



**Caledonia and Cayuga Distribution System
2019 Annual Water Quality Report**

January 1, 2019 – December 31, 2019

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Caledonia and Cayuga Distribution System



Caledonia and Cayuga Distribution System Overview

Chloraminated water is received from the City of Hamilton's Woodward Water Treatment Plant at the Caledonia Reservoir. Sodium hypochlorite is added to the water to achieve breakpoint chlorination and create a free chlorine residual that meets regulatory requirements. The chlorinated water is sent through transmission water mains to the Caledonia Distribution System. A standpipe provides secondary water storage and maintains water pressure within the distribution system.

Potable water is also sent via transmission water mains to Cayuga. At the Cayuga Reservoir, sodium hypochlorite is added to assist with maintaining a disinfectant residual prior to being pumped to the Cayuga distribution system. A standpipe provides secondary storage and maintains water pressure within the distribution system.

The distribution system infrastructure services approximately 11,387 people (2016 Census).

Haldimand County operates and maintains all aspects of the drinking water system, including reservoirs, hydrants, valves, sample stations and watermains.

Expenditure Information

Haldimand County staff are diligent in prioritizing projects on an annual basis to eliminate unnecessary expenditure. Using the best available information at the time of this report, key expenditures occurring in the Caledonia and Cayuga Distribution System are identified in Table 1. All drinking water expenditure information is not included in this report.

Table 1: Caledonia and Cayuga Distribution System 2019 Expenditures

Caledonia and Cayuga Distribution System:	
Pump Valve Actuator Replacement (Caledonia)	
Online Analyzer Replacements (Caledonia)	
Pump Rebuild (Cayuga)	
Standpipe Rehabilitation and Mixing System (Cayuga)	
Total Cost	\$958,302

Multi-Barrier Approach

Through the Walkerton Inquiry, Justice O'Connor recommended that drinking water is best protected by taking an approach that uses multiple barriers to prevent contamination from affecting our drinking water. The multi-barrier approach addresses potential threats by ensuring barriers are in place to either eliminate or minimize their impact. This holistic approach recognizes that each barrier may not be able to completely remove a contaminant, but by working together the barriers provide a high-level of protection. Typical barriers include:

Source Protection

- **Source Protection Plans**
- **Treatment**
 - **Treatment and Disinfection Goals**
- **Distribution System**
 - **Residual Maintenance**
- **Monitoring**
 - **Sampling Programs**
- **Emergency Preparedness**
 - **Emergency Plans**



Haldimand County has adopted the multi-barrier approach in ensuring safe, reliable drinking water. *Figure 1* shows how administration, design, maintenance, and operation work together to establish and maintain multi-barrier protection (US EPA, 1998).

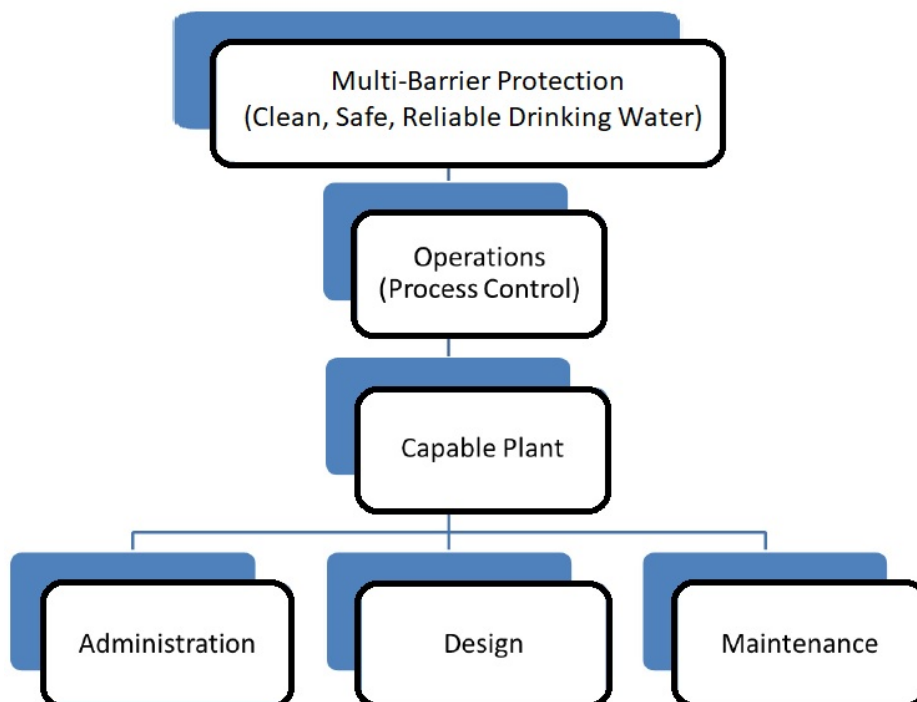


Figure 1: Responsibilities for Clean, Safe and Reliable Drinking Water

A description of the responsibilities in each area is summarized as follows:

- **Administration:** The administrators or managers of a water treatment system are responsible for providing the resources (budget and staff) and policies (hours of staffing, reporting requirements, training and certification requirements, etc.). Funding may also need to be justified and obtained if the design of a system is inadequate or major upgrades are required. Managers establish and maintain emergency response plans and communication procedures to ensure prompt response to unsafe drinking water.
- **Design:** The designer's responsibility is to provide the physical infrastructure (pipes, valves, tanks, meters, etc.) capable of reliably producing and distributing the quality and quantity of water required. The design must provide adequate flexibility and controllability to enable the operator to make appropriate adjustments.
- **Maintenance:** The system must be maintained in good working order with the key equipment functional at all times. Should a key piece of equipment break down then it should be repaired in a timely manner.
- **Operations:** Once a capable system is in place, then it is the operator's responsibility to deliver safe drinking water through monitoring, testing and process control (for example by changing the setting on the dosing pumps). Operators are also responsible for maintaining records (log books, data forms, etc.), which aid in troubleshooting and design of upgrades. A further, and commonly unrecognized responsibility of the operator is to communicate the needs of the facility to administrators for possible action.

WATER SAMPLING

To comply with drinking water legislation, drinking water systems are required to monitor their water quality. Haldimand County has committed to providing safe, reliable drinking water and is diligent in ensuring that sampling and monitoring programs effectively characterize water quality. All samples are taken by certified operators and tests performed by accredited, licensed laboratories.

Microbiological Sampling

Microbial quality is one of the primary indicators for the safety of a drinking water supply. Of all contaminants in drinking water, human and/or animal feces present the greatest danger to public health. Pathogenic or disease causing micro-organisms (including certain protozoa, bacteria or viruses) may be found in untreated water supplies. Bacteriological monitoring or testing is a way to detect and control pathogenic bacteria in treated drinking water supplies. Heterotrophic Plate Count (HPC) and background bacteria are monitored to identify potential changes in water quality and are not used as an indicator of adverse human health effects. Table 2 provides a summary of microbiological sampling completed in the Caledonia and Cayuga Distribution System during 2019.

Table 2: 2019 Caledonia and Cayuga Distribution System Microbiological Sampling

	Number of Samples	Range of E.coli Results (cfu/100ml)	Range of Total Coliform Results (cfu/100ml)	Number of HPC Samples	Range of HPC Results (cfu/ml)	Number of Background Samples	Range of Background Results (cfu/ml)
Caledonia Distribution	212	0	0 - >80	53	0 – 29	212	0 – 96
Cayuga Distribution	156	0	0	52	0 – 1	156	0 – 2

*Note: At a minimum, 25% of all drinking water samples must be analyzed for HPC.

Operational Sampling

Operational sampling and monitoring is important in maintaining the integrity of each barrier in the multi-barrier approach. Schedule 7 and 8 of Ontario Regulation 170/03 specify requirements for operational checks that municipalities must follow. Table 3 provides a summary of operational samples taken for the drinking water system. Regulatory requirements were achieved for all samples taken. Although not included in this report, Caledonia and Cayuga Reservoirs have continuous monitoring chlorine residual analyzers, which monitor all water pumped to the distribution systems.

Table 3: 2019 Caledonia and Cayuga Distribution System Operational Sampling

	Number of Grab Samples	Range of Results	Regulatory Requirement	Minimum Recommended Target
Free Chlorine Caledonia	371	0.69 – 1.53 mg/L	≥ 0.05 mg/L	≥ 0.20 mg/L
Free Chlorine Cayuga	319	0.28 – 1.26 mg/L	≥ 0.05 mg/L	≥ 0.20 mg/L

As result of public inquiries, a quarterly treated water hardness sampling program was initiated in the County.

The term hardness was originally applied to waters that were hard to wash in, referring to the soap wasting properties of hard water. Hardness prevents soap from lathering by causing the development of an insoluble curdy precipitate in the water; hardness typically causes the buildup of hardness scale (such as seen in cooking pans). Dissolved calcium and magnesium salts are primarily responsible for most scaling in pipes and water heaters and can cause numerous problems in laundry, kitchen, and bath. Hardness is usually expressed in grains per gallon (or ppm) as calcium carbonate equivalent.

The degree of hardness standard as established by the American Society of Agricultural Engineers (S-339) and the Water Quality Association (WQA) is shown in the following table:

Table 4: Standard Degree of Hardness

Degree of Hardness	Grains per Gallon (gpg)	Ppm (mg/L)
Soft	< 1.0	< 17.0
Slightly Hard	1.0 – 3.5	17 - 60
Moderately Hard	3.5 – 7.0	60 - 120
Hard	7.0 – 10.5	120 - 180
Very Hard	> 10.5	> 180

The sample results in Table 5 indicate that the average values for Caledonia and Cayuga is considered to be hard water as taken from the Degree of Hardness Table above.

Table 5: 2019 Caledonia and Cayuga Distribution System Hardness Sampling

Parameter	Sample Date	Caledonia	Cayuga
Total Hardness (mg/L as CaCO ₃)	March 5, 2019	170	180
	May 24, 2019	140	140
	September 3, 2019	132	128
	November 19, 2019	126	140
2019 Average >		142	147

Lead Sampling

The community lead testing program is a requirement of O.Reg. 170/03 under the Safe Drinking Water Act, 2002. Haldimand County is exempt from sampling private residences due to having less than 10% of plumbing sample locations exceed the standard for two consecutive periods of reduced sampling. Annual pH and alkalinity samples are taken, as well as distribution system lead samples, every three years. There are no regulatory limits for alkalinity and pH, however Haldimand County sample results are within the operational guidelines provided by the MECP. A summary of 2019 sampling has been provided in Table 6.

Table 6: 2019 Caledonia and Cayuga Distribution System Lead Sampling

	Sample Type	Number of Samples	Range of Results	Number of Exceedances
Caledonia	Plumbing - Lead	Exempt By Regulation		
	Distribution - Lead	Not Required By Regulation in 2019		
	Distribution - Alkalinity	4	83 – 88 mg/L	N/A
	Distribution - pH	4	7.04 – 7.76	N/A
Cayuga	Plumbing - Lead	Exempt By Regulation		
	Distribution - Lead	Not Required By Regulation in 2019		
	Distribution - Alkalinity	4	84 – 87 mg/L	N/A
	Distribution - pH	4	7.04 – 7.34	N/A

Organic Sampling

To protect drinking water from pathogens, a disinfectant (usually chlorine) is added to the drinking water. Disinfectants can react with naturally-occurring materials in the water to form disinfection byproducts, which may pose health risks.



A challenge for water systems is balancing pathogen control and disinfection byproduct formation. It is important to provide protection from pathogens while minimizing health risks from disinfection byproducts. More information on each byproduct is summarized in Table 7.

Haldimand County sample for haloacetic acids (HAA) and trihalomethanes (THM) in the distribution system where there is an elevated potential for the formation of these byproducts. In 2019 the County initiated sampling at the Caledonia and Cayuga Reservoir Outlets, as it is believed that concentrations are typically found to be higher just after the chlorination process.

Table 7: Disinfection Byproduct Information

Disinfection Byproduct	How it is formed?	Health Effects
Trihalomethanes	Trihalomethanes occur when naturally-occurring organic and inorganic materials in the water react with the disinfectants, chlorine and chloramine.	Some people who drink water containing total trihalomethanes in excess of the MCL over many years could experience liver, kidney, or central nervous system problems and increased risk of cancer.
Haloacetic Acids	Haloacetic acids occur when naturally-occurring organic and inorganic materials in the water react with the disinfectants, chlorine and chloramine.	Some people who drink water containing haloacetic acids in excess of the MCL over many years may have an increased risk of getting cancer.

Regulatory reporting is based on a running annual average of quarterly sample results. The calculated THM and HAA averages were below the maximum allowable concentrations (MAC) permitted by the MECP. Table 8 provides a summary of 2019 organic sample results.

Table 8: 2019 Caledonia and Cayuga Distribution System DBP Sampling

Parameter	Sample Dates	Sample Results (ug/L)	Annual Average (ug/L)	Regulatory MAC (ug/L)	Exceedance
Haloacetic Acids Caledonia Reservoir Outlet	February 13, 2019	5.3	7.5	80	No
	May 10, 2019	5.3			
	August 6, 2019	14.1			
	November 12, 2019	5.4			
Haloacetic Acids Caledonia Distribution	February 13, 2019	10.4	16.8	80	No
	May 10, 2019	17.5			
	August 6, 2019	21.4			
	November 12, 2019	17.8			
Haloacetic Acids Cayuga Reservoir Outlet	November 12, 2019	19.0	N/A	80	No
Haloacetic Acids Cayuga Distribution	February 13, 2019	15.6	21.1	80	No
	May 10, 2019	22.2			
	August 6, 2019	25.5			
	November 12, 2019	21.2			
Trihalomethanes Caledonia Distribution	February 13, 2019	36	44.5	100	No
	May 10, 2019	51			
	August 6, 2019	39			
	November 12, 2019	52			
Trihalomethanes Cayuga Distribution	February 13, 2019	31	43.3	100	No
	May 10, 2019	37			
	August 6, 2019	50			
	November 12, 2019	55			

WATER USE

Raw Water

Haldimand County does not have a Permit to Take Water for the Caledonia and Cayuga Distribution System. All water supplied to the Caledonia and Cayuga Distribution System originates from Lake Ontario and is treated by the City of Hamilton at their Woodward Water Treatment Plant.

Potable Water

As required by Schedule 22 of Ontario Regulation 170/03, Table 9, Table 10, *Figure 1* and *Figure 2* are intended to provide a summary of potable water supplied to the Caledonia and Cayuga Distribution System in 2019.

Table 9: 2019 Caledonia Reservoir Monthly Potable Water Flow Data

System	Month	Monthly Total m ³	Daily Average m ³	Maximum Daily m ³
Caledonia Reservoir	January	96,373	3,109	3,459
	February	83,147	2,970	3,375
	March	93,585	3,019	3,659
	April	89,869	2,996	3,429
	May	101,763	3,283	3,853
	June	102,845	3,428	4,419
	July	108,323	3,494	4,200
	August	105,779	3,412	4,374
	September	96,935	3,231	3,996
	October	91,851	2,963	3,294
	November	89,440	2,981	3,474
	December	93,615	3,020	3,638

The Caledonia Reservoir flows include all water pumped to York and Cayuga. *Figure 2* compares the monthly flows over the last five years at the Caledonia Reservoir. When comparing the average monthly flows for 2018 and 2019, there was a 2.1% decrease in potable water pumped by the Caledonia Reservoir in 2019.

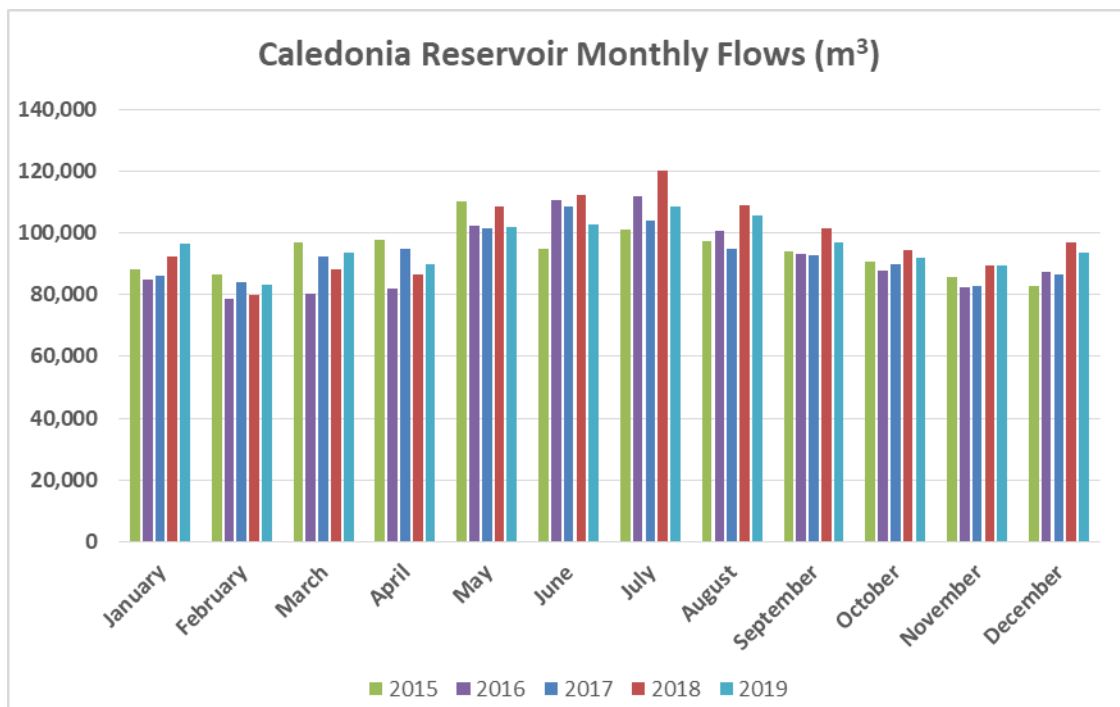


Figure 2: Caledonia Reservoir Five Year Monthly Flow Comparison

Table 10: 2019 Cayuga Reservoir Monthly Water Quantities and Flow Rates

System	Month	Monthly Total m ³	Daily Average m ³ /d	Maximum Daily Flow m ³ /d
Cayuga Reservoir	January	18,259	589	846
	February	15,958	570	704
	March	18,636	601	961
	April	16,879	563	841
	May	19,478	628	892
	June	20,333	678	814
	July	21,556	695	917
	August	21,483	693	693
	September	20,281	676	693
	October	19,323	623	671
	November	19,903	663	1255
	December	17,929	578	679

Figure 3 compares the monthly flows over the last five years at the Cayuga Reservoir. When comparing the average monthly flows for 2018 and 2019, there was a 11.1% increase in potable water pumped by the Cayuga Reservoir in 2019.

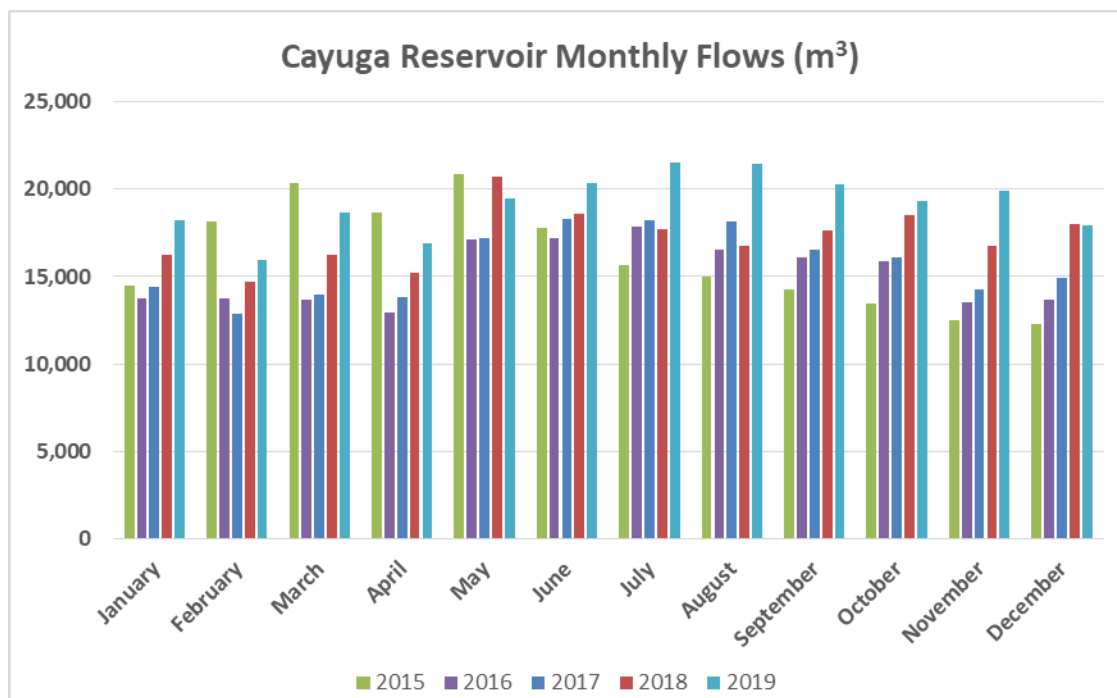


Figure 3: Cayuga Reservoir Five Year Monthly Flow Comparison

Each facility is assigned a rated capacity in their Engineer’s Report. When the maximum daily flow for 2019 and the rated capacity are compared, the Caledonia and Cayuga Reservoirs are operating at approximately 40% of design capacity, however this calculation does not take into account any operational and infrastructure limitations.

Table 11: Summary Comparison of Rated Capacities and 2019 Maximum Flows

System and Municipal Drinking Water License	Rated Capacity	Maximum Daily Flow (m ³ / day)	Percentage of Capacity
Caledonia 066-103	13,000 m ³ /day	4,419	34.0%
Cayuga 066-103	2,333 m ³ /day	1,255*	53.8%

* This flow was related to a standpipe refurbishment project and is not representative of typical peak system water demand.

To ensure the water treatment facility is capable of meeting current and projected demands, Haldimand County staff annually review plant capability and performance and update development allocation accordingly.

REGULATORY COMPLIANCE

Adverse Water Quality Incidents

Regulatory compliance requires reporting adverse water quality incidents to the Ministry of Health (MOH) and the Ministry of the Environment, Conservation and Parks (MECP). In all instances, corrective action is initiated to resolve the issue. An incident summary is provided in Table 11.

Table 12: 2019 Caledonia and Cayuga Distribution System Adverse Events

Incident Date	Parameter	Result	Corrective Action	Date Resolved
October 23, 2019	Total Coliforms	Caledonia Sample Station #3 >80 cfu/100 mL	Resampled – upstream, downstream and at the original adverse location on October 23, 2019 and October 24, 2019.	October 28, 2019

For each adverse identified in Table 12, resamples were taken at the source of the adverse and upstream and downstream locations. Upon direction from the MOH, a second set of samples were collected and analyzed. All samples were negative for the presence of total coliform bacteria.

Annual Drinking Water Inspection

The MECP annually confirms compliance with drinking water legislation by conducting inspections on municipal drinking water systems. All aspects of the drinking water system are reviewed, including treatment equipment, disinfection, training records, and operational data required under the Safe Drinking Water Act and Ontario Regulations 170/03, 169/03 and 128/04. These inspections provide Haldimand County an opportunity to review best management practices and work towards continually improving the operation and management of the drinking water systems. Any issues of regulatory non-compliance are identified and corrective actions issued.

The Caledonia and Cayuga Distribution System inspection occurred on November 7, 2019. Below is a summary of the key inspection findings:

Caledonia and Cayuga Distribution System – Waterworks # 260004566

There were two instances of non-compliance identified during the 2019 inspection period. As a result of the non-compliances, the County received a **91.17%** inspection rating from the MECP.

The following issues were identified during the drinking water inspection:

1. The owner/operating authority was not in compliance with the requirements to prepare Form 1 documents as required by their Drinking Water Works Permit during the inspection period. Haldimand County connected new watermains to service a 43-hectare development for Phase 4 of the McClung/Avalon community in Caledonia. A Form 1 was not completed until November 22, 2019.

Follow-Up Required: The owner shall develop a procedure on completing Forms required by Schedule B of the Drinking Water Works Permit #066-203 and submit it to the Provincial Officer by February 7, 2020. The owner shall provide training on the procedure to staff responsible for complying with the procedure and submit it to the Provincial Officer by March 6, 2020

County Follow-Up: The existing procedure will be reviewed and revised to ensure proper documentation is completed for Drinking Water Works Permit Schedule B activities. Once the procedure is finalized, training will be provided to affected County staff.

2. During the inspection period, the owner of the Caledonia-Cayuga Distribution System installed new piping and valving at the Cayuga pumping station. The owner failed to demonstrate that the new equipment was disinfected in accordance with condition 2.6 in Schedule B of the Drinking Water Works Permit #066-203.

County Follow-Up: The County developed a procedure on disinfecting watermains on October 21, 2019 and provided training to staff on October 25, 2019. No further actions was required by the MECP.

During each inspection, the Ministry may provide recommendations and best practices specific to each drinking water system. It is recommended that owner's and operators develop an awareness of the identified items and consider measures to address them. The following item was identified during the 2019 drinking water inspection:

1. During the physical inspection it was discussed that the future use and maintenance schedule is uncertain due to future expansion of the distribution system. In June 2017, an inspection and report of the Caledonia standpipe was completed by Landmark Municipal Services. The report recommended that the exterior should be replaced within 3-4 years. The report also recommended that the interior should be re-lined with the corrosion pits repaired where required.

Recommendation: It is recommended that Haldimand County develops a plan for the Caledonia standpipe. This plan should include, but not be limited to future use of the standpipe and maintenance/repair schedule.

County Follow-Up: The County is currently investigating options for the Caledonia standpipe and have identified a budget to address the issues identified in the Landmark report and future servicing needs.

Haldimand County continues to work closely with regulatory bodies to ensure a continued supply of safe, reliable drinking water to its users. All recommendations have been addressed and communicated to the MECP.

REPORT AVAILABILITY

This report can be viewed online at:

<https://www.haldimandcounty.ca/drinking-water/>

Reports can also be obtained upon request at any Haldimand County Satellite Office:



Cayuga Administration Building
45 Munsee Street North
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