal drinking water licence may be issued under the *Safe Drinking Water Act*. This financial plan must be approved by resolution by the Council of the municipality. The financial plans must include a statement that the financial impact of the drinking water system has been considered and that the plan covers a period of at least six years. The financial plan must also be available to the public free of charge.

9.2 Source Water Protection, Clean Water Act, 2006

With the multi-barrier approach (source to tap) for drinking water, protection of the water source is the first barrier. In Part 2, Report of the Walkerton Inquiry, Justice O'Connor made seventeen recommendations for improving source protection. He indicated that source protection should be developed on a watershed basis with preparation of source protection plans. The Clean Water Act was passed by the Ontario legislature in 2006 to enable the process.

Peterborough is part of the Trent Conservation Coalition Source Protection Region, consisting of the Crowe Valley, Ganaraska, Kawartha, Lower Trent and Otonabee Conservation Authorities. The task of developing a plan was a local process, funded by the Province and involved watershed residents working with municipalities, conservation authorities, property owners, farmers, industry, health officials, community groups, and others. The Source Protection Committee oversaw the process of developing the Drinking Water Source Protection Plan.

During the multi-year process, drinking water sources were evaluated for quality and quantity. The areas around the intake location were mapped and existing land uses were examined. From this, a threats list was created and the Plan introduces strategies to mitigate or eliminate the significant drinking water threats.

The Trent Source Protection Plan was approved on October 23, 2014 and the requirements under the Plan take effect January 1, 2015.

The Otonabee Region Conservation Authority (ORCA) has entered into an agreement to enforce Part IV under the Clean Water Act on behalf of 7 municipalities in the Otonabee-Peterborough Source Protection Area (including the City of Peterborough). To meet these responsibilities a Risk Management Official/ Inspector has been hired by ORCA, and the Risk Management Office has been established at ORCA. ORCA has also entered into agreements with the same 7 municipalities to undertake activities related to preparing for implementation, implementation and developing an education and outreach program. Activities related to implementation include assisting municipalities with required updates to Official Plans, Zoning by-laws and ensuring municipal staff are aware of their responsibilities. Going forward, ORCA will continue to assist local municipalities, residents and stakeholders to implement the Trent Source Protection Plan, and coordinate the activities of the Otonabee-Peterborough Source Protection Authority. Other activities will include assisting Regional Staff at the Trent Conservation Coalition with communications and activities related to the Source Protection Committee.

9.3 Ontario Water Resources Act

In 1990, The Ontario Legislature passed the *Ontario Water Resources Act* (OWRA). The intention of this legislation is to develop the foundations for effective water management decisions. Good water management depends on knowing and understanding the past, current and future quality and quantity of our groundwater and surface water resources - and the natural processes and human activities that affect Ontario's water.

9.3.1 Water Taking and Transfer Regulation 387/04

The purpose Regulation 387/04 is to provide for the conservation, protection and wise use and management of Ontario’s water. The regulation issues a permit to take water that will balance the need for water used and the ecosystem. The permit shall describe the allowable volume of water to be taken daily.

9.3.2 Charges for Industrial and Commercial Water Users Regulation 450/07

The purpose of this regulation is to recover a portion of the cost the Government of Ontario incurs in the administration of Acts for the purpose of promoting the conservation, protection and management of Ontario’s water. Commercial and industrial water users are charged back $3.71 per million litres of water used annually. Owners of water works are required to submit an annual report to the Ministry including the names of commercial and industrial users along with their annual water usage.

9.4 Infrastructure for Jobs and Prosperity Act, 2015

9.4.1 O Reg 588/17 Asset Management Plan

This regulation is designed to standardize how municipalities plan and manage their physical infrastructure, such as roads, bridges, and water systems. The Ministry of Infrastructure has provincial oversight of the regulation. Municipalities were required to create a strategic policy to guide asset management planning by July 1, 2019, and must review it every five years. The water system has a completed Asset Management Plan that was updated in 2025.

9.5 Legislative Annual Reports

Table 4 is a list of the annual reports that are required by Federal and Provincial Legislation.

Table 4: Legislative Reports

Report Name	Legislation	Regulatory Body	Due Date	Description
MECP Summary Report to Municipalities	Safe Drinking Water Act, Regulation. 170/03 Sec 22 (1)	MECP	Mar 31	Details of compliance to Certificate of Approval ordinances and summary of monthly averages, maximum and peak levels of water flow rates delivered. The Commission must review this report.
MECP Annual Report	Safe Drinking Water Act, Regulation 170/03 Sec 11	MECP	Feb 28	Report of chemicals used, water notices submitted with corrective actions, microbiological & operational testing and summary of Organic & Inorganic testing completed each calendar year Report must be available to the public
Dam Management	Lakes and Rivers Improvement Act, 1990	MNR	Feb 28	Report detailing Dam head water levels to show compliance within Ministry thresholds
Permit to Take Water	Ontario Water Resources Act Regulation 387/04	MECP	Mar 31	Daily water taking volumes.
Commercial & Industrial Water Report	Ontario Water Resources Act Regulation 450-07	MECP	Mar 31	Consumption report on industrial & commercial water users >50,000L in any given day.
NPRI	Canadian Environmental Protection Act	EPA	Jun 1	Reporting on annual releases to air, water, land, disposal or recycling.

9.6 Fines

According to sections 141 – 143 of the Safe Drinking Water Act, 2002, the maximum fines are as follows:

Maximum Individual Fines

	First Offence	$20,000/ day
	Second Offence	$50,000/ day and/or 1 year imprisonment
Operating without permit		
	First Offence	$50,000/ day
	Second Offence	$100,000/ day and/ or 1 year imprisonment
Causing Drinking Water Hazard		
	First Offence	$4,000,000/day
	Second Offence	$7,000,000/ day and/ 5 years imprisonment

Maximum Corporation Fines

	First Offence	$100,000/ day
	Second Offence	$200,000/ day and/or 1 year imprisonment
Operating without permit		
	First Offence	$250,000/ day
	Second Offence	$500,000/ day and/ or 1 year imprisonment
Causing Drinking Water Hazard		
	First Offence	$6,000,000/day
	Second Offence	$10,000,000/day

Glossary

Source: The Drinking Water Dictionary (AWWA)

Alum	The common name for aluminum sulfate, a chemical used in the coagulation process to remove particles from water.
Coagulation	The process of destabilizing charges on particles in water by adding chemicals (coagulants). Natural particles in water have negative charges that repel other material and thereby keep it in suspension. In coagulation, positively charged chemicals are added to neutralize or destabilize these charges and allow particles to accumulate and be removed by a physical process such as sedimentation or filtration.
CAZA	The Canadian Association of Zoos and Aquarium
Head Loss	A reduction of water pressure (head) in a hydraulic or plumbing system. Head loss is a measure of (1) resistance of a medium bed (or other water treatment system), a plumbing system or both to the flow of water through it or (2) the amount of energy used by water in moving from one location to another. In water treatment technology, head loss is basically the same as pressure drop.
Heterotrophic Plate Count (HPC)	A bacteria enumeration procedure used to estimate bacterial density in an environmental sample, generally water. Other names for the procedure include total plate count, standard plate count, plate count and aerobic plate count.
Hydrologic Cycle	The natural process recycling water from the atmosphere down to (and through) the Earth and back to the atmosphere.
MECP	Ministry of the Environment, Conservation & Parks
MNR	Ministry of Natural Resources of Ontario
NPRI	National Pollutant Release Inventory
NTU	Nephelometric Turbidity Units
Operating Authority	In respect to a drinking water system, the person or entity that is given responsibility by the owner for the operation, management, maintenance or alteration of the system.
Owner	Includes, in respect to a drinking water system, every person who is a legal or beneficial owner of all or part of the system but does not include the Agency or any of its predecessors where the Agency or predecessor is registered on title as the owner of the system.
Radionuclides	A material with an unstable atomic nucleus that spontaneously decays or disintegrates producing radiation.
Tuberculation	(1) The formation of tubercles in pipe. (2) Localized corrosion at scattered locations resulting in knoblike mounds.
Turbidity	(1) A condition in water formed by the presence of suspended matter, resulting the scattering and absorption of light. (2) Any suspended solids that impart a visible haze or cloudiness to water that can be removed by treatment. (3) An analytical quantity, usually reported in nephelometric turbidity units (NTU), determined by measurements of light scattering.