2019 Annual and Summary Report

January 1 to December 31, 2019

Guelph Drinking Water System

Corporation of the City of Guelph

Gazer Mooney Subdivision Distribution System

Township of Guelph/Eramosa

Water Services

Environmental Services Department

Last Revision: January 29, 2020

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Executive Summary

The purpose of this report is to provide information to system owners and stakeholders to satisfy the regulatory requirements of the Safe Drinking Water Act (SDWA) including the Drinking Water Quality Management Standard (DWQMS); Section 81 of the Clean Water Act (CWA); and regulatory reporting required under O. Reg. 170/03 - Section 11 and Schedule 22.

This report is a compilation of information that helps to demonstrate the ongoing provision of a safe, consistent supply of high quality drinking water to customers located within the City of Guelph and the Gazer Mooney Subdivision (located in the Township of Guelph/Eramosa).

Water Services is a municipally-owned and operated water utility, established in 1879. The Guelph Drinking Water System (Guelph DWS) consists of water supply and treatment facilities and a water distribution system. The Guelph DWS is a Class II Water Treatment Subsystem and Class IV Water Distribution Subsystem.

The Gazer Mooney Subdivision Distribution System (Gazer Mooney SDS) is a Class I Distribution System supplied with water from the Guelph DWS. Guelph Water Services is the Operating Authority for this system owned by Guelph/Eramosa Township.

Both the Guelph DWS and the Gazer Mooney SDS are required to comply with the Safe Drinking Water Act (SDWA) and other regulations as well as requirements contained in Permits to Take Water (PTTW), Municipal Drinking Water Licences (MDWL), and Drinking Water Works Permits (DWWP). Having met the quality management system requirements of the SDWA, Guelph Water Services is an accredited Operating Authority with an up-to-date Operational Plan (OP). The OP is available upon request from Guelph Water Services.

The source of Guelph's drinking water is a series of 21 operational groundwater wells and a shallow groundwater collector system. These sources consists primarily of true groundwater sources, with some "groundwater under the direct influence of surface water with effective in-situ filtration" (GUDI-WEF) sources (Carter 1, Carter 2, Arkell 1, Arkell 15 and the Arkell Springs Glen Collector System).

The water system is operated to meet daily, seasonal, and other operational demands (including fire demands) with various combinations of supply sources in operation at any given time. A total of 17,160,654 cubic meters (17.2 billion litres) of water was treated and pumped to the system in 2019. The average daily water demand was 47,015 cubic metres (47.0 million litres). The maximum daily production of water in 2019 was 58,441 cubic metres (58.4 million litres) and occurred on November 30, 2019. A large watermain break occurred on this day, resulting in an increased amount of water pumped. Please see the

Results of Emergency Response Testing section for more information. The minimum daily production of water in the same time period was 32,477 cubic metres (32.5 million litres) and occurred on December 26, 2019.

All water provided to the Guelph Drinking Water System and the Gazer Mooney Subdivision Distribution System was treated with sodium hypochlorite (for chlorine disinfection) with some sources also using UV treatment, two sites using sodium silicate for dissolved iron and manganese sequestering and one site using green-sand filtration for manganese removal. All of the water supplied was continually tested and met all regulatory standards. City of Guelph Water Services maintained the drinking water system in a fit state of repair and followed best industry practices during the repair and maintenance of the system.

The City of Guelph has approximately 44,000 fully metered water service connections, 557.3 kilometres of underground watermains, and a population of approximately 131,794[1]. The Gazer Mooney Subdivision has approximately 72 fully metered water service connections, 2 kilometres of underground watermains, and an approximate population of 200 people.

As the Operating Authority for both the Guelph DWS and Gazer Mooney SDS, Guelph Water Services is annually inspected by the Ministry of the Environment, Conservation and Parks (MECP) for compliance with regulatory requirements. There were four incidents of non-compliance associated with the Guelph DWS in 2019; the Gazer Mooney SDS had no incidents of non-compliance. Through the 2018-2019 MECP inspection, Water Services received a 89.42% score for the Guelph DWS and a 100% score for the Gazer Mooney SDS.

In 2019, Guelph Water Services reported three Adverse Water Quality Incidents (AWQIs) in the Guelph Drinking Water System – please refer to section b) Adverse Water Quality Incidents.

In conjunction with the Wellington-Dufferin-Guelph Public Health (WDGPH) and the MECP, all appropriate corrective actions and required reporting were completed with no health-based issues for the AQWIs.

There was one AWQI in the Gazer Mooney Subdivision Distribution System in 2019. Please refer to section b) Adverse Water Quality Incidents, Table 2 for a description of the AWQI. In conjunction with the MECP and WDGPH all appropriate corrective actions and required reporting were completed with no health-based issues stemming from these AWQIs.

[1] Statistics Canada, 2016 Census of Population.

Water Services' risk assessment updates, emergency response testing, internal and external audits help facilitate continual improvement of Water Services' processes and programs through implementation of corrective actions.

Water Services continues to implement:

- Recommendations of the 2016 Water Efficiency Strategy.
- Source water protection based on a MECP approved Source Water Protection Plan.
- Arkell Springs Forest Stewardship Project investments (to protect the Arkell Wellfield's source water quality).
- The Lead Reduction Plan in accordance with the regulatory relief provisions of the SDWA.
- Facility asset management and infrastructure reviews to optimize priority projects.
- A robust backflow prevention program overseeing 2,879 properties with 6,790 backflow prevention devices installed.

Details of ongoing and emerging water quality, supply/treatment, and distribution initiatives are outlined in section h) of this report and include successful programs related to: water conservation and efficiency, Arkell Springs forest stewardship, source water protection, lead reduction and frozen services prevention and monitoring.

The City has completed this Annual & Summary Report to satisfy the regulatory requirements of the Safe Drinking Water Act, O. Reg. 170/03 (Section 11 and Schedule 22). For more information please contact Guelph Water Services at (519) 837-5627 or waterservices@guelph.ca.

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Purpose

The purpose of this report is to provide information to several stakeholders and to satisfy the regulatory requirements of the Safe Drinking Water Act (SDWA) including the Drinking Water Quality Management Standard (DWQMS), Clean Water Act (CWA) and regulatory reporting required under O. Reg. 170/03 - Section 11 and Schedule 22. The report is a compilation of information that helps to demonstrate the ongoing provision of a safe, consistent supply of high quality drinking water to customers located within the City of Guelph and the Gazer Mooney Subdivision, located in the Township of Guelph/Eramosa.

Scope

This Water Services Annual and Summary Report includes information from both the **Guelph Drinking Water System** and the **Gazer Mooney Subdivision Distribution System** for the period of January 1 to December 31, 2019, unless otherwise noted. The information is required to be reported to the following:

- the Drinking Water System Owners:
  - Guelph City Council, Chief Administrative Officer (CAO) and Deputy CAO – Infrastructure, Development and Enterprise;
  - Township of Guelph Eramosa (Council and CAO);
- Senior officials of Guelph Water Services and Township of Guelph/Eramosa; and
- the general public and interested stakeholders.

This report satisfies the requirements of both the Safe Drinking Water Act (SDWA) and Ontario Regulation 170/03:

Section 11, Annual Reports which includes:

- a brief description of the drinking water systems;
- a list of water treatment chemicals used;
- a summary of the most recent water test results required under O. Reg. 170/03 or an approval, Municipal Drinking Water Licence (MDWL) or order;
- a summary of adverse test results and other issues reported to the Ministry of the Environment, Conservation and Parks (MECP) including corrective actions taken;
- a description of major expenses incurred to install, repair or replace required equipment; and
- the locations where this report is available for inspection.

Schedule 22, Summary Report which includes:

- list the requirements of the Safe Drinking Water Act, the regulations, the system's approval, Drinking Water Works Permit (DWWP), MDWL, and any orders applicable to the system that were not met at any time during the period covered by the report;
- for each requirement that was not met, the duration of the failure and the measures that were taken to correct the failure;
- a summary of the quantities and flow rates of the water supplied during the period covered by the report, including monthly average and maximum daily flows; and
- a comparison of this information to the rated capacity and flow rates approved in the system's approval, DWWP and/or MDWL.

This report satisfies applicable requirements for both the Guelph Drinking Water System and the Gazer Mooney Subdivision Distribution System.

A copy of this report is available for viewing at:

- **City of Guelph Water Services**, 29 Waterworks Place, Guelph;
- **Township of Guelph/Eramosa**, 8348 Wellington Rd. 124, Rockwood; and
- **Online** at guelph.ca/water.

Any inquiries can be made to:

- City of Guelph Water Services by e-mailing waterservices@guelph.ca or by calling 519-837-5627.
- Township of Guelph/Eramosa Public Works – Water / Wastewater by e-mailing general@get.on.ca or by calling 519-856-9596.

Notice

Please note that every reasonable effort is made to ensure the accuracy of this report. This report is published with the best available information at the time of publication. In the event that errors or omissions occur, the online report will be updated. Please refer to the online version of the report for the most current version.

Please note that some hyperlinks in the document are linked to Guelph's electronic document management system (EDMS), which is available for internal City use only.

Systems Overview

Guelph Drinking Water System

Water Services at the City of Guelph is committed to providing consumers with a safe, consistent supply of high quality drinking water while meeting or exceeding, and continually improving on legal, operational and quality management system requirements. Water Services strives to provide reliable and cost-effective water treatment and distribution systems for the safe production and delivery of consistently high quality water. Established in 1879, Water Services and is a municipally-owned and operated water utility.

The Guelph Drinking Water System is classified as a Class II Water Treatment Subsystem and a Class IV Water Distribution Subsystem. All necessary licences have been obtained by staff to operate the Guelph Drinking Water System. As of December 31, 2019 thirty-three team members held drinking water certificates to operate and maintain the water system.

In 2019, Water Services maintained full scope accreditation to the Drinking Water Quality Management Standard (DWQMS) Version 2.0 after a successful on-site verification audit, conducted by the third-party accreditation body - NSF International Strategic Registrations. This full accreditation satisfies part of the requirements under the Municipal Drinking Water Licensing Program.

The distribution system (including watermains, valves, fire hydrants, services, and meters) serves a population of approximately 131,794[2] within the City of Guelph. All new system components meet NSF 61[3] requirements or approved equivalents and are installed and maintained in accordance with approved industry standards. Water system customers are fully metered and billed in accordance with the Water and Wastewater Customer Rates and Charges by-law.

The Guelph Drinking Water System distribution system is comprised of the following infrastructure:

- 6.38 kilometres of 900-1,050 mm diameter water supply aqueduct;
- five underground storage reservoirs with a combined approximate capacity of 48,000 cubic metres (48 million litres);

[2] Statistics Canada, 2016 Census of Population.
[3] NSF/ANSI Standard 61: Drinking Water System Components - Health Effects

- three water towers with a combined approximate capacity of 11,200 cubic metres (11.2 million litres);
- 557.3 kilometres of buried watermain with a diameter < 900 mm;
- 4,286 watermain valves;
- 2,809 fire hydrants; and
- approximately 44,000 water services and water meters.

The source of Guelph's drinking water is a series of 21 operational groundwater wells and a shallow groundwater collector system. The drinking water sources consist primarily of true groundwater, with some "groundwater under the direct influence of surface water with effective in-situ filtration" (GUDI-WEF) sources. The GUDI-WEF sources include: Carter Well 1 and 2; Arkell 1; Arkell 15; and the Arkell Springs Glen Collector System.

The Guelph Drinking Water System uses 12 per cent Sodium Hypochlorite (that is NSF 60[4] certified) for primary disinfection for the following 11 sources:

- Downey Well
- Burke Well
- Park Well 1 and 2
- Emma Well
- Dean Well
- University Well
- Queensdale Well
- Helmar Well
- Calico Well
- Water Street Well (UV treatment available on site)

12 per cent Sodium Hypochlorite along with ultraviolet light treatment is used as part of a multi-barrier primary disinfection for the following ten sources:

- Arkell Wells 1, 6, 7, 8, 14 and 15
- Arkell Springs Glen Collector System
- Carter Wells 1 and 2
- Membro Well

NSF 60-certified Sodium Silicate, used for aesthetic purposes to sequester dissolved iron and manganese is also used at Helmar Well and Queensdale Well.

[4] NSF/ANSI Standard 60: Drinking Water Treatment Chemicals - Health Effects

In total, Water Services operates and maintains 31 facilities.

The replacement cost of the Guelph Drinking Water System is estimated to be $620.3 million or approximately $4,578 per capita (2019, based on 2017 projected population).

The Guelph Drinking Water System operations are funded directly from the sale of water, with minor additional funding through government grant programs. Property taxes are not used to fund the operation, maintenance or capital renewal of the system.

A total of 17,160,654 cubic meters (17.2 billion litres) of water was treated and pumped to the system in 2019. The average daily water demand was 47,015 cubic metres (47.0 million litres). The maximum daily production of water in 2019 was 58,441 cubic metres (58.4 million litres) and occurred on Nov 30, 2019. The minimum daily production of water in the same time period was 32,477 cubic metres (32.5 million litres) and occurred on December 26, 2019.

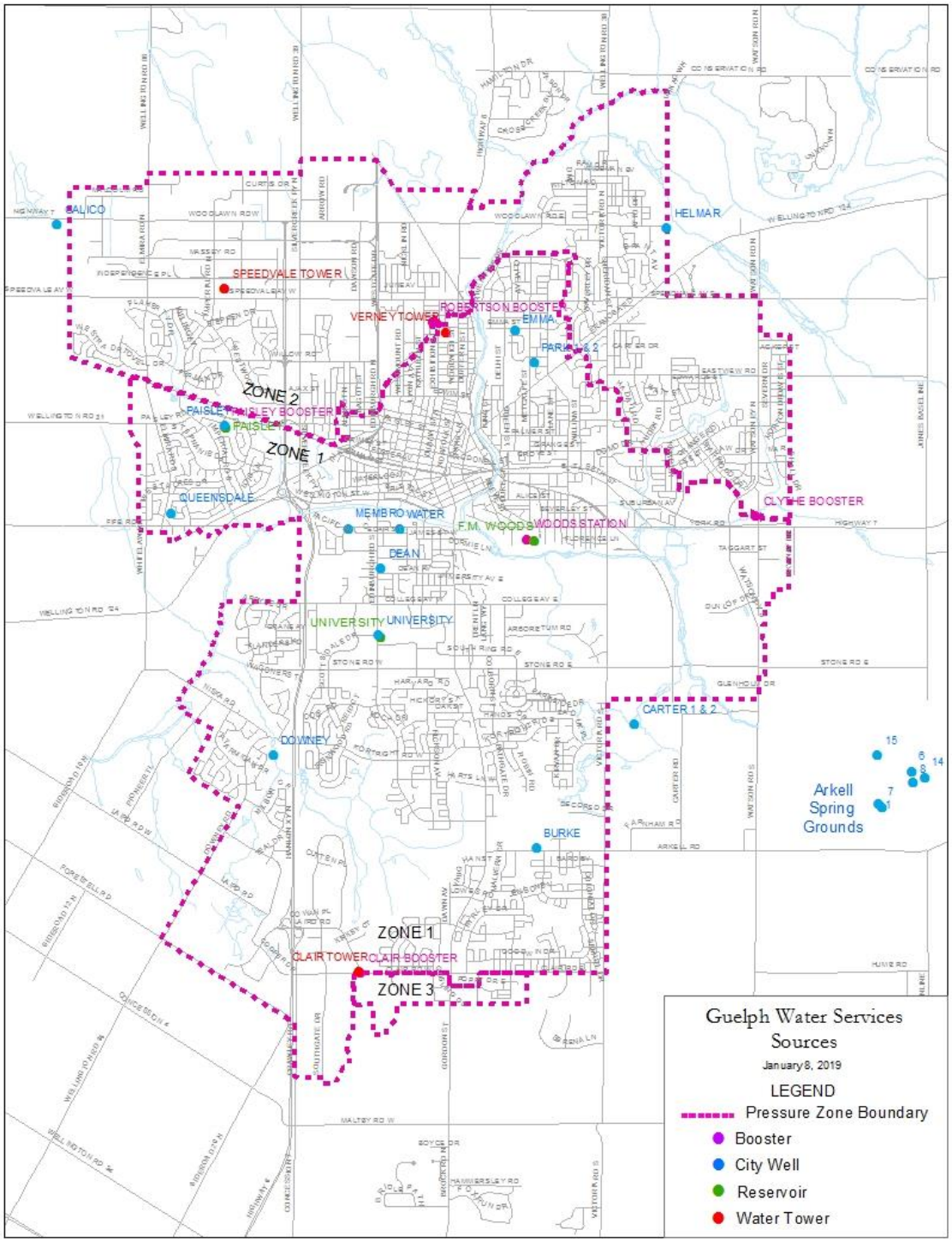
In 2019, all regulatory microbiological and chemical quality samples were taken by certified operators and tests on water samples collected throughout the drinking water system were performed by accredited, licensed laboratories. These tests include both regulatory and operational testing – in most cases only regulatory reporting is included in this report. In all cases, the drinking water supplied to all customers was confirmed safe and the water was of higher quality than all Ontario and Canadian health-related guidelines.

The Guelph Drinking Water System is defined as a large residential system operated under the regulatory requirements of the Safe Drinking Water Act and the Ontario Water Resources Act (accessed at Ontario e-laws). In 2019, the Guelph Drinking Water System operated under Municipal Drinking Water Licence (MDWL) 017-101, Issue numbers 11 and 12 and the Drinking Water Works Permit (DWWP) 017-201, Issue numbers 7 and 8.

The MDWL and the DWWP describe system-specific requirements that are supplementary to provincial regulations and act as licences for water supply and distribution operations. These documents outline specific conditions and requirements regarding operation, maintenance and upgrades that are required by the system and are considered regulatory in nature. These documents are available by request for viewing at Water Services, 29 Waterworks Place, Guelph.

Figure 1: Guelph Drinking Water System shows the locations of the Guelph Drinking Water System facilities that were active in 2019.

Figure 1: Guelph Drinking Water System



Gazer Mooney Subdivision Distribution System

The Gazer Mooney Subdivision Distribution System is a Class 1 Distribution Subsystem that serves approximately 200 people, and is owned by the Township of Guelph/Eramosa. The system is operated by Guelph Water Services through a legal agreement that was signed by representatives of the City of Guelph and the Township of Guelph/Eramosa. The current agreement came into effect on March 1, 2019 and will continue until February 29, 2024 and will be automatically renewed and extended to February 28, 2029, unless terminated earlier.

All of the water for the Gazer Mooney Subdivision Distribution System is supplied from the Guelph Drinking Water System. All water is treated to provincial standards in the Guelph Drinking Water System and no further treatment chemicals are added to the Gazer Mooney Subdivision Distribution System.

All new distribution infrastructure components meet NSF 61 requirements or approved equivalents and are installed and maintained in accordance with approved industry standards. The system is fully metered.

The Gazer Mooney Subdivision Distribution System is comprised of the following infrastructure:

- approximately 720 meters of 200mm diameter watermain;
- approximately 600 meters of 150mm diameter watermain;
- six watermain valves;
- six fire hydrants;
- one sampling station; and
- approximately 72 water services and water meters.

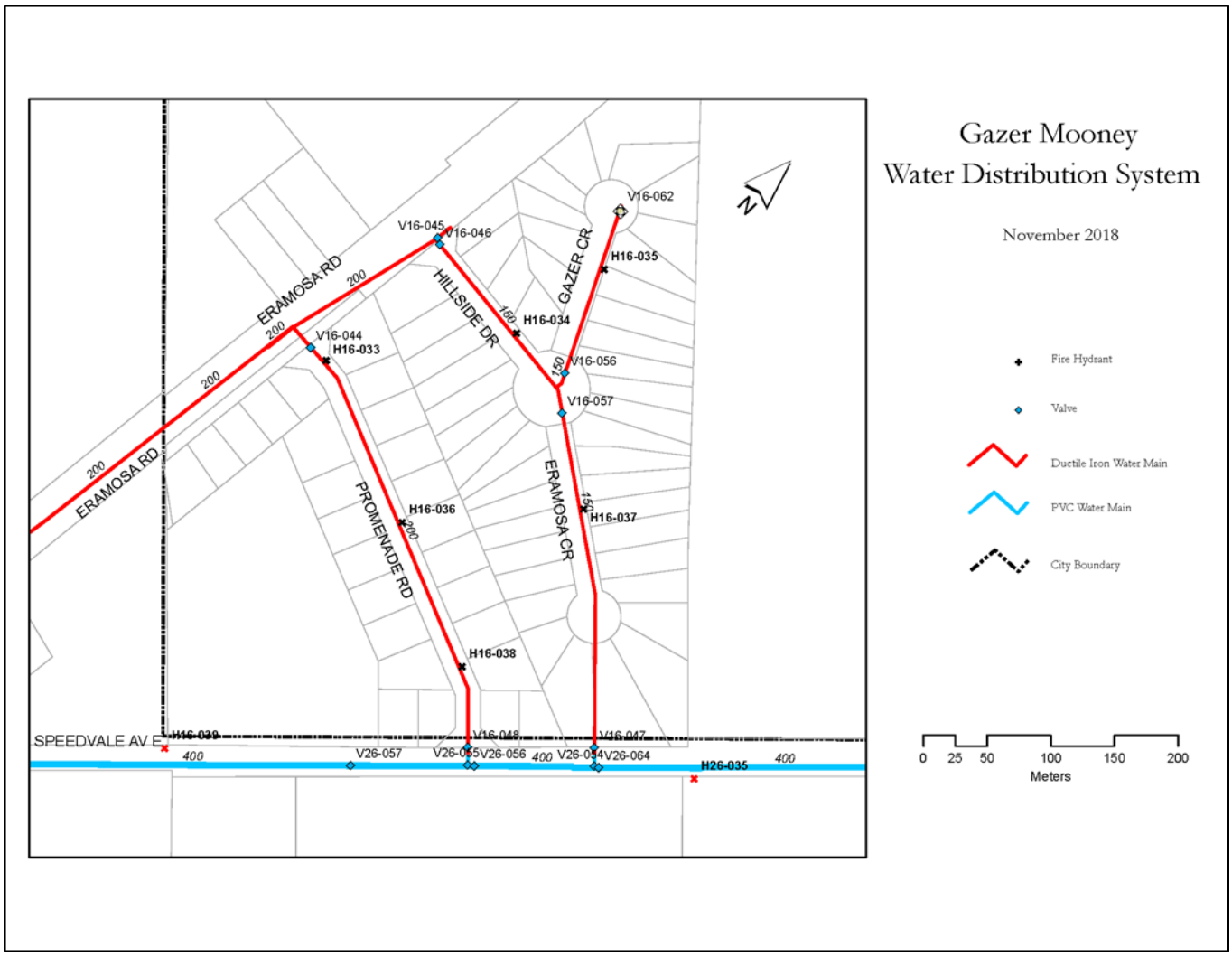
The cost of construction of the Gazer Mooney Subdivision Distribution System in 1980 was listed as $197,933.

The Gazer Mooney Subdivision Distribution System is considered a small residential system and is operated under the regulatory requirements of the Safe Drinking Water Act and the Ontario Water Resources Act which may be found at Ontario e-laws.

In 2019, the Gazer Mooney Subdivision Distribution System operated under Municipal Drinking Water Licence No. 104-103, Issue number 2; and Drinking Water Works Permit No. 104-203, Issue number 2. These documents are available by request for viewing at Water Services, 29 Waterworks Place, Guelph and at the Township of Guelph/Eramosa, 8348 Wellington Rd. 124, Rockwood.

Figure 2: Gazer Mooney Water Distribution System shows the location of the Gazer Mooney Subdivision Distribution System.

Figure 2: Gazer Mooney Water Distribution System



Water Services' Annual and Summary Report

a) Incidents of Regulatory Non-Compliance

This section describes all incidents of non-compliance.

Guelph Drinking Water System

There were four incidents of non-compliance associated with the Guelph Drinking Water System in 2019. The four incidents are described below:

- Caps on the water level monitoring access points on two wells, located inside secure buildings, were found to not be in place. This was immediately corrected at the time of inspection.
- A Form 1 (Record of Watermains Authorized as a Future Alteration) was completed in November 2019 for work on a watermain that occurred in September 2019. The City's DWWP requires the Form 1 to be completed prior to the watermain being placed into service. Water Services is working with Engineering and Transportation Services to develop a procedure to ensure that Form 1's are completed prior to any watermain additions, modification, replacement or extension being placed into service.
- A chlorine residual in a dead-end of the distribution system was found to be below 0.05mg/L, which is discussed further in section b) Adverse Water Quality Incidents. Water Services is committed to ensuring that an acceptable chlorine residual is maintained throughout the water distribution system and has implemented a regular flushing program in this area.
- It was found that HPC analysis was not completed on two treated water samples taken on February 6, 2019. This was caused by human error, where the treated water samples were mistakenly recorded on the chain of custody as raw water samples; HPC analysis is not required for raw samples. Water Services now has separate chains of custody for raw and treated water samples to help eliminate the chance of this reoccurring.

A score of 89.42% was achieved in the 2018-2019 Ministry of the Environment, Conservation and Parks Annual Inspection Report for the Guelph Drinking Water System.

Water Services has corrected all issues of non-compliance identified during the MECP inspection. Through the root-cause analysis process, Water Services initiates continual improvement measures and implements new policies and procedures to prevent issues of non-compliance from re-occurring.

Gazer Mooney Subdivision Distribution System

There were no incidents of non-compliance associated with the Gazer Mooney Subdivision Distribution System in 2019.

A score of 100% was achieved in the 2018-2019 Ministry of the Environment, Conservation and Parks Annual Inspection Report for the Gazer Mooney Subdivision Distribution System.

b) Adverse Water Quality Incidents

This section describes all Adverse Water Quality Incidents (AWQI's). This term refers to any unusual test result from treated water that does not meet a provincial water quality standard, or a situation where disinfection of the water may be compromised. An adverse water quality incident indicates that on at least one occasion and at a certain instance in time, a water quality standard was not met. On average, the Guelph Drinking Water System processes four to five AWQI's annually.

Many AWQI's have proven to be the result of water sampling and testing problems rather than poor water quality. False positive results can be caused by: contaminated sampling containers and equipment; improper sampling technique; handling and transportation; and sampling analysis errors.

Please note: The City was granted regulatory relief from Schedule 15.1 of O. Reg. 170/03 in favour of a Guelph specific Lead Reduction Plan (LRP). Residential sample results collected under the LRP that have lead concentrations above 10 µg/L, are tracked and reported to Wellington-Dufferin-Guelph Public Health, the Ministry of the Environment, Conservation and Parks (as per MDWL 017-101, Schedule D) and the customer. See 0 Status of Ongoing and Emerging Water Quality, Supply and Distribution Initiatives for more information on the Lead Reduction Plan.

Guelph Drinking Water System

In 2019, there were three adverse water quality incidents (AWQI's #144857, #144859 and #148104) and a summary of these are included in Table 1.

Table 1: Guelph Drinking Water System Adverse Water Quality Incidents, 2019

#	Date	AWQI #	Location	Description	Corrective Action	Re-sample Results Good	Deviation from Critical Control Point[5]
1 & 2	Feb. 25	144857 and 144859	Burkes Well - POE (S002)	Sodium result of 66 mg/L at S002	Water Services was informed by the laboratory of two sodium exceedances, both at a concentration of 66mg/L. Wellington-Dufferin-Guelph Public Health (WDGPH), MECP, and Spills Action Centre (SAC) were notified. Re-samples were taken and results of 71 mg/L were received on March 4, confirming Burke treated source water is above the aesthetic objective lower limit of 20 mg/L. Resample results were communicated to the WDGPH and the AQWI was closed.	No[6]	No

[5] Please see Section c) Deviations from Critical Control Point (CCP) Limits and Response Actions of this report for a description of "critical control points".

[6] The aesthetic objective for sodium in drinking water is 200 mg/L. The local Medical Officer of Health should be notified when the sodium concentration exceeds 20 mg/L so that this information may be communicated to local physicians for their use with patients on sodium restricted diets. Water Services communicated the sodium test results to the Wellington-Dufferin-Guelph Public Health Unit.

#	Date	AWQI #	Location	Description	Corrective Action	Re-sample Results Good	Deviation from Critical Control Point[5]
3	Sept. 17	148104	Hydrant H29-068	Distribution system chlorine residual below 0.05 mg/L	Hydrant H29-068 was flushed on Sept. 17 as part of a Dead-End-Flushing Program and a chlorine residual of 0.00mg/L was recorded. After 35 minutes of flushing at approximately 7 L/sec., a residual of 0.64 mg/L was achieved. Wellington-Dufferin-Guelph Public Health (WDGPH), MECP, and Spills Action Centre (SAC) were notified. Hydrant H29-068 is now part of the regular flushing program and has scheduled flushings to maintain acceptable secondary disinfection free chlorine residuals. The AWQI is closed.	Yes	Yes

Gazer Mooney Subdivision Distribution System

There was one adverse water quality incident in the Gazer Mooney Subdivision Distribution System in 2019.

Table 2: Gazer Mooney Subdivision Distribution System Adverse Water Quality Incidents, 2019

#	Date	AWQI #	Location	Description	Corrective Action	Re-sample Results Good	Deviation from Critical Control Point[7]
1	Mar. 26	145058	Gazer Mooney Lift Station (GM223)	Sodium result of 26 mg/L at GM223	Wellington-Dufferin-Guelph Public Health (WDGPH), MECP, Spills Action Centre (SAC), and Guelph/Eramosa Township staff were notified. Re-samples were taken and results of 24 mg/L were received on March 28, confirming Gazer Mooney treated water is above the aesthetic objective lower limit of 20 mg/L. Resample results were communicated to the WDGPH and the AQWI was closed.	No[8]	No

[7] Please see Section c) Deviations from Critical Control Point (CCP) Limits and Response Actions of this report for a description of "critical control points".

[8] The aesthetic objective for sodium in drinking water is 200 mg/L. The local Medical Officer of Health should be notified when the sodium concentration exceeds 20 mg/L so that this information may be communicated to local physicians for their use with patients on sodium restricted diets. Water Services communicated the sodium test results to the Wellington-Dufferin-Guelph Public Health Unit.

c) Deviations from Critical Control Point (CCP) Limits and Response Actions

A critical control point in the drinking water system is where control can be applied to prevent or eliminate a drinking water hazard, or to reduce it to an acceptable level. Water Services has identified three Critical Control Points (CCP) in the drinking water system:

1) Multi-Barrier Primary Disinfection - To remove or inactivate pathogens potentially present in the source water.
2) Secondary Disinfection - To ensure the maintenance of a disinfectant residual throughout the distribution system.
3) Backflow Prevention - To prevent cross-contamination that can result from the flowing back of or reversal of the normal direction of flow of water.

Any deviations from the CCPs are reported to both the Owners and Top Management, and are summarized in b) Adverse Water Quality Incidents in this report. There was one deviation from the Critical Control Points in 2019. The deviation was related to secondary disinfection. Information about this incident and actions taken to resolve the issue is outlined in b) Adverse Water Quality Incidents under item 3.

Additional information (e.g. critical control limits and response actions) is included in Appendix A: Summary of Critical Control Points and Critical Control Limits.

d) The Effectiveness of the Risk Assessment Process

This section confirms the occurrence of reviews of the risk assessment process. The risk assessment process determines the effectiveness of identifying and appropriately assessing the risk of hazards and hazardous events to the drinking water system. It also identifies the appropriate control measures; critical control points (CCPs); and related critical control limits (CCLs) related to the hazards and hazardous events. A description of the CCPs and CCLs are included in Appendix A: Summary of Critical Control Points and Critical Control Limits.

The annual risk assessment review was conducted by Water Services staff over several meetings between August 15 and August 30, 2019. The updated risk assessment outcomes was subsequently reviewed and approved at a management meeting on September 24, 2019. The results of the Risk Assessment are not made available to the public, but are made available to internal staff and the Guelph DWS Owners.

Through the risk assessment process, the following Water Services program or process aspects were added:

- Locates - Inability to properly locate due to no tracer wire installed or installed incorrectly or not locatable material leading to watermain damage;
- Locates - Inability to properly locate due to inaccessible, incorrect or not updated records resulting in damaged watermain.

e) Internal and Third-Party Audit Results

Internal auditing and third-party auditing is performed to fulfill the mandatory requirements of the Drinking Water Quality Management Standard (DWQMS). The internal audit is completed using trained internal Water Services staff as auditors. The purpose of audits are to evaluate the level of conformance of Water Services to the DWQMS. Audits identify both conformance and non-conformance with the Standard, as well as, opportunities for improvement. Appendix B: Summary of Internal and External Audit Plans includes the past two years' internal and external audit plans and the plan for the upcoming year.

2019 Internal Audit

The internal audit was completed on April 1 to April 5, 2019 and looked at 17 processes at Water Services. Many strengths were identified during the internal audit, including a sense of pride, ownership and commitment to the DWQMS and processes outlined in the Operational Plan. Participating staff at all levels are knowledgeable and aware of their duties as it relates to providing safe drinking water to the water consumers.

There were no non-conformities identified during these internal audits.

Various opportunities for improvement, such as: improved document and records control; training; communications; essential services; staffing levels; emergency management; and standard operating procedure creation were also noted in the internal audit report. Water Services strives to promptly address issues identified in internal audits as part of continuous improvement of its procedures and processes. The next internal audit is scheduled to take place between March 2 and 6, 2020.

2019 External Audit

The third-party external on-site verification audit was completed between November 25 and November 27, 2019 by NSF International Strategic Registrations and looked at 24 processes at Water Services. Accreditation to the DWQMS Version 2.0 was maintained.

The auditor noted that there continues to be strong evidence of ongoing commitment to the DWQMS at the City of Guelph. System strengths observed during the audit include:

- Staff participation / engagement
- Ownership / pride
- DWQMS documentation
- Management review process
- Internal audit process
- Continual improvement
- Communication: internal and external
- Risk assessment process
- Leak detection program
- Emergency planning / testing processes

There were two minor non-conformities identified during this audit. The first minor non-conformance related to Document and Records Control (DWQMS Element 5). The auditor noted that: there was a standard operating procedure that does not reflect current practices for calibration and verification of colorimeters; and an obsolete version of design specifications was found to be available to operators.

The second minor non-conformance relates to Essential Supplies and Services (DWQMS Element 13) and documentation around chemical receiving. Instances were identified where the lot number was missing on the bill of lading from our chemical supplier.

In both minor non-conformances, immediate containment of the issues were taken. A root-cause-analysis was completed to identify corrective and preventative actions to ensure that the issues will not occur again. In both minor non-conformances, the auditor accepted our corrective and preventative actions and the minor non-conformances are considered closed.

Noted opportunities for improvement by the auditor were related to improving the following processes:

- Document and Records Control (DWQMS 5);
- Communications (DWQMS 12);
- Infrastructure Maintenance, Rehabilitation and Renewal (DWQMS 15);
- Sampling, Testing and Monitoring (DWQMS 16); and

- Continual Improvement (DWQMS 21).

Water Services maintains a culture of continual improvement and works towards implementing improvements suggested by the external auditor. The minor non-conformances and opportunities for improvement will be reviewed by the external auditor at the next on-site audit, scheduled between November 23 and 25, 2020.

f) Results of Emergency Response Testing

Emergency response testing is regularly completed as part of the Water Services' Quality Management System (QMS) to ensure that Water Services maintains a reasonable readiness to deal with emergencies and abnormal events. The ability to properly manage emergencies and unplanned failures is critical in demonstrating that Water Services has taken a diligent approach in its operations.

Water Services' last emergency test exercise involved a mock scenario where a large watermain break occurred on a section of 20 inch watermain that feeds the west end of the city, which resulted in low pressure and/or no water for the affected customers, a boil water advisory and a workplace incident where a car drove into the watermain trench, resulting in an investigation by the Ministry of Labour. The emergency test exercise was held on November 1, 2019 and included representatives from the Ministry of the Environment, Conservation and Parks (Inspector), representatives from Wellington-Dufferin-Guelph Public Health (WDGPH) as well as Water Services and other City staff. All other Water Services' staff participated in sessions that took place between November 6 and 8, 2019.

Water Services had three actual emergency events in 2019.

The first one occurred on May 10, 2019. A contractor who was working on site at Water Services punctured the gas main with a backhoe. Water Services staff evacuated the building until the gas supply could be shut off. Fire Services were on scene to assess the situation and determine when staff could return to work. The gas main was repaired by Union Gas.

The second emergency involved four watermain breaks on a section of Silvercreek Parkway on the weekend of September 13, 2019. Based on the poor structural condition of this segment of watermain, an emergency replacement of that section of pipe was initiated on September 16, 2019. Following completion of reconstruction of this segment of pipe it was returned to regular service in early October.

The third emergency involved a large watermain break on a 16" watermain on Speedvale Avenue between the Hanlon Parkway and Silvercreek Parkway on November 30, 2019. This resulted in significant water loss from the Speedvale Tower; although pressure was maintained throughout the north end of the city during the watermain break. Emergency repairs were completed by a contractor, with Water Services staff overseeing the repairs.

Feedback from emergency testing and from actual emergency events is gathered during debriefing sessions and improvement items are incorporated into the Emergency Plan, standard operating procedures and/or daily operations.

Table 3 includes the dates of Completed Emergency Response Tests for the past three years and planned tests for 2020.

Table 3: Emergency Response Tests

Hazardous Event / Hazard[9]	2017	2018	2019	2020
Long-term impacts of climate change	Dec. 8, 13 (2017 test)	Jan. 26 (2017 test)		
Source water supply shortfall	Jan. 20 (2016 test)			Planned test
Extreme weather events (e.g. tornado, ice storm, flood)	Dec. 8, 13 (2017 test)	Jan. 26 (2017 test)		
Sustained extreme temperatures (e.g. heat wave, deep freeze)	Dec. 8, 13 (2017 test)	Jan. 26 (2017 test)		
Chemical spill impacting source water				Planned test
Sustained pressure loss		Nov. 23, 28-30 (2018 test)	Nov. 1, 6-8 (2019 test)	

[9] The Hazardous Event / Hazard list reflects the MECP's mandated "Potential Hazardous Events for Municipal Residential Drinking Water Systems to Consider in the Risk Assessment" document.

Hazardous Event / Hazard[9]	2017	2018	2019	2020
Backflow / Cross-connection		Nov. 23, 28-30 (2018 test)		
Terrorist threat				Planned test
Vandalism				
Sudden changes to raw water characteristics (e.g. turbidity, pH)	Dec. 8, 13 (2017 test)	Jan. 26 (2017 test)		Planned test
Failure of equipment or process associated with primary disinfection (e.g. UV, chlorination)				
Failure of equipment or process associated with secondary disinfection (e.g. chlorination)				
Loss or contamination of treated water supply		Nov. 23, 28-30 (2018 test)	Nov. 1, 6-8 (2019 test) Sept. 13 and Nov. 30 (main breaks)	
Loss of monitoring system			Nov. 3 (AWQI)	

g) Operational Performance and Statistics

The following section describes Operational performance statistics within Water Services that includes:

- 2019 Totalized Pumpages as per the Municipal Drinking Water Licence and Permits to Take Water;
- 2019 Instantaneous Flows as per Permit to Take Water requirements;
- Water Production and Population;
- 2019 Arkell Springs Glen Collector Flows;

- Water Supply Capacity;
- System Maintenance and Updates; and
- Status of Ongoing and Emerging Water Quality, Supply and Distribution Incentives.

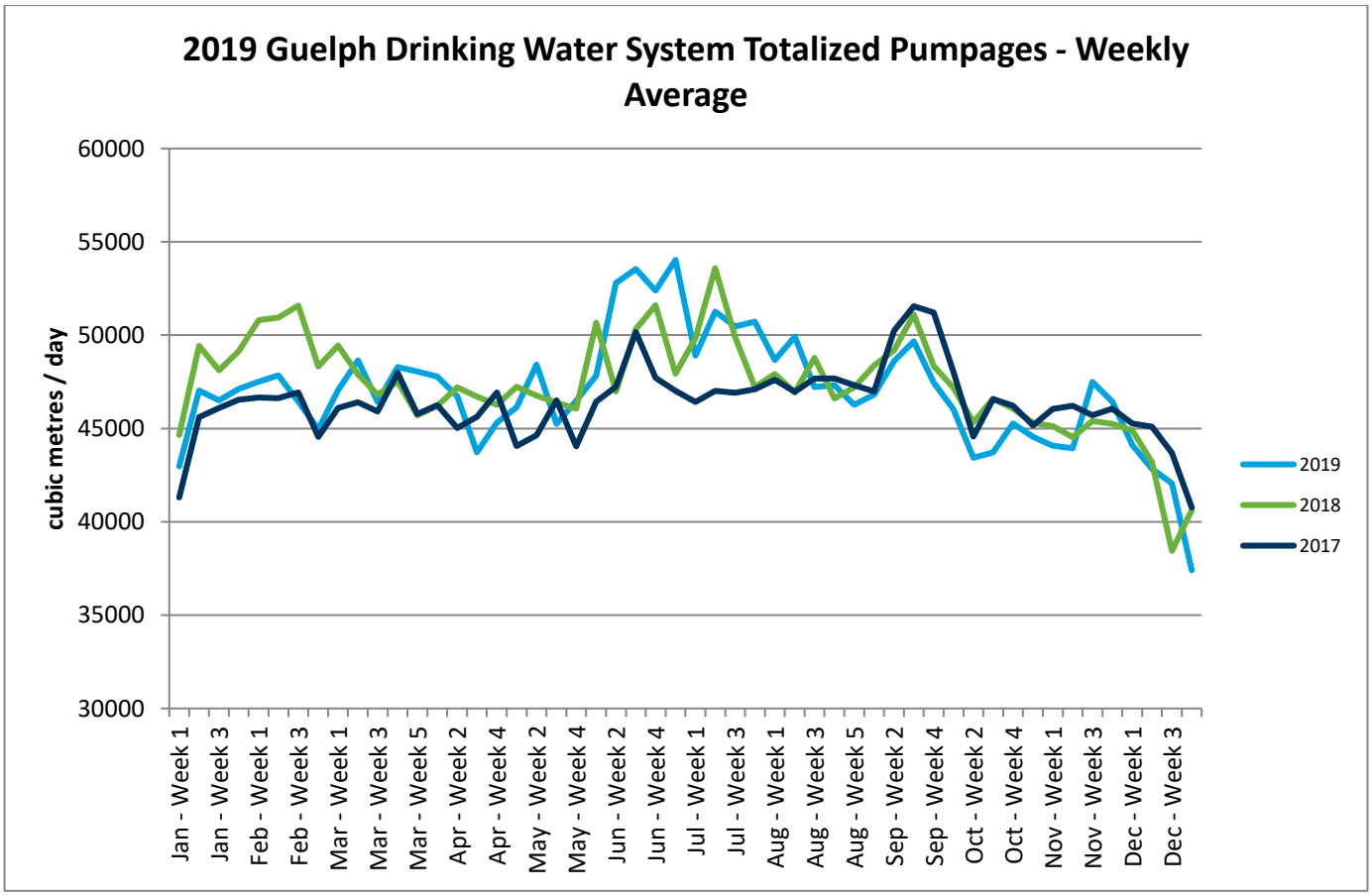
2019 Totalized Pumpages and Instantaneous Flows

The Safe Drinking Water Act and the Ontario Water Resources Act each require that operating authorities record and report both water takings as governed by Permits-to-Take-Water, and water being supplied to the City of Guelph.

Summaries of total water pumped, instantaneous flows and capacity (flows and volumes compared to rated capacities) by the City of Guelph can be found in Appendix C: Total Water Pumped and Instantaneous Flows.

Figure 3 below, depicts the water pumpage rate in cubic metres per day (m^3/day) that is averaged each week.

Figure 3: Totalized Pumpages, 2019



Water Services processed 17,160,654 cubic metres (17.2 billion litres) of water to the distribution system in 2019, equivalent to 6,864 Olympic-sized swimming pools. This represents 0.9 per cent less water being supplied to the distribution system in 2019 as compared to the same time period in 2018 and 1.4 per cent more water than in 2017.

The average daily water demand was 47,015 cubic metres (47.0 million litres). The maximum day production of water in 2019 was 58,411 cubic metres (58.4 million litres) and occurred on November 30, 2019. The minimum day production of water in the same time period was 32,477 cubic metres (32.5 million litres) and occurred on December 26, 2019.

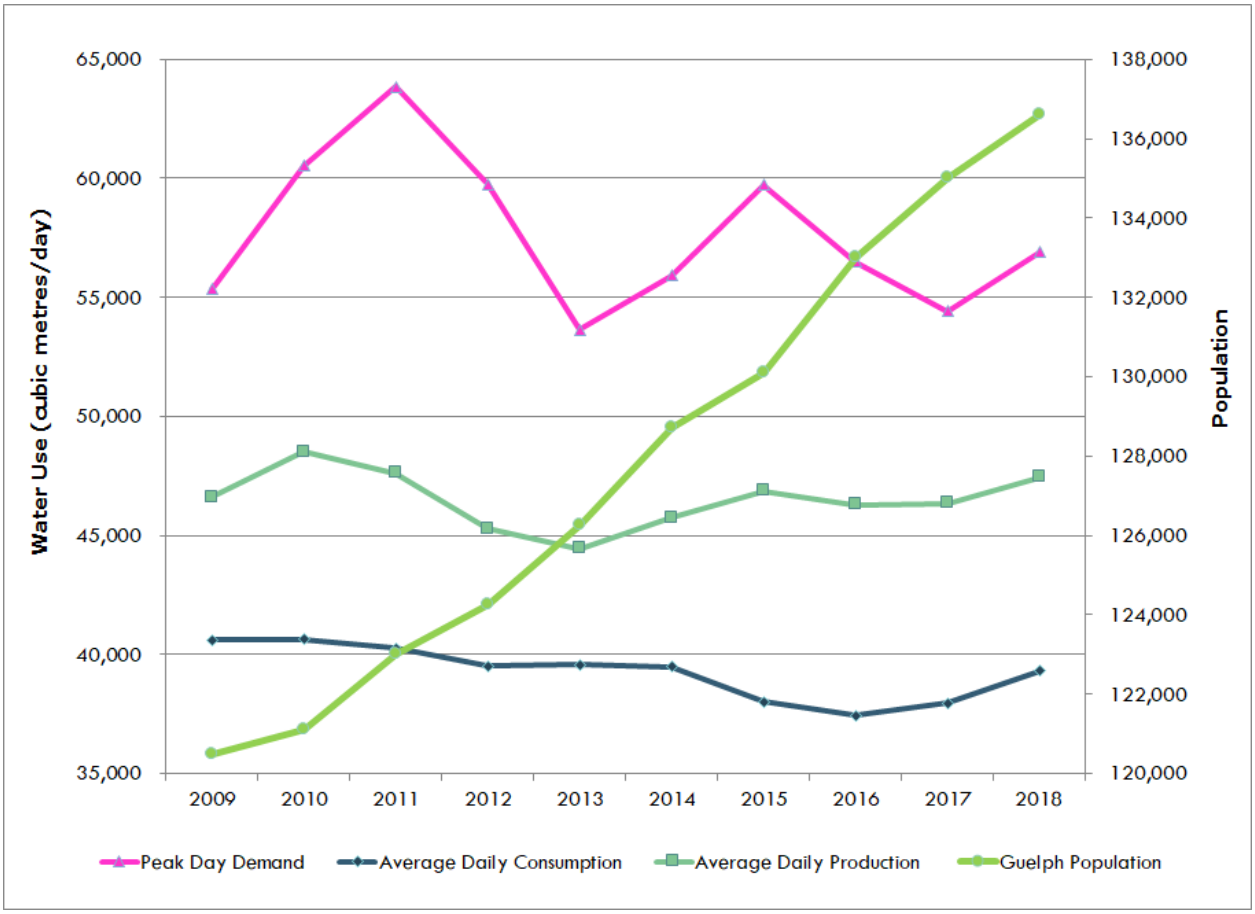
Water Production, Consumption and Population

Figure 4 below shows the City of Guelph's annual average daily water production, annual average daily consumption, annual peak day demand, and population from 2009 to 2018. Consumption data for 2019 was not available at the time of publication.

During this time, the City of Guelph's population increased 12 per cent while at the same time annual average daily water production and consumption demonstrate a downward trend (3 per cent) based on linear regression.

Fluctuation in water production and consumption is anticipated to occur, year to year, based on a number of factors, including seasonal temperatures and annual precipitation, system demands (including planned and unplanned maintenance) and steady population growth.

Figure 4: Guelph Water Production, Water Consumption, Population



Arkell Springs Glen Collector System Source Water

The Arkell Springs Glen Collector System (Collectors), one of Guelph's many water sources, consists of a gravity-fed, under-drain system that collects shallow overburden groundwater. This system has been in use since the early 1900's and can represent as much as 40 per cent of the total city-wide daily water production when in operation. When the output of this source is reduced, Water Services is required to make up the difference from other water supplies. Throughout the year, the production from this water supply varies from an approximate low of 4,000 cubic metres (4 million litres) up to an approximate high of 20,000 cubic metres (20 million litres) per day.

Seasonally, between April 15 and November 15, the City has a Permit-to-Take-Water that allows water to be pumped from the Eramosa River to a pond and trench-based Recharge System. In the Recharge System, the river water enters the trench where it filters through the ground and is later captured in the Arkell Springs Glen Collector System.

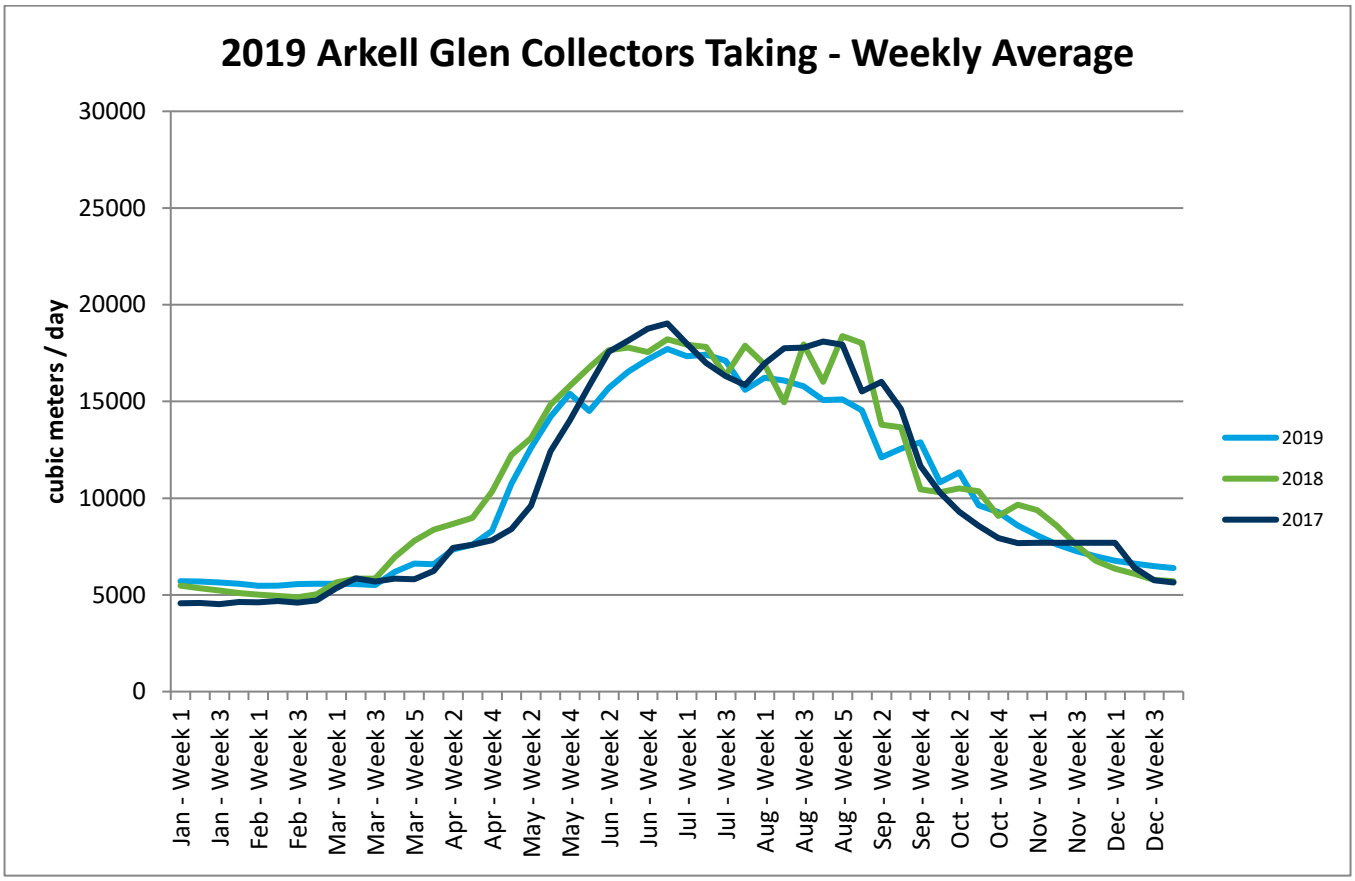
In 2016, the Recharge System was out of service to accommodate infrastructure improvements including an extension of the trench system in an effort to capture more water in the Collectors. The Recharge System was returned to service in May 2017 and tested during 2017 and 2018 to determine the impact of the extended trench on the Collector flows. In 2018, 1,368,766 m^3 of raw water was pumped from the Eramosa River (from April through November) and 1,119,787 m^3 of raw water was pumped from Arkell Well 7 (from March through September) to the Recharge System as part of a Collector System capacity test. Recent modelling showed that approximately 52 per cent of this volume was captured in the Collector system.

The productivity of the Collectors can be used as one of many predictive tools. If the production volume from the Collectors is low, then it can be assumed that other water supplies would be needed to make up the difference. This may alter how regular maintenance is performed as well as the urgency with which repairs are made to supplies that unexpectedly go off-line as they may be needed to supplement overall production for the City when the Collector System is unable to produce a sufficient supply.

The Collectors have produced 3,853,004 cubic metres (3.9 billion litres) of water in 2019, which is approximately 22 per cent of Guelph's total water production. This represents 4.2 per cent less water as compared to the same time period in 2018 and 1.4 per cent more water than in 2017.

For a visual representation, please refer to Figure 5, which depicts the Arkell Spring Grounds Collector flow volumes in cubic metres per day (m^3/day) that is averaged each week.

Figure 5: 2019 Arkell Spring Grounds Glen Collector System Volumes



Please note: Arkell Well 7 contributed 1,119,787 m^3 to the Recharge System (from March through September 2018) with approximately half (560,000 m^3) captured in the Collector flow post filtration through the ground.

Water Supply Capacity

Pumping stations are typically rated on their firm capacity, which is defined by the Ministry of Environment, Conservation and Parks (MECP) Design Guidelines for the Design of Drinking Water Distribution Systems (2008) by the following criteria:

- Capacity of the pumping station with the largest unit out of service if the station supplies a pressure zone with adequate storage available for fire protection and balancing;
- Capacity of the pumping station with the two largest units out of service if the pumping station serves a pressure zone that does not have adequate floating storage available and is the sole source of supply in the area.

This approach however, does not address the "system" firm capacity. Neither is it directly applicable to a groundwater system with many sources. Firm Capacity assessment of a water supply system is essentially an exercise in risk assessment, such that a municipality will incorporate measures or strategies to minimize the risk of certain aspects of the system being off-line, and will accept a level of risk that a portion of the system will not be available due to maintenance, water quality issues or other.

A proposed approach to more accurately reflect system conditions for the City considers equipment reliability (i.e. assumptions for percentage of inoperable wells or pumps) and also potential future contamination issues. This will also take into consideration wells that are presently shut down for water quality reasons and whether it would be acceptable to bring these sources back online in emergency conditions.

Historically, City staff have assessed a safe, sustainable yield of existing groundwater supplies through hydrogeological assessments conducted mainly through quadrant studies, subsequent pumping tests and operational data. The groundwater flow model has also been used to confirm sustainable capacity, however both of these methods reflect permitted capacities, either takings allowed in the Permit to Take Water (PTTW) or those included in Environmental Certificates of Approval (ECA) for each well or pumping station.

In order to more accurately address the questions of system firm capacity, Water Services staff annually review the operational water demand data for water supply facilities under maximum demands. Values used for permitted pumping rate and firm capacity calculations by well are provided in Table 4. The permitted pumping rate is the rate of pumping allowed as identified in the Permits to Take Water. The firm capacity rate is the actual rate of pumping that can be achieved at each well.

Table 4: Permitted Rates and Point of Entry Firm Capacities of Water Supply Wells

Well Name	Permitted Daily Maximum (m^3/day)	Permitted Rate (L/s)	Point of Entry Firm Capacity[10] (m^3/day)	Point of Entry Firm Capacity (L/s)
Arkell 1	**3,273**	**37.9**	**1,640**	**19.0**
Arkell Springs Wellfield[11]	**28,800**	**333.3**	**28,800**	**333.3**
Burke	**6,546**	**75.8**	**5,790**	**67.0**
Carter 1 and Carter 2	**7,855**	**75.8**	**5,184**	**60.0**
Membro	**6,050**	**78.0**	**3,200**	**37.0**
Water St.	**3,400**	**44.4**	**2,500**	**28.9**
Dean	**2,300**	**34.6**	**1,500**	**17.4**
University	**3,300**	**38.2**	**2,400**	**27.8**
Downey	**5,237**	**60.6**	**5,000**	**57.9**
Park 1 and Park 2	**10,300**	**119.2**	**9,500**	**110.0**
Emma	**3,100**	**35.9**	**2,330**	**27.0**
Helmar	**3,273**	**37.9**	**1,300**	**15.0**
Paisley	**3,200**	**37.0**	**1,300**	**15.0**
Calico	**5,237**	**60.6**	**1,040**	**12.0**
Queensdale	**5,237**	**60.6**	**1,210**	**14.0**

[10] The firm capacity rate is the actual rate of pumping that can be achieved at each well.
[11] The Arkell Springs Wellfield consists of five (5) municipal drinking water production wells: Arkell 6, Arkell 7, Arkell 8, Arkell 14 and Arkell 15. All of the aforementioned Arkell Wells are contained within the same Permit to Take Water (No. 5061-9ZKKWV). Notwithstanding the specified maximum permitted taken per day, any combination of these wells can be used to obtain the permitted rate.

Water Services staff use the calculated firm capacity values in order to aid planning of scheduled shutdowns and maintenance of the water supply wells. Staff hold monthly meetings to review project statuses that affect firm capacity. At the meetings there are discussions related to the progress of maintenance and upgrade operations. The purpose of the monthly meeting is to ensure adequate servicing capacity is available to meet the City's water demands while maintenance and capital upgrades are undertaken to maintain the system in a fit state of repair.

System Maintenance and Updates

The tables that follow summarize Water Services' maintenance work – for Water Distribution (Table 5) and for Water Treatment (Table 6).

Table 5: Water Distribution Maintenance Activity

Job Type	2017 Total	2018 Total	2019 Total
Acoustic Leak – Dry	**1**	**0**	**5**
Blow Off Install	**0**	**0**	**0**
Dig to find leak	**0**	**0**	**1**
Hi/Low Jumper Install	**0**	**0**	**0**
Hydrant Install (WW)	**0**	**0**	**1**
Hydrant Remove	**0**	**0**	**1**
Hydrant Repair	**35**	**6**	**301**[12]
Hydrant Repair Hit	**2**	**7**	**2**
Hydrant Replace (WW)	**2**	**2**	**9**
Hydrant Replace Hit	**2**	**1**	**1**
Main Break	**47**	**72**	**58**

[12] Water Services has started tracking all repairs through a Work and Asset Management Program, resulting in a more detailed accounting of the number of repairs completed.

Job Type	2017 Total	2018 Total	2019 Total
Other (e.g. exploratory excavations, miscellaneous repairs, etc.)	**2**	**11**	**1**
Re-route Watermain	**0**	**0**	**0**
Sample Station Install	**17**	**1**	**1**
Sample Station Replace	**10**	**0**	**1**
Service Cut Off	**3**	**5**	**3**
Service Lowered	**0**	**0**	**0**
Service New Install	**0**	**2**	**2**
Service Repair	**91**	**99**	**489**[13]
Service Replace	**7**	**11**	**14**
Trench Repair	**0**	**0**	**0**
Valve Install (WW)	**1**	**4**	**5**
Valve Remove	**0**	**0**	**0**
Valve Repair	**7**	**7**	**54**
Valve Replace (WW)	**22**	**25**	**20**
Meters New	**487**	**315**	**367**
Meters Exchanged	**712**	**950**	**4,612**[14]
Watermains Cleaned (km)	**150.65**	**225**	**15.6**
Watermains Re-lined (m)	**171**	**0**	**1,390**

[13] Water Services has started tracking all repairs through a Work and Asset Management Program, resulting in a more detailed accounting of the number of repairs completed.
[14] 1,344 meters were exchanged by Water Services, 3,268 meters were exchanged through the Water Meter Replacement Program.

The next table (Table 6) includes Water Treatment-related maintenance activities and expenditures (may include programs that have a series of projects).

Table 6: Water Treatment Maintenance Activity, 2019

Maintenance Activity	Location
Below Grade Well Inspections	Arkell 15, Carter 1, Paisley, Park 1, and Queensdale
Clair/Zone 3 Booster Testing	Clair Booster Station
Contact Chamber/Reservoir Inspections	Downey, Paisley, Park, Queensdale and FM Woods Station
Electrical "as found" Drawings	Arkell
Electrical and Instrumentation Upgrades	Various Sites
Facility Lighting Upgrades	Various Sites
Facility Repairs and Maintenance	Various Sites
Fencing and Security Upgrades	Arkell
Process and Monitoring Equipment Upgrades	Various Sites
Process Piping Upgrades	Queensdale
Pump Replacements	Arkell 14, Park and Queensdale
Standby Power Generator Installation	Arkell Well 8
Turbidimeter Installations and Removals	Membro and Burke
Well Pump Discharge Pressure Transmitters	Various Sites
Well Rehabilitations	Paisley, Park 1 and Queensdale

SCADA System Improvements

The Supervisory Control and Data Acquisitions (SCADA) system is the computerized control system that monitors and automatically controls the pumps, valves, water towers and online instrumentation at the 25 water facilities located throughout the City and 8 water facilities

located in the Arkell Springs well field. SCADA also monitors 49 flowmeters and pressure transmitters located throughout the water distribution system.

The SCADA system performs the vital role of monitoring/logging process data to ensure regulatory compliance, and providing tools to the Operations team that enables them to run the City's water system in a consistent manner. Furthermore, the SCADA system is also configured to automatically shut down facilities and/or notify an on-call operator in the case of abnormal process conditions. The SCADA system also monitors the security systems at all water facilities. Lastly, the SCADA system also provides process data reports and queries that are used for compliance reporting, hydraulic system modelling, and long term planning.

In 2019, SCADA system uptime was over 99.995 per cent, due to SCADA network upgrades that were undertaken in 2017 to add redundant auto-failover backup SCADA network links to all facilities and due to SCADA backup system upgrades in 2018-2019.

Upgrades to the SCADA system in 2019 were focused around updating SCADA system programming standards, modernizing control system programming, and updating backup systems. In addition to incremental updates, all-new SCADA code and screens were deployed at 2 facilities in conjunction with capital projects.

Table 7 below, provides a summary of improvements to SCADA and Security undertaken in 2019.

Table 7: SCADA and Security - Maintenance and Improvement Activities, 2019

SCADA / Security Maintenance & Improvement Activities	Location(s)
Additional SCADA data-logging redundancy (with secondary data-loggers)	Various Sites
Process flow diagrams and piping & instrumentation diagrams (P&ID's) updates	All Sites
Equipment layout drawings updates	All Sites
Facility electrical drawings updates	Various Sites
SCADA Input / Output Lists and standardized connection diagram updates	Various Sites
SCADA backup server upgrades	Various Sites
New building temperature transmitters for facility monitoring	All Sites

SCADA / Security Maintenance & Improvement Activities	Location(s)
Updates to SCADA design and programming guidelines for capital projects	All Sites
SCADA programming standards updates	All Sites
SCADA software code updates (multi-year program)	Various Sites
New display screens to show current treatment chemical tank inventories in terms of level, percentage, tank capacity, and volume remaining	All Sites
Operator display screen updates to use high performance HMI concepts	Various Sites
Security systems upgrades	All Sites

Form 1s, Form 2s and Form 3s

Form 1s and 2s are required by the MECP to document significant changes to the drinking water system. Engineering Services staff complete the Form 1 – Record of Watermains Authorized as a Future Alteration. Water Services' staff complete the Form 2- Record of Minor Modification or Replacements to the Drinking Water System. Form 3s are associated with the addition of Emergency Stand-by Power. Water Services' staff complete the Form 3 – Record of Addition, Modification or Replacement of Equipment Discharging a Contaminant of Concern to the Atmosphere.

Table 8 below provides a summary of Form 1s, Form 2s and Form 3s completed over the course of 2019.

Table 8: Summary of Form 1s, Form 2s and Form 3s, 2019

Form Type	Total Number of Completed Forms
Form 1 – Record of Watermains Authorized as a Future Alteration	3
Form 2 – Record of Minor Modification or Replacements to the Drinking Water System	11
Form 3 – Record of Addition, Modification or Replacement of Equipment Discharging a Contaminant of Concern to the Atmosphere	1

Water Distribution Locates

In 2014, The City of Guelph registered its utility infrastructure with ON1Call, as mandated by the Ontario Underground Infrastructure Notification System Act, 2012.

Since registering, the City experienced a significant increase in locate request volumes. This increase in volume ensures that Water Services is notified of and attends all locate requests for every excavation in proximity to water infrastructure. This prevents damage to City infrastructure and protects the City's water quality and quantity.

In order to provide efficient locate services across the corporation, the City has transitioned all infrastructure locates into one corporate group which is housed at Water Services. This includes water, sanitary and storm sewers, traffic signals, and fibre optics. Utility locators now locate all infrastructure in one site visit rather than each department individually. Table 9 includes all water locate requests received and responded to in 2019 with a year to year comparison below in Table 10.

Table 9: Water Distribution Locates Requested and Responded to in 2019

Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
289	382	538	837	1,408	925	862	952	818	842	546	198

Table 10: Historical Locate Requests Received

Year	Total
2019	8,597
2018	8,275
2017	8,622
2016	7,979
2015	9,255

Status of Ongoing and Emerging Water Quality, Supply and Distribution Initiatives

This includes summaries and updates related to the implementation of the:

- 2016 Water Efficiency Strategy;
- Arkell Springs Forest Stewardship Project,
- Source Water Protection Plan;
- Lead Reduction Plan; and
- Frozen Services Monitoring Program.

Water Efficiency Strategy

The City of Guelph strives to be a leader in water conservation and efficiency. As one of Canada's largest communities reliant on a finite groundwater source for drinking water supply, the City's ability to reclaim water and wastewater serving capacity through conservation and efficiency initiatives offers numerous benefits to our community and local ecosystem. Water Services continues to promote the ongoing sustainability of our finite water resources through active water conservation and efficiency programming to meet the water reduction targets as outlined in the 2014 Water Supply Master Plan.

Appendix I: Water Efficiency Program – 2019 Annual Progress Report presents the achievements and progress made for the period of January 1 to December 31, 2019 in the implementation of the 2016 Water Efficiency Strategy.

Source Water Protection Plan

The City of Guelph is committed to drinking water source protection and in 2016, Council appointed risk management staff to implement the Source Water Protection program.

The City of Guelph falls under the Grand River Source Protection Plan, which was approved by the MECP and became effective on July 1, 2016. Of the 72 policies identified in the Grand River Source Protection Plan, the City of Guelph is the primary implementing body for 48 of the 72 policies, with the remaining policies to be implemented by provincial ministries. As of December 31, 2019, 28 of the 48 policies have been fully implemented, based on priority basis or deadline.

Appendix K: Source Water Protection includes a highlight of the progress made for the period of January 1 to December 31, 2019 in the implementation of the City of Guelph's Source Water Protection program. This third annual report summarizes information requested from the Risk Management Official by the Source Protection Authorities, as required under Section 81 of the Clean Water Act, 2006 (CWA).

For more information on Guelph's Source Water Protection Program, visit guelph.ca/sourcewater.

Arkell Springs Forest Stewardship Project

The Arkell Spring Grounds cover an area of 804 acres. The area is comprised of old and new forested areas. The objective of the Arkell Springs Forest Stewardship Project has been to protect the drinking water source supply by monitoring general forest health, managing tree plantings and enhancing fallow areas with new plantings.

Managed forest stands require continued maintenance and observation to ensure the health of the forest and prevent any unnecessary losses. The many benefits of this long-standing Stewardship Project include:

- the creation and maintenance of a diverse and functioning forest cover;
- maintenance and re-generation of older forested areas on the property;
- protection and recharge of underground aquifers which supply the City's water;
- prevention of undesirable surface water runoff and flooding into local waterways;
- localized temperature stabilization;
- retain precipitation to enhance infiltration and improve supply; and
- regulating water flow.

This property management approach results in the highest possible quality of water to supply Guelph's drinking water system.

To improve the overall health of the property, a tree planting program for fallow farm fields has been ongoing since 2007. On a volunteer basis, the Community Environmental Leadership Program (CELP) with the Upper Grand District School Board has planted 28,500 trees on 18 acres, and Bartram Woodlands (on-site contractor) has planted 39,240 trees on another 16 acres.

In 2019, a five-year plan for forest management was developed to identify priorities at the Arkell Spring Grounds. The plan identifies tree planting, maintenance and invasive vegetation removal to ensure the health of this site. It further recommends a forest inventory plan to guide the management of this important source protection measure.

Arkell Springs Forest Stewardship Project is an important part of the Arkell and Carter Integrated Property Management Plan.

Lead Reduction Plan

The City has been working proactively to address the presence of lead service lines (LSLs) in Guelph since 2007 through identification and replacement of both the private and public portions of LSLs. Full LSL replacement has demonstrated to be effective in reducing lead concentrations and achieving regulatory compliance as measured at the point to water consumption.

The City of Guelph's Lead Reduction Plan (LRP) was developed in lieu of a Corrosion Control Plan (as outlined in Ontario Regulation 170/03 Schedule 15.1) and was formally approved by the MECP on March 21, 2012. The LRP focuses on physical lead service line replacement through verification sampling, financial incentives and public outreach.

As per the City of Guelph MDWL 017-101 - Schedule D, the City is required to submit all lead sampling data every 6 months and an annual Evaluation Report to assess the effectiveness of the Lead Reduction Plan.

Lead Sampling in the Guelph Drinking Water System

The following table presents summary results for lead sampling in the Guelph Drinking Water System as per Schedule D for the period of January 1 to December 31, 2019.

Table 11: Lead Reduction Plan Lead Sampling - Guelph Drinking Water System, 2019[15]

Number of Locations	Location Type	Number of Samples	Lead Range (mg/L)
95	Plumbing that Serves Private Property	110	0.0000 – 0.038
10	Distribution System	20	< 0.0005

Lead Sampling in the Gazer Mooney Subdivision Distribution System

In the Gazer Mooney Subdivision Distribution System, all samples were below the Ontario Drinking Water Quality Standards (ODWQS) for lead of 0.01 mg/L, as presented in the following table.

Table 12: Lead Reduction Plan – Gazer Mooney Subdivision Distribution System, 2019

Number of Locations	Location Type	Number of Samples	Lead Range (mg/L)	pH Range	Alkalinity Range (mg/L)
1	Distribution	2	<0.0005	7.78 – 7.88	260 – 270

Lead Sampling

Over 5,000 homes/businesses have been sampled for lead to identify the presence of LSLs and to monitor lead levels following a LSL replacement. For the period of January 1 to December 31, 2019, 90 private plumbing locations were sampled for the purposes of verifying the presence of a LSL. Of these locations, 11 locations were above 0.005 mg/L

[15] Includes all samples as required by the MDWL or Lead Reduction Plan.

indicating presence of a lead service line and 4 also exceeded the ODWQS of 0.01 mg/L. Lead samples are collected before and after a LSL replacement has been undertaken. There were 5 locations resampled in order to monitor lead levels post-replacement. Based on sample results to date, regulatory compliance is expected at individual sites that have undergone a full LSL replacement or where there is no lead remaining in the service line.

Lead Service Line Replacements

Since 2007, there has been a total of 703 lead service lines replaced in the City. As a result, 91 per cent of these homes are now considered to be 'lead-free' service lines (i.e. either a full replacement or a partial replacement that connected to a non-lead material). There were 14 LSL replacements undertaken in the City between January 1 to December 31, 2019. Of these, there were 3 LSL replacements on City property and 2 LSLs were replaced on both City and private property by coordinating the work with the homeowner. An additional 9 LSL replacements were completed on private property by the homeowner.

Since 2010, the City initiated financial incentive programs to encourage replacement of privately-owned LSL by reducing the financial burden to property owners. The grants cover, on average, 75 per cent of the LSL replacement cost for homeowners. From 2010 to Dec. 31, 2019, 229 privately owned lead service lines were replaced through the grant program, as presented in Table 13.

Table 13: Private Lead Service Line Replacement Grant Programs (2010 – Dec. 31, 2019)

Year	Grant Program Total	Cumulative Total
2010	60	60
2011	62	122
2012	31	153
2013	20	173
2014	9	182
2015	12	194
2016	7	200
2017	13	213
2018	7	220
2019	**9**	**229**

Targeted outreach regarding the Grant Programs is directed at all properties with known or suspected privately-owned LSLs. The main barriers to privately owned LSL replacement for homeowners include financial costs, disruption to property, rental properties and people who are unconcerned about the health risks of lead in drinking water. Direct communications continued to be been tailored to address these barriers.

Frozen Water Pipe Prevention and Monitoring Program

Water Services takes a proactive approach in monitoring and preventing frozen water pipes. The purpose of the 2015 Council-approved Frozen Water Pipe Policy is to prevent and manage interruptions to the City's supply of water, caused by the temporary freezing of City and/or customer water pipes, so that customers maintain reliable, continuous access to water.

Water Services monitors daily temperatures, frost levels, degree-days and water temperature in the water distribution system. When certain thresholds are reached, the freeze prevention program is initiated.

The Frozen Water Pipe Program requires customers to take specific actions to prevent the freezing of water pipes. Water Services has identified two tiers for their frozen water pipe prevention program. Tier 1 properties are most susceptible to freezing and have historically frozen every year or are properties where running water will ensure the water mains in the area do not freeze. Tier 2 properties are also at risk for freezing and have had frozen pipes in the past during prolonged periods of severe winter temperatures. Through communication with these customers, Water Services works hard to ensure that frozen water pipes are prevented. The customers in both of these Tiers are registered in our notification program.

For more information on the Frozen Water Pipe Program, visit guelph.ca/frozenpipes.

2019 Frozen Water Pipe Program Statistics

Through the winter of 2018/2019 Guelph experienced fluctuating temperatures throughout the early part of the winter (November and December). Early into 2019, nighttime temperatures consistently remained below -10°C, dropping below -20°C and remaining steady for over a week. The result of which pushed frost down into the ground creating a scenario with high probability of frozen water pipes.

By late January, 3.5 feet of frost was noted in the ground – the lowest frost depth for the season. With the addition in the cumulative mean daily temperature (i.e. the lower the temperature, the quicker the approach to the cumulative temperature trigger) it was decided to initiate the freeze prevention program.

On January 21, Tier 1 and Tier 2 customers began running water as per the actions set out in this program to prevent water pipes from freezing. As temperatures warmed up in February, the frost level in the ground rose and forecasted temperatures saw no return to cooler temperatures. By late February, all customers were contacted to cease running their water, as per the program.

Summary of 2018/2019 Winter Statistics

- Temperature hit cumulative low trigger amount of -400°C: February 19.
- Lowest temperature recorded for the season was on February 1: -25.58°C.
- Lowest frost depth recorded for the season was 3.5 feet was on January 29.
- No frozen calls were received during the season.

h) Raw and Treated Water Quality and Drinking Water Quality Trends

Guelph Drinking Water System

This section describes the water quality monitoring, both regulatory and operational, that has been completed in 2019.

Water Quality Review – Guelph Drinking Water System

Under the Safe Drinking Water Act, municipalities are required to monitor both the raw and treated quality of the source water supplied. This monitoring is performed for both regulatory compliance and due diligence and is expected to identify any changes within the treated water, as well as, in raw source waters.

A note about all tables included in this section

1. All regulated chemicals detected in the City of Guelph's treated water sources that are above the lab's MDL (minimum detection limit) are underlined indicating a hyperlink to an Excel Workbook in Guelph's electronic document management system (EDMS). The workbook contains a definition of the parameter and an Excel worksheet for each treated source where the parameter has been detected with values for all sample results from January 1, 2007 to December 31, 2019. This database is used to closely track the instances of the identified chemical parameters and therefore provide time for planning and budgeting if treatment or an alternative supply is eventually required due to the presence of a given parameter. The database is updated annually.
2. Tabulated data is from the best available information at the time of table creation.
3. If sampling for a particular schedule's parameters (e.g. Schedule 23 and 24) did not occur within the calendar year of the report, then the most recent values are included in the report for reference.
4. All acronyms and initials included in tables are described in Appendix L: Glossary.
5. Please note that some hyperlinks in the tables are linked to Guelph's electronic document management system (EDMS). Note: EDMS is available for internal use only.

The following section summarizes Distribution free chlorine residual test results (January 1 to December 31, 2019) required by O. Reg. 170/03 Schedule 7-2, where secondary disinfection is provided.

Please note that the City of Guelph takes additional operational daily Distribution samples and tests for free chlorine residual in order to better monitor the free residual in the Distribution System and respond accordingly. There was no instance of an adverse result in 2019 associated with these sampling sites, as presented in Table 14.

Table 14: O. Reg. 170/03 Schedule 7-2, City of Guelph - Distribution Manual Free Chlorine Residual Summary, 2019

Parameter	ODWQS Criteria	Total Analyses	Total Samples above Detection Limit	Total Outside ODWQS Criteria	Range (mg/L)
Free Chlorine Residual – Zone One	0.05 – 4.0	297	297	0	0.52 – 1.21
Free Chlorine Residual – Zone Two	0.05 – 4.0	297	297	0	0.35 – 1.03

Table 15 below summarizes raw bacteriological sampling and test results required by O. Reg. 170/03 Schedule 10-4 including investigative re-sampling for the period of January 1 to December 31, 2019. There were a total of 886 raw samples taken and 2,658 raw analyses conducted.

Table 15: O. Reg. 170/03 Schedule 10-4, City of Guelph - Raw Bacteriological Sampling Summary, 2019

Parameter	ODWQS Criteria	Total Analyses	Total Outside ODWQS Criteria	Range (cfu/100 mL)
Raw - E. coli	n/a	886	n/a	0 – 4
Raw - Total Coliform	n/a	886	n/a	0 – 78
Raw - Background	n/a	886	n/a	0 – 480

Table 16 summarizes treated bacteriological sampling and test results required by O. Reg. 170/03 Schedule 10-3 and 6-3 including investigative re-sampling for 2019.

- Number of POE[16] samples taken: 554
- Number of POE analyses: 2,209
- Number of Distribution samples taken: 1,534
- Number of Distribution analyses: 7,693

Table 16: O. Reg. 170/03 Schedule 10-2, 10-3 and 6-3, City of Guelph - Treated Bacteriological Sampling Summary, 2019

Parameter	ODWQS Criteria	Total Analyses	Total Outside ODWQS Criteria	Range	Units
POE - E. coli	0	554	0	0	cfu /100 mL
POE - Total Coliform	0	554	0	0	cfu /100 mL
POE – HPC	n/a	547	n/a	0 – 1300	cfu /mL
POE – Background	n/a	554	n/a	0 – 9	cfu /100 mL
POE – Free Chlorine Residual	0.05 - 4.0	549[17]	0	0.53 – 1.44	mg/L
Distribution - E. coli	0	1,578	0	0	cfu /100 mL
Distribution - Total Coliform	0	1,578	0	0	cfu /100 mL
Distribution – HPC	n/a	703	n/a	0 – 280	cfu /mL
Distribution – Background	n/a	1,578	n/a	0 – 380	cfu /100 mL
Distribution – Free Chlorine Residual	0.05 - 4.0	1,914	0	0.30 – 1.30	mg/L

[16] Point of Entry - the point at or near which treated water enters the distribution system.
[17] Total number of samples used specifically to satisfy the requirements of O. Reg. 170/03 Schedule 10-3 and 6-3 (Treated Source samples taken for Operational purposes are not included).

Table 17 summarizes raw source turbidity sampling and test results required by O. Reg. 170/03 Schedule 7-3 for the period of January 1 to December 31, 2019. Schedule 7-3 requires monthly raw source turbidity sampling, but the City of Guelph samples all raw sources and tests for turbidity on a weekly basis to better monitor this aspect of raw water quality.

Table 17: O. Reg. 170/03 Schedule 7-3, City of Guelph - Raw Source Turbidity Sampling Summary, 2019

Parameter	ODWQS Criteria	Total Analyses	Total Outside ODWQS Criteria	Range (ntu)
Raw Source Turbidity	n/a	1036	n/a	0.05– 1.00

Table 18 summarizes raw source Ultraviolet Transmittance (UVT) sampling and test results required by the City's Municipal Drinking Water Licence (MDWL), where UV for primary disinfection is used for the period of January 1 to December 31, 2019. The MDWL requires a UVT test to be conducted and recorded on a weekly sampling schedule.

Table 18: O. Reg. 170/03 Schedule 7-3, City of Guelph - Raw Ultraviolet Transmittance Sampling Summary, 2019

Parameter	MDWL Criteria (% UVT)	Total Analyses	Total Outside MDWL Criteria	Range (% UVT)
Raw UVT F.M. Woods Station	93.5	58	0	94.6 - 100
Raw UVT Membro Well	90.0	102	0	90.0 – 99.8
Raw UVT Water St. Well	87.0	52	0	88.1 – 98.1

Microparticulate Analysis

As a part of the Guelph Drinking Water System's Municipal Drinking Water Licence, Guelph Water Services is required, twice annually, to assess the Arkell Springs Glen Collector System which is characterized as groundwater under the influence of surface water with effective in situ filtration (GUDI-WEF). The purpose of the assessment is to ensure that the source continues to meet the GUDI-WEF source water characteristics as outlined by the MECP. Sampling was performed on this water source in the spring and fall of 2019. The source continues to meet the GUDI-WEF source water characteristics.

Treated Water Quality Statistics – Guelph Drinking Water System

O. Reg. 170/03 Schedule 6-5 - Continuous Monitoring Results Summary

Water Services utilizes over forty regulatory and operational continuous monitoring devices to measure water quality. Each regulatory device has controls associated with it such that in the event that the device detects that a measured value is outside the acceptable parameters for that location, the device causes an alarm to be sent to an Operator for immediate response (24 hours per day, seven days per week) and either automatically shuts down the station or activates a second alarm for immediate Operator response.

Both the minimum allowable levels (if applicable) and the target values for Water Services regulatory continuous monitoring devices are listed in Table 19. The target values represent a safety margin to ensure that regulatory requirements are satisfied at all times. Please note that, continuous monitoring values all fell within acceptable regulatory standards in 2019.

Table 19: O. Reg. 170/03 Schedule 6-5, Continuous Monitoring Results Summary, 2019

Parameter	ODWQS or Regulatory Minimum	Target Range	Units
Point of Entry Free Chlorine Residual	0.05 mg/L	Greater than 0.4	mg/L
UV Dose F.M. Woods Station	24 mJ/cm^2	Greater than 40	mJ/cm^2
UV Dose Water St. Well	40 mJ/cm^2	Greater than 45	mJ/cm^2
UV Dose Membro Well	20 mJ/cm^2	Greater than 40	mJ/cm^2

O. Reg. 170/03 Schedule 13-6 and 13-7, "Three Month" Sampling Results Summary

In 2019, all operational Treated Sources were sampled and analyzed for Schedule 13-6, 13-16.1 and 13-7 parameters as per O. Reg. 170/03.

Regulation 170/03, Schedule 13-6 requires a minimum of one distribution sample taken from the Distribution System where THM's (trihalomethanes) are most likely to develop (locations with high retention times). Water Services uses the Speedvale, Clair and Verney Elevated Tanks for this purpose in the Guelph Drinking Water System. The Maximum Allowable Concentration (MAC) for THM's is 0.1 mg/L. However, for this parameter, the MAC uses a running annual average of quarterly samples.

The results of the running annual average value for THMs for all related Distribution System samples in each quarter of 2019 (Jan. 01 to Dec. 31) is below the half of the maximum allowable concentration (½ MAC): Q1 = 0.023 mg/L; Q2 = 0.028 mg/L; Q3 = 0.034 mg/L and Q4 = 0.039 mg/L.

Regulation 170/03, Schedule 13-6.1 requires a minimum of one distribution sample taken from the Distribution System where HAAs (haloacetic acids) are most likely to develop. Water Services uses Woods Sample Station, Ptarmigan Sample Station, Clair Tower Sample Tap and Edinburgh South Sample Station for this purpose in the Guelph Drinking Water System. The Maximum Allowable Concentration (MAC) for HAAs is 0.08 mg/L. However, for this parameter, the MAC uses a running annual average of quarterly samples.

The results of the running annual average value for HAAs for all related Distribution System samples in each quarter of 2019 (Jan. 01 to Dec. 31) is below the half of the maximum allowable concentration (½ MAC): Q1 = 0.024 mg/L; Q2 = 0.021 mg/L; Q3 = 0.027 mg/L and Q4 = 0.025 mg/L.

All operational Treated Sources were sampled and analyzed for Nitrates and Nitrites as per Regulation 170/03, Schedule 13-7. There was no instance of an adverse result in 2019. Raw sampling results are also presented in Table 20.

Table 20: O. Reg. 170/03 Schedule 13-6 and 13-7, City of Guelph – "Three Month" Sampling Results Summary, 2019

Parameter	ODWQS MAC	½ MAC	Total Samples	Samples Above MDL	Total Above ODWQS Criteria	Min (mg/L)	Max (mg/L)	Average[18] (mg/L)
Trihalomethanes	0.100[19]	n/a	23	23	0	0.0125	0.0712	0.0363
Haloacetic Acids	0.08[20]	n/a	14	12	0	< 0.005	.040	0.025
Nitrate + Nitrite (as nitrogen)	10	5	47	33	0	< 0.10	2.14	1.08
Nitrate + Nitrite (as nitrogen) - Woods' Raw Sources (Operational Sampling)	n/a	n/a	35	35	n/a	0.36	4.65	1.29
Nitrate + Nitrite (as nitrogen) - University Raw Source (MDWL Sampling)	10	5	5	5	0	0.35	0.62	0.41
Nitrate + Nitrite (as nitrogen) - Paisley Raw Source (MDWL Sampling)	10	5	5	5	0	1.99	2.14	2.05

[18] This is the average of values above the lab detection limit.
[19] This standard is expressed as a running annual average.
[20] This standard is expressed as a running annual average.

Operational VOC Scan Results Summary

Please note that Schedule 13-6, 13-6.1 and Schedule 24 parameters are also part of the "Operational VOC Sampling Regime" and therefore the values in the "Operational VOC Scan Results Summary" in Appendix D: Treated Water Quality Statistics include a repetition of the relevant data from the Schedule 13-6, 13-6.1 and Schedule 24 tables. The "Operational VOC Scan Results Summary" lists the total number of samples analyzed for these parameters in 2019 (January 1 to December 31, 2019). Table 21 (below), highlights specific VOC parameters due to their presence / significance within the water supply. There was no instance of an adverse result in 2019.

Table 21: City of Guelph Operational VOC Scan Selected Results Summary, 2019

Parameter	ODWQS MAC	½ MAC	Total Samples	Samples Above MDL	Total Above ODWQS Criteria	Min (mg/L)	Max (mg/L)	Average (mg/L)
Trichloroethylene	0.005	0.0025	148	54	0	< 0.0001	0.00199	0.00063
Trihalomethanes	0.100[21]	n/a	135	58	0	< 0.0002	0.0365	0.00835

[21] This standard is expressed as a running annual average.

O. Reg. 170/03 Schedule 23 Results Summary

In 2019, all operational treated sources were sampled and analyzed for Schedule 23 parameters as per O. Reg. 170/03. All of the City of Guelph's treated ground water sources are on a three year sampling schedule. F.M. Woods' Station is the exception and is sampled on the annual surface water schedule due to the fact that five of the nine sources that supply F.M. Woods are GUDI-WEF sources (the Carter Well 1 and 2, Arkell 1, Arkell 15 and the Arkell Springs Glen Collectors).

The results of the Schedule 23 inorganic parameter analysis in 2019 were all under half of the maximum allowable concentration (½ MAC) and the majority were under the laboratory's MDL (minimum detection level). Please refer to the section titled "O. Reg. 170/03 Schedule 23 Results Summary" included in Appendix D: Treated Water Quality Statistics for more information.

Table 22: O. Reg. 170/03 Schedule 23, 13-2a, City of Guelph - Annual Schedule 23 Sampling Results Summary, 2019

Parameter	ODWQS MAC	½ MAC	Total Samples	Samples Above MDL	Total Above ODWQS Criteria	Min (mg/L)	Max (mg/L)	Average (mg/L)
Antimony	0.014	0.007	24	5	0	< 0.0001	0.00092	0.00065
Arsenic	0.025	0.0125	24	5	0	< 0.0002	0.0043	0.002
Barium	1.0	0.5	24	24	0	0.035	0.11	0.0672
Boron	5.0	2.5	24	24	0	0.014	0.043	0.028
Cadmium	0.005	0.0025	24	5	0	0.00009	0.00013	0.00011
Chromium	0.05	0.025	24	2	0	0.008	0.015	0.0079
Mercury	0.001	0.0005	12	0	0	< 0.0001	< 0.0001	n/a
Selenium	0.01	0.005	24	0	0	< 0.002	< 0.002	n/a
Uranium	0.02	0.01	24	22	0	< 0.00010	0.0017	0.00107

O. Reg. 170/03 Schedule 24 Results Summary

In 2019, all operational Treated Sources were sampled and analyzed for Schedule 24 parameters as per O. Reg. 170/03. All of the City of Guelph's treated ground water sources are on a three year sampling schedule. F.M. Woods' Station is the exception and is sampled on the annual surface water schedule due to the fact that five of the nine sources that supply F.M. Woods' are GUDI-WEF sources (the Carter Well field, Arkell 1, Arkell 14 and the Arkell Springs Glen Collectors).

The results of the Schedule 24 organic parameter analysis in 2019 were all under half of the maximum allowable concentration (½ MAC) and the majority were under the laboratory's MDL (minimum detection level). Please refer to the section entitled "O. Reg. 170/03 Schedule 24 Results Summary" included in Appendix D: Treated Water Quality Statistics for more information.

It should be noted that, before 2012, values for TCE (trichloroethylene) at Membro and Emma occasionally crested the ½ MAC value of 0.0025 mg/L and as a result Water Services moved to an "Increased Frequency Sampling Plan" as required by Regulation 170/03 - 13-5 which requires that sampling for this parameter be sampled every "three months" until two consecutive sample results are below the ½ MAC value. As a precautionary measure, Water Services samples on a monthly schedule at Membro and Emma wells. All other sources, are sampled annually (minimally) for VOC's (Volatile Organic Carbons) through a "Guelph VOC Scan" in order to better track parameters such as TCE via more data. Currently, TCE is above the MDL but below the ½ MAC at Membro, Water Street, Emma and Park treated water samples.

Table 23: O. Reg. 170/03 Schedule 24, 13-4a, City of Guelph - Annual Schedule 24 Sampling Results Summary, 2019

Parameter	ODWQS MAC	½ MAC	Total Samples	Samples Above MDL	Total Above ODWQS Criteria	Min (mg/L)	Max (mg/L)	Average (mg/L)
Alachlor	0.005	0.0025	12	0	0	< 0.0005	< 0.0005	n/a
Atrazine + N-dealkylated metabolites	0.005	0.0025	12	0	0	< 0.001	< 0.001	n/a
Azinphos-methyl	0.02	0.01	12	0	0	< 0.002	< 0.002	n/a
Benzene	0.005	0.0025	66	0	0	< 0.0001	< 0.0001	n/a
Benzo(a)pyrene	0.00001	0.000005	12	0	0	< 0.000005	< 0.000005	n/a
Bromoxynil	0.005	0.0025	12	0	0	< 0.0005	< 0.0005	n/a
Carbaryl	0.09	0.045	12	0	0	< 0.005	< 0.005	n/a
Carbofuran	0.09	0.045	12	0	0	< 0.005	< 0.005	n/a
Carbon Tetrachloride	0.005	0.0025	66	0	0	< 0.0001	< 0.0001	n/a
Chlorpyrifos	0.09	0.045	12	0	0	< 0.001	< 0.001	n/a
Diazinon	0.02	0.01	12	0	0	< 0.001	< 0.001	n/a

Parameter	ODWQS MAC	½ MAC	Total Samples	Samples Above MDL	Total Above ODWQS Criteria	Min (mg/L)	Max (mg/L)	Average (mg/L)
Dicamba	0.12	0.06	12	0	0	< 0.001	< 0.001	n/a
1,2-Dichlorobenzene	0.2	0.1	66	0	0	< 0.0002	< 0.0002	n/a
1,4-Dichlorobenzene	0.005	0.0025	66	0	0	< 0.0002	< 0.0002	n/a
1,2-Dichloroethane	0.005	0.0025	66	0	0	< 0.0002	< 0.0002	n/a
1,1-Dichloroethylene	0.014	0.007	66	0	0	< 0.0001	< 0.0001	n/a
Dichloromethane	0.05	0.025	66	0	0	< 0.0005	< 0.0005	n/a
2,4-Dichlorophenol	0.9	0.45	12	0	0	< 0.00025	< 0.00025	n/a
2,4-Dichlorophenoxy-acetic acid (2,4-D)	0.1	0.05	12	0	0	< 0.0001	< 0.0001	n/a
Diclofop-methyl	0.009	0.0045	12	0	0	< 0.0009	< 0.0009	n/a
Dimethoate	0.02	0.01	12	0	0	< 0.0025	< 0.0025	n/a
Diquat	0.07	0.0035	12	0	0	< 0.007	< 0.007	n/a
Diuron	0.15	0.075	12	0	0	< 0.01	< 0.01	n/a
Glyphosate	0.28	0.14	12	0	0	< 0.01	< 0.01	n/a

Parameter	ODWQS MAC	½ MAC	Total Samples	Samples Above MDL	Total Above ODWQS Criteria	Min (mg/L)	Max (mg/L)	Average (mg/L)
Malathion	0.19	0.095	12	0	0	< 0.005	< 0.005	n/a
2-Methyl-4-chlorophenoxyacetic acid	0.1	0.05	12	0	0	< 0.00012	< 0.00012	n/a
Metolachlor	0.05	0.025	12	0	0	< 0.0005	< 0.0005	n/a
Metribuzin	0.08	0.04	12	0	0	< 0.005	< 0.005	n/a
Chlorobenzene	0.08	0.04	66	0	0	< 0.0001	< 0.0001	n/a
Paraquat	0.01	0.005	12	0	0	< 0.001	< 0.001	n/a
Pentachlorophenol (PCP)	0.06	0.03	12	0	0	< 0.0005	< 0.0005	n/a
Phorate	0.002	0.001	12	0	0	< 0.0005	< 0.0005	n/a
Picloram	0.19	0.095	12	0	0	< 0.005	< 0.005	n/a
Polychlorinated Biphenyls (PCB)	0.003	0.0015	12	0	0	< 0.00005	< 0.00005	n/a
Prometryn	0.001	0.0005	12	0	0	< 0.00025	< 0.00025	n/a
Simazine	0.01	0.005	12	0	0	< 0.001	< 0.001	n/a
Terbufos	0.001	0.0005	12	0	0	< 0.0005	< 0.0005	n/a

Parameter	ODWQS MAC	½ MAC	Total Samples	Samples Above MDL	Total Above ODWQS Criteria	Min (mg/L)	Max (mg/L)	Average (mg/L)
Tetrachloroethylene (PCE)	0.03	0.015	66	0	0	< 0.0001	< 0.0001	n/a
2,3,4,6-Tetrachlorophenol	0.1	0.05	12	0	0	< 0.0005	< 0.0005	n/a
Triallate	0.23	0.115	12	0	0	< 0.001	< 0.001	n/a
Trichloroethylene	0.005	0.0025	66	24	0	< 0.0001	0.00167	0.00046
2,4,6-Trichlorophenol	0.005	0.0025	12	0	0	< 0.0005	< 0.0005	n/a
Trifluralin	0.045	0.0225	12	0	0	< 0.001	< 0.001	n/a
Vinyl Chloride	0.002	0.001	66	0	0	< 0.0002	< 0.0002	n/a

O. Reg. 170/03 Schedule 13-8 and 13-9, "Five Year" Sampling Results Summary

In 2019, all operational Treated Sources were sampled and analyzed for the Schedule 13-9 Fluoride parameter as per O. Reg. 170/03. In 2019, Fluoride (naturally present and not added as part of the treatment process) was detected at all treated sources; the analytical results were all under the maximum allowable concentration (MAC). The values in Table 24 reflect the 2019, Schedule 13-9 sampling regime.

Sodium, however, is sampled on a more frequent basis (annually) than the Schedule 13-8 requirement due to the fact that at every treated source, sodium levels are above the lower reportable limit of 20 mg/L.

The increased frequency of sampling provides more data in order to better establish sodium value trends. Sodium results for 2019 can be referenced in Table 24. This data is provided to Wellington-Dufferin-Guelph Public Health, as required.

Table 24: O. Reg. 170/03 Schedule 13-8 and 13-9, City of Guelph – "Five Year" Sampling Results Summary

Parameter	ODWQS MAC	½ MAC	Total Samples	Samples Above MDL	Total Above ODWQS Criteria	Min (mg/L)	Max (mg/L)	Average (mg/L)
Sodium	20 and 200[22]	n/a	32	32	32	23	170	88.9
Fluoride	1.5 and 2.4[23]	n/a	10	10	0	0.12	0.73	0.30

[22] The aesthetic objective for sodium in drinking water is 200 mg/L. The local Medical Officer of Health should be notified when the sodium concentration exceeds 20 mg/L so that this information may be communicated to local physicians for their use with patients on sodium restricted diets.

[23] Where supplies contain naturally occurring fluoride at levels higher than 1.5 mg/L but less than 2.4 mg/L, the Ministry of Health and Long Term Care recommends an approach through local boards of health to raise public and professional awareness to control excessive exposure to fluoride from other sources.

General Chemistry Results Summary

Water Services has initiated an "Annual General Chemistry" sampling event through RCAp (Rapid Chemical Analysis Package). This body of data can be used to answer customer inquiries, as well as, inquiries from Water Services staff and consultants in terms of treatment upgrades.

Please note that Schedule 23 parameters are also part of the "Annual General Chemistry Sampling Regime" and therefore the values in the "General Chemistry Results Summary" section in Appendix D: Treated Water Quality Statistics include a repetition of the relevant data from the Schedule 23 Table. The "General Chemistry Results Summary" lists the total number of samples analyzed for these parameters in 2019.

In 2019, all operational Treated Sources were sampled and analyzed for general chemistry parameters. Please refer to the "General Chemistry Results Summary" in Appendix D: Treated Water Quality Statistics for the full list of parameters.

Table 25 highlights specific parameters due to their presence / significance within the water supply.

Table 25: City of Guelph General Chemistry Selected Results Summary, 2019

Parameter	ODWQS MAC	ODWQS AO	ODWQS OG	Total Samples	Samples Above MDL	Total Above Criteria	Min (mg/L)	Max (mg/L)	Average (mg/L)
Ammonia-N	n/a	n/a	n/a	12	2	n/a	< 0.05	0.18	0.16
Chloride	n/a	250	n/a	12	12	n/a	39	280	160
Hardness (Calculated as CaCO3)	n/a	n/a	80-100	12	12	12	330	570	448
Iron	n/a	0.3	n/a	24	6	2	< 0.005	1.8	0.56
Lead	0.01	n/a	n/a	23	2	0	<0.0005	0.0014	<0.00073
Manganese	n/a	0.05	n/a	24	19	0	<0.002	0.037	0.0088
Sodium	n/a	20 and 200	n/a	38	38	38	23	170	91

Gazer Mooney Subdivision Distribution System

This section describes the regulatory water quality monitoring that has been collected in the Gazer Mooney Subdivision Distribution System in 2019. For regulatory sampling schedules that do not occur in 2019 related to the Gazer Mooney System, the most recent historical data is listed.

Water Quality Review - Gazer Mooney Subdivision Distribution System

Under the Safe Drinking Water Act, municipalities are required to monitor both the raw and treated quality of the source water supplied. This monitoring is performed for both regulatory compliance and due diligence and is expected to identify any changes within the treated water as well as in the raw source waters.

A note about all tables included in this section

1. All regulated chemical parameters where values above the lab's MDL (minimum detection limit) have been detected in the City of Guelph's treated water sources are underlined indicating a hyperlink to an Excel Workbook in Guelph's EDMS. The workbook contains a definition of the parameter, an Excel worksheet for each treated source where the parameter has been detected with values for all sample results from January 1, 2007 to December 31, 2019. This database is used to closely track the instances of the identified chemical parameters and therefore provide time for planning and budgeting if treatment or an alternative supply is eventually required due to the presence of a given parameter. The database is updated quarterly.
2. Tabulated values are from best available information at the time of table creation. While the values documented here satisfy the regulatory minimum regulatory requirements, Water Services performs many additional operational tests not listed in this report.
3. All acronyms and initialisms included in tables are described in Appendix L: Glossary.
4. Please note that some hyperlinks in the tables are linked to Guelph's electronic document management system (EDMS) which is available for internal City use only.

Table 26 summarizes daily Distribution free chlorine residual test results required by O. Reg. 170/03 Schedule 7-2 for the period of January 1 to December 31, 2019. There was no instance of an adverse result in 2019.

Table 26: O. Reg. 170/03 Schedule 7-2, Gazer Mooney - Distribution Manual Free Chlorine Residual Summary, 2019

Parameter	ODWQS Range	Total Samples	Total Samples Outside of ODWQS Criteria	Min (mg/L)	Max (mg/L)	Average (mg/L)
Free Chlorine Residual	0.05 – 4.0	105	0	0.49	1.07	0.92

Table 27 summarizes bacteriological sampling and test results required by O. Reg. 170/03 Schedule 10 for the period of January 1 to December 31, 2019. There was no instance of an exceedance for a Regulatory microbiological parameter in 2019. There were 52 Distribution samples taken and 573 Distribution analyses completed in 2019.

Table 27: O. Reg. 170/03 Schedule 10-2, Gazer Mooney Treated Bacteriological Sampling Summary, 2019

Parameter	ODWQS Criteria	Total Analyses	Total Outside ODWQS Criteria	Range	Units
Distribution - E. coli	0	52	0	0	cfu/100 mL
Distribution - Total Coliform	0	52	0	0	cfu/100 mL
Distribution – HPC	n/a	52	n/a	0 - 3	cfu/mL
Distribution – Background	n/a	52	n/a	0 - 3	cfu/100 mL
Distribution– Free Chlorine Residual	0.05 – 4.0	105	0	0.49 – 1.07	mg/L

Treated Water Quality Statistics – Gazer Mooney Subdivision Distribution System

O. Reg. 170/03 Schedule 13-6, "Three Month" Sampling Results Summary

In 2019, Gazer Mooney Subdivision Distribution System was sampled and analyzed for Schedule 13-6 and 13-6.1 parameters as per O. Reg. 170/03. Regulation 170/03, Schedule 13-6 requires a minimum of one distribution sample taken from the Distribution System where THMs (trihalomethanes) are most likely to develop (points with high retention times). The MAC for THMs is 0.1 mg/L. However, for this parameter the MAC uses a running annual average of quarterly samples. These results are presented in Table 28.

The results of the running annual average value for THMs in the Gazer Mooney Subdivision Distribution System samples in 2019 were below the half maximum allowable concentration (½ MAC): Q1 = 0.020 mg/L; Q2 = 0.018 mg/L; Q3 = 0.018 mg/L and Q4 = 0.019 mg/L.

Regulation 170/03, Schedule 13-6.1 requires a minimum of one distribution sample taken from the Distribution System where HAAs (haloacetic acids) are most likely to develop. The MAC for HAAs is 0.08 mg/L. However, for this parameter the MAC uses a running annual average of quarterly samples.

The results of the running annual average value for HAAs in the Gazer Mooney Subdivision Distribution System samples in 2019 is below the half maximum allowable concentration (½ MAC): Q1 = not detected; Q2 = not detected; Q3 = not detected and Q4 = not detected.

Table 28: O. Reg. 170/03 Schedule 13-6, Gazer Mooney - "Three Month" Sampling Results Summary, 2019

Parameter	ODWQS MAC mg/L	½ MAC mg/L	Total Samples	Samples Above MDL	# Above ODWQS Criteria	Min (mg/L)	Max (mg/L)	Average (mg/L)
Trihalomethanes	0.100[24]	n/a	4	4	0	0.013	0.020	0.019
Haloacetic Acids	0.08[25]	n/a	4	0	0	<0.005	<0.005	n/a

O. Reg. 170/03 Schedule 13-8 and 13-9, "Five Year" Sampling Results Summary

In 2019, Gazer Mooney Subdivision Distribution System was sampled and analyzed for the Schedule 13-9 Fluoride parameter as per O. Reg. 170/03. In 2019, Fluoride (naturally present and not added as part of the treatment process) was detected; the analytical result was under the maximum allowable concentration (MAC). The values in Table 29 reflect the 2019, Schedule 13-9 sampling regime.

Sodium, however, is sampled on a more frequent basis (annually) than the Schedule 13-8 requirement due to the fact that at every treated source, sodium levels are above the lower reportable limit of 20 mg/L. The increased frequency of sampling provides more data in order to better establish sodium value trends. Sodium results for 2019 can be referenced in Table 29. This data is provided to Wellington-Dufferin-Guelph Public Health, as required.

[24] This standard is expressed as a running annual average.
[25] This standard is expressed as a running annual average.

Table 29: O. Reg. 170/03 Schedule 13-8 and 13-9, Gazer Mooney - "Five Year" Sampling Results Summary

Parameter	ODWQS MAC	½ MAC	Total Samples	Samples Above MDL	Total Above ODWQS Criteria	Min (mg/L)	Max (mg/L)	Average (mg/L)
Sodium	20 and 200[26]	n/a	2	2	2	24	26	25
Fluoride	1.5 and 2.4[27]	n/a	1	1	0	0.17	0.17	0.17

General Chemistry Results Summary

In addition to the regulatory sampling and analysis required for the operation of the Gazer Mooney Subdivision, Water Services samples for parameters as listed in Table 30 in order to gather additional data and answer common inquiries from the public.

[26] The aesthetic objective for sodium in drinking water is 200 mg/L. The local Medical Officer of Health should be notified when the sodium concentration exceeds 20 mg/L so that this information may be communicated to local physicians for their use with patients on sodium restricted diets.

[27] Where supplies contain naturally occurring fluoride at levels higher than 1.5 mg/L but less than 2.4 mg/L, the Ministry of Health and Long Term Care recommends an approach through local boards of health to raise public and professional awareness to control excessive exposure to fluoride from other sources.

Table 30: Gazer Mooney General Chemistry Results Summary, 2019

Parameter	ODWQS MAC mg/L	ODWQS AO	½ MAC mg/L	Total Samples	Samples Above MDL	Total Above ODWQS Criteria	Min (mg/L)	Max (mg/L)	Average (mg/L)
Sodium	20 and 200[28]	n/a	n/a	3	3	3	24	26	25
Chloride	n/a	250	n/a	1	1	0	40	40	40

[28] The aesthetic objective for sodium in drinking water is 200 mg/L. The local Medical Officer of Health should be notified when the sodium concentration exceeds 20 mg/L so that this information may be communicated to local physicians for their use with patients on sodium restricted diets.

i) Follow-up on Action Items from Previous Management Reviews

A Management Review meeting was held on January 25, 2019 and January 29, 2020. The following is a summary of results of the management review. Appendix F: Action Items from Management Review includes the action items from the meetings. Items 1-12 are from the January 25, 2019 Management Review meeting and items 13-17 are from the January 30, 2020 Management Review Meeting.

Results of the Management Review, the identified deficiencies, decisions and action items

The summary below includes identified deficiencies and decisions from the meeting held on January 30, 2020.

Deficiencies

- There were four identified non-compliance issues identified in the 2018-2019 Ministry of the Environment, Conservation and Parks inspection. Through the Root-Cause Analysis program, Water Services has worked to implement policies and procedures to reduce the likelihood of these non-compliances re-occurring in the future.
- Three AWQI's occurred in 2019 in the Guelph Drinking Water System and one in the Gazer Mooney Subdivision Distribution System. Three of the AWQIs were related to sodium exceedances and one related to an incident where the chlorine residual in a dead-end watermain was found to be below 0.05mg/L.
- There was one deviation from a Critical Control Point relating to the low distribution system (secondary) chlorine residual found in a dead-end section of watermain. Corrective and preventive actions have been taken to prevent this from re-occurring in the future.
- There were two minor non-conformance issues identified in the 2019 accreditation (external) audit. A corrective action plan was sent to the accreditation body and was accepted on December 15, 2019.

Decisions

- See section d) The Effectiveness of the Risk Assessment Process regarding decisions made in the Risk Assessment process on September 24, 2019.
- Investigate using J-Plugs on the drop tubes in the production wells.
- Consider adding water loss data to the Annual and Summary Report for 2020.

- Perform additional analysis on the frozen services program, specifically the running tap program, and how it relates to water consumption and water production.
- Look at adding a line for performance testing to Table 6 for next year's annual report.
- Have the SCADA group provide C3 Water with copies of facility P&ID, PFD and equipment layout drawings so that the hydraulic model can be adjusted to take into account pipe friction factors within treatment facilities.

j) The Status of Management Action Items Identified Between Management Reviews

Water Services is very committed to continually improving the drinking water system, including improving on existing programs and processes. Throughout the year, continual improvement suggestions (management action items) can be presented throughout many different activities, such as: emergency tests, audits, staff suggestions, debrief sessions, root-cause analysis meetings, etc. These items are logged into Water Services' Continual Improvement Database and the appropriate teams meet every other month to update on the status of these items.

Appendix G: Status of Management Action Items Identified between Reviews is a list of continual improvement items identified in 2019 for management follow-up.

k) Changes that Could Affect the Drinking Water System and the Quality Management System

Appendix E: Legal and Other Requirements Table includes a summary of legislative and regulatory updates from January 1 to December 31, 2019 that could affect the Drinking Water System and/or the Quality Management System.

Changes Affecting the Drinking Water System (DWS) - Licence Approvals and Amendments

Municipal Drinking Water Licence (MDWL) Renewal

The Municipal Drinking Water Licence was renewed in 2019 and expires in 2024. Table 31 below includes Licence documents' dates of issue and expiry. Copies of the documents listed in Table 31 are available by contacting Water Services at waterservices@guelph.ca or calling 519-837-5627.

As part of the MDWL renewal, the updated Financial Plan was submitted to Council for approval in March 2019 and the Operational Plan was endorsed by Council in January 2019.

Table 31: Municipal Drinking Water Licensing Documents

Document	Issue Date (yyyy-mm-dd)	Expiry (yyyy-mm-dd)
Municipal Drinking Water Licence (#017-101)	2019-07-26	2024-07-24
Drinking Water Works Permit (#017-201)	2019-07-26	2024-07-24
Municipal Long Range Financial Plan (#017-301)	2019-02	2024-07-24
DWQMS Certificate of Registration - Guelph Drinking Water System (017-OA1)	2018-12-20	2021-11-25
Operational Plan Re-endorsement Guelph Drinking Water System (resolution)	2019-01-14	2023-10-31
Agreement Regarding Water Services for the Gazer-Mooney Subdivision	2019-03-01	2029-02-28
Gazer Mooney Municipal Drinking Water Licence (#104-103)	2016-01-28	2021-01-26
Gazer Mooney Drinking Water Works Permit (#017-203)	2016-01-28	2021-01-26
Operational Plan Re-endorsement Gazer Mooney Subdivision Dist. System (resolution)	2019-09-16	2023-10-31
DWQMS Certificate of Registration - Gazer Mooney (104-OA2)	2018-12-20	2021-11-25

Permits to Take Water (PTTW) Renewals

The Water St. Wellfield PTTW and the Downey PTTW were both renewed in 2019 and expire in 2029.

One PTTW is scheduled for renewal in 2020. The Arkell Bedrock PTTW expires on May 31, 2020.

Sentry Monitoring Wells

A consultant was retained in 2015 to develop a groundwater monitoring network in the area of the Membro and Emma Production Wells. These particular wells were categorized as having a drinking water quality issue for Trichloroethylene (TCE), a volatile organic compound (VOC) under the Clean Water Act. The source(s) of the VOCs is (are) unknown but there are potential sources in the vicinity of each well. The main objective of this project was to review the potential contaminant sources and install monitoring wells (i.e. Sentry Wells) between the potential VOC sources and the municipal wells that will be monitored and used to document changes in groundwater quality. These wells can provide an early warning of potential contamination moving toward the production well and also track changes in existing groundwater quality.

As such, a sampling plan has been created to regularly collect water quality samples from each of the eight (8) Sentry Wells, within their respective vertically discrete sampling intervals. Review of the data collected thus far is ongoing and the retained consultant is expected to deliver a final report on the status of this project in early 2020.

Carter Monitoring Program – Operational Testing

The Permit to Take Water for Carter Well 1 and 2 requires that the Carter Wells be operated at increased levels in conjunction with monitoring in the Torrence Creek Subwatershed. This monitoring was completed via consultant in 2019. The purpose of the monitoring is to quantify impacts within this subwatershed.

Staff Certification

The following tables (Table 32, Table 33 and Table 34) describes all Operators and Management staff with various classes of provincial Drinking Water Operator Certificates and years' experience, as of December 31, 2019. Due to the system reclassification in late 2018, there was an increase in Class I operators in 2019 to meet the new certification requirements.

Table 32: Water Services Employees (Operators and Management Staff) with Drinking Water Operator Certificates

Certificate Class	Number of Certified Employees		
	2017	2018	2019
Operator-In-Training	3	7	8
Class I	0	1	11
Class II	3	3	2
Class III	8	7	5
Class IV	19	19	7
Total Certified Employees	**33**	**37**	**33**

Table 33: Competency and Years of Experience for Certified Management Staff

Role	Minimum Competency Required[29]	Competency Achieved	Years' Experience
Manager of Operations / ORO -Overall Responsible Operator	Class IV Certificate	Class IV Certificate	30+
Supervisor of Distribution - Construction	Class I Certificate or higher	Class IV Certificate	23
Supervisor of Distribution	Class I Certificate or higher	Class IV Certificate	20
Supervisor Water Treatment and Maintenance	Class I Certificate or higher	Class IV Certificate	10
Supervisor Meters and Locates	n/a	Class IV Certificate	19

Table 34: Years of Experience of Certified Operational Staff

Role	<5 years	5-9 years	10-14 years	15-19 years	20-24 years	25+ years
Distribution Operators	5	3	6	1	0	2
Water Treatment Operators	4	0	1	4	1	1

[29] Minimum competency includes the certification requirements listed here, plus the completion of ongoing training requirements of O. Reg. 128/04.

Changes Affecting the Quality Management System (QMS)

Ontario's updated Drinking Water Quality Management Standard (DWQMS) Version 2.0

Guelph Water Services implemented the requirements of the updated DWQMS Version 2.0, released in February 2017, in its quality management system. Water Services was accredited to DWQMS Version 2.0 in the 2018 external audit and maintained accreditation in the 2019 audit.

Quality Management System Implementation

Guelph Water Services strives for continual improvement in all of its programs and processes. Improvements made to the drinking water system and its process are evaluated through: internal and external audits; staff suggestions; risk assessments; emergency training and testing; consumer feedback and through the management review process.

Water Services at the City of Guelph is committed to providing consumers with a safe, consistent supply of high quality drinking water while meeting or exceeding, and continually improving on legal, operational and quality management system requirements.

Throughout 2020, we will continue with a proactive approach to the DWQMS by:

- Maintaining accreditation to the DWQMS 2.0;
- Identifying ways to improve the drinking water system and its related processes;
- Expanding knowledge and involvement of staff for collaboration and integration of the quality management system;
- Ensuring that any deficiencies identified are responded to and corrected quickly and efforts are taken to ensure that the problem does not reoccur;
- Collaborating with other municipalities to ensure that we are enhancing our performance standards and operating practices; and
- Continuing advancements to emergency prevention and preparedness, including the risk assessment process.

l) Consumer Feedback

Table 35 below represents the number of all customer calls received, but do not necessarily reflect the number of individual issues (as more than one call could relate to a single issue).

Table 35: Number of Customer Calls Received, 2017-2019

Type of Call	# Calls 2017	# Calls 2018	# Calls 2019
Discoloured Water	106	116	132
Distribution	54	21	14
Flushing	13	5	2
Frozen	3	51	54
Hydrant - Accident Report	5	5	1
Hydrant – Investigation	35	25	27
Hydrant Out-of-Service	137	98	133
Leak	83	73	57
Meter	8	9	29
Other	33	43	24
Pressure	92	102	74
Private Issue	5	12	14
Service Box Repairs	194	212	220
Swabbing	16	39	2
Trench Investigation	4	9	N/A[30]
Valve	19	28	26
Water Quality / Appearance	39	62	36
Watermain	6	5	3
Watermain Break Investigation	96	107	93
Well Interference Inquiries	3	5	0

[30] As of 2019, trenches are maintained by the Operations Department.

m) The Resources Needed to Maintain the Drinking Water System and Quality Management System

Water Services currently has one full-time Quality Management Specialist, who is also the Quality Management System Representative. Everyone at Water Services plays a role in ensuring the success of the Quality Management System. Beyond the work of all staff, the Quality Management Specialist has access to a Water Compliance Specialist; five Water Services Technicians; a Customer Service Clerk; and a seasonal Records Management Assistant to ensure that reporting and documentation requirements of the QMS are met.

Operational challenges in the drinking water system continue to drive the need for additional resources, such as:

- A changing staff profile, with experienced staff that have retired or are due to retire in the next few years;
- Aging city infrastructure requiring increased capital budget considerations;
- Potential source water supply shortfall (e.g. current supplies not meeting future demand, drought, contamination and demands of future growth) requiring increased capital project and budget considerations;
- Distribution system issues (e.g. dead ends in the distribution system, frozen city-side infrastructure, larger infrastructure failures and aging water meter infrastructure, aging watermains, watermains located on easements); and
- Private property issues (e.g. substandard water services).

n) Results of Infrastructure Review

The identification of water infrastructure requirements are achieved by reviewing the needs of existing and new infrastructure through the completion of asset management plans both at Water Services and corporately.

Distribution Infrastructure Needs

Distribution infrastructure needs are outlined in the corporate Asset Management Plan, which is developed using industry best management practices and completed by the Corporate Asset Management group in the Engineering and Transportation Service Division (Engineering Services). This linear plan is reviewed by Water Services who then assists in developing a priority sequence for project completion.

During the annual budget preparation process, Engineering and Water Services review infrastructure conditions, inventory age, CAPS (capital asset prioritisation system), and system criticality. From this evaluation, Engineering and Water Services finalize the list of priority projects that also considers the priorities of wastewater and road reconstruction projects so that these projects can share the costs of excavation and rehabilitation. New linear infrastructure reviews are primarily driven by Engineering Services.

Annual summaries of road reconstruction, sewer and watermain projects are identified on a capital project infrastructure map that is released by Engineering and Transportation Services early spring each year.

Water Supply and Treatment Facilities Infrastructure Needs

On July 28, 2014 Guelph City Council unanimously approved the Water Supply Master Plan update, defining preferred water supply servicing alternatives in meeting the needs of existing customers and future community growth.

In concert with the Water Supply Master Plan Update, the City's Engineering and Transportation Services Division completed an update to the linear water distribution network model as part of the 2014 Development Charges Background Study to define water distribution improvements needed for growth servicing.

As part of the above mentioned studies, a number of system upgrades have been identified including: additional water supply sources; new pumping stations; storage facilities; and new water distribution mains. To help integrate these complex works, the City completed the Pressure Zone 1 and 2 studies in 2015 and 2017, respectively. These studies support the implementation of capital projects as outlined in the Water and Wastewater Capital Budget deliberations.

In 2017, Water Services completed the Water Facility and Property Asset Management Plan. This Plan identifies and prioritizes capital projects and land acquisitions required to maintain and renew its existing facility assets and associated operations over a 25 year planning horizon in accordance with asset management industry best management practices as well as current codes, guidelines and standards. A 10-year capital forecast for Facility and Water Plant Upgrades was presented to and endorsed by Council as part of the 2020 Capital Budget deliberations to address a backlog in infrastructure investment required to sustain operation of the City's critical water supply facilities and processes.

As a result of the above noted studies, key capital projects have been initiated/completed in 2019. The following provides the project name with a brief description of these key projects.

Upgrades

F.M. Woods Station Upgrades and Engine House and Pumping Station Building (Heritage Building) Retrofit

In 2019, works were initiated on the F.M Woods Station Upgrades to address critical infrastructure upgrades and retrofit of the Engine House and Pumping Station Building (Heritage Building) to provide office space for staff, respectively. 2019 works included the completion of architectural design of new office space for the Heritage Building, tendering for consultant selection for the F.M. Woods Upgrades and completion of the reservoir inspections. The Heritage Building is scheduled for completion in Q4 2020, with the F.M. Woods Upgrades being completed in 2023.

Burke Well Station Upgrades

Originally built in 1975, Burke well is one of the largest individual wells in the City pumping about six million litres of water and supplies about 13,000 Guelph households with water each day. This water treatment plant, completed in Q2 2019, is the first of its kind for the City, and was constructed to remove iron and manganese from groundwater. Removal of these metals allow our pipes to stay cleaner longer; therefore, prolonging the life of this important City asset while also reducing the need for flushing programs and conserving water. For the community, this new treatment plant will improve overall water quality and service delivery.

The upgrades include construction of a building to house a pressure filtration system. The upgrades resulted in a reclassification of the Water System by the MECP for both treatment and distribution on December 20, 2018. The Guelph Drinking Water System is now classified as a Class 2 Water Treatment System and a Class 4 Water Distribution System.

Clythe Well Treatment Upgrades and Zone 2 Environmental Assessment

The Environmental Assessment (EA) was completed for the Clythe Well station in 2018. As a result, the City purchased a parcel of land in their preferred location, which will house the new Water Treatment Plant. Design of this treatment plant is anticipated to be initiated in 2020 after the completion of the Zone 2 EA. The Zone 2 EA will determine the need for future water storage requirements on the East Side of the City which may impact the design

criteria for the new Clythe Well station. The Zone 2 EA is anticipated to be completed in 2020.

Paisley Pumping Station Upgrades

Upgrades to the Paisley Pumping Station were initiated in 2018 and will be completed in 2021 to ensure asset life is maintained. The scope of this project includes assessment of the reservoirs, re-alignment of the pipes to accommodate a new watermain connection from Paisley Road, upgrades to ensure electrical efficiencies and upgrades to the SCADA and MCC (electrical system). Work is also being completed in preparation for the new Paisley Road Feeder Main Engineering Project, which will promote redundancy in water distribution to the west side of the City. In 2019, design of the new pumping station was almost completed with construction starting in 2020.

Middle Reach of the Aqueduct

In 2018, preliminary projects were completed in preparation for the condition assessment and potential maintenance of the middle reach of the aqueduct. Studies included completion of an Environmental Impact Study and key contingency planning for unplanned changes in water quality including operational responses. Meetings were also held with various stakeholders including the Township of Puslinch, site neighbours, the Health Unit and the MECP. It is anticipated that inspection will occur in the summer/fall of 2020 to inform future capital needs for aqueduct maintenance and renewal. A new laneway will be constructed to provide operational access to the middle reach in early 2020.

Calico Well Upgrades

Calico Well was taken out of service in August 2018 for scheduled contact chamber cleaning and inspection. During the cleaning process, the well casing that extends through the contact chamber was found to be damaged due to material corrosion. The site remains non-operational as consultant reports and recommendations are being reviewed to determine the best approach to deal with several process and building related issues. As a result of this supply being off-line, the section of the feedermain between the station and the City’s distribution system has been isolated and taken out of service.

Membro Well Upgrades

Upgrades to the Membro Well station were initiated in 2019 to bring the new replacement well online after receiving the final Permit to Take Water from the Ministry of the Environment, Conservation and Parks in October 2019. Design of the upgraded facility was initiated in late 2019 with completion in Q1 2020. Upgrades, in addition to the addition of the new replacement well, may include the realignment of the UV system and energy upgrades such as VFDs and lighting. The main upgrades will include the building of an addition to the existing well house, pumps and piping to connect the new well to the distribution system and SCADA programming modifications.

In Q1 2020, a pumping test will be completed at the replacement well to confirm pumping capacity. This is required to inform the upgrades as noted above. During this test, dye tracer testing from the nearby sewage lift station will also be completed to determine a potential bacteria source pathway. This testing will occur for the duration of the pumping test which is anticipated to be completed in Q2 2020. If the dye is detected before Q2 2020, the pumping test will continue to determine the influence of this increased water taking on nearby wells.

Guelph South Feasibility Study

In 2019, the City initiated the feasibility study at the Guelph South test well in order to evaluate the potential availability of new water supply for future use, as per the Water Supply Master Plan. Further, the City has also partnered with the University of Guelph on this project to better understand interactions between the shallow groundwater and surface water in the area. Works include the installation of a new well in the proximity of the test well, pumping tests and installation of groundwater and surface water monitoring equipment. The majority of the work will be completed in 2020.

Logan Well Feasibility Study

In 2019 the City initiated the feasibility study at the Logan well in order to evaluate the potential availability of new water supply for future use, as per the Water Supply Master Plan. Works included tree clearing and maintenance of the access laneway in 2019. Preliminary tests of the well were conducted to determine the condition of the well. The full work plan will be implemented in 2020 which includes rehabilitation of the well and pumping tests.

Backflow Prevention Program

Preservation of drinking water quality within Guelph's infrastructure is supported by the City of Guelph's Building Services Division through administration of the Guelph Backflow Prevention Program and By-law (By-law Number 2016 - 20028). As defined under the By-law, Backflow means the flowing back of or reversal of the normal direction of flow of water. The By-law requires that no connections are made to the City's water supply where a private premise risk may exist without the installation of an approved backflow prevention device to isolate premises, sources, and zones to prevent cross-connections in every building or structure where a City water supply or other potable water supply exists.

Annually, Building Services provides a Backflow Report, included in Table 36 below, that tracks the number of letters sent out regarding backflow device annual testing and re-surveying requirements of the By-law. In accordance with the by-law, failure by property owners to maintain or replace the backflow prevention would result in the shut-off of water servicing to the premise to protect the integrity of the City's water supply.

Table 36: 2019 Backflow Report - Number of Letters Sent out for Annual Testing and Re-survey

Letter Type	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	TOTAL
1st Letter Annual Testing	147	159	177	210	273	185	143	172	120	135	164	118	**2003**
2nd Letter Annual Testing	60	85	114	109	128	138	133	97	125	41	93	98	**1221**
Disconnect Letter Annual Testing	68	33	44	39	53	63	67	72	49	36	37	60	**621**
1st Letter re-survey	34	30	39	36	32	25	30	22	18	5	41	7	**319**
2nd Letter re-survey	14	23	14	24	28	22	20	24	16	16	4	18	**223**

Letter Type	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	TOTAL
Disconnect Letter re-survey	12	7	12	10	15	15	16	15	20	11	7	4	**144**
Water service disconnected	0	0	0	0	0	0	0	0	0	0	0	0	**0**

As presented in Table 37, the City of Guelph has a total of 2,879 properties (2,734 active and 145 inactive properties) that have a total of 6,790 backflow prevention devices installed. Of the total, 1,708 buildings have premise isolation and 1,026 buildings are without premise isolation (e.g. residential irrigation systems, plaza facility – plaza owner has premise isolation). From January 1 to December 31, 2019, of the 31 new properties that have a backflow prevention device, 12 are with premise and 19 are without premise isolation.

Table 37: Backflow Devices Installed by Type in 2019

Devices Installed by Type	# of Devices
New Backflow Permits	43
Total Number of New Devices Installed	**125**
New Properties	31
Active Properties	2,734
Inactive Properties	145
Total Properties with Backflow Prevention Devices	**2,879**
Active Buildings with Premise Isolation	1,708
Active Buildings without Premise Isolation	1,026
Total Active Backflow Prevention Devices	**6,790**

o) Operational Plan Currency, Content and Updates

On an ongoing basis, the Operational Plan is updated by the Quality Management Specialist with the help of additional Water Services Staff. The Operational Plan was presented to Council on January 14, 2019 for endorsement. Updates to the Operational Plan were communicated to Water Services management and staff via email on September 10, 2019.

Notable updates include:

- Element 2 – Quality Management System Policy
  - Added the new Supervisor of Distribution.
- Element 3 – Commitment and Endorsement
  - Added the new Supervisor of Distribution.
- Element 5 – Document and Records Control
  - QMS 05: Added "T" for Water Treatment and "SW" for Source Water to the list of the naming conventions used for our procedures.
  - QMS 05-01: Added the water bylaw and backflow bylaws to QMS 05-01 Document Master List.
  - QMS 05-02: Added the online retention time for the Annual & Summary Report, as per discussions with the MECP.
  - QMS 05-04: Updated the hyperlinks to the following new documents: lab agreement, meter agreement, DWWP, MDWL, Membro Raw Water Assessment, Operational Plan Endorsement, Downey PTTW, and chemical contract.
- QMS 06 – Drinking Water System
  - QMS 06: Updated the Burke Section, distribution section and added Clair Booster Station to Table 1.
  - QMS 06-01: Added the schematics for the new Burke Treatment facility. Added information about utilizing one or multiple cells in reservoirs and the reservoirs at Woods, Park, University and Paisley. Updated the treated sample locations at Water and Emma. Changed the title from "Sample Process Schematics" to "Treatment System Process Schematics".
  - QMS 06-03: Added the section on the responsibilities of Water Services as per the Gazer Mooney Agreement.
- QMS 07 – Risk Assessment
  - QMS 07: Updated the control & response measures section.
  - QMS 07-01: Updated the Consequence section to include the affect on fire flow capabilities based on the amount of water loss in each section.
  - QMS 07-02: Added rationale sections to each risk score. Separated into 2 sections: contributing factors of the hazard event occurring and possible

consequences if the hazardous event occurred. Added fire flow impact to the consequence section. Added additional control measures and response measures.

- QMS 08 – Risk Assessment Outcome
  - QMS 08-02: Added the corresponding risk numbers to the critical control points.
  - QMS 08-03: Revised the control measures and their descriptions to match our current programs and processes.
- QMS 09 – Organizational Structure, Roles, Responsibilities and Authorities
  - QMS 09-01: The organizational structure was updated to more clearly define Owner, Owner Representative and Top Management Responsibilities.
  - City Council is defined as the Owner of the Guelph Drinking Water System. The CAO, DCAO, General Manager of Engineering and Transportation Services and General Manager of Environmental Services form the Senior Management Team. Water Services Managers and Supervisors (the Management Team) and the General Manager Environmental Services make up Top Management.
- QMS 10 – Competencies
  - Revised licence requirements for treatment operators, distribution operators, the ORO and acting ORO to reflect requirements based on our new system classification.
  - Removed the separate on-the-job training form for Maintenance as they are now classified as Treatment Operators as well.
  - Created 10-04 Administration On-the-Job Training Form.
- QMS 11 – Personnel Coverage
  - Updated the section for licence requirements for the ORO now that we are classified as a Class 2 Treatment and a Class 4 Distribution system.
- QMS 12 – Communications
  - QMS 12: Revised section 2 to better describe the current practices.
  - QMS 12-01: Updated the A&S Report section to match the 2018 A&S Report. Added section 4 Operational Plan.
  - QMS 12-03: Updated meeting information for the functional areas. Deleted the section on Procedure Review Meetings as these are often done alone by staff and not in a meeting format.
  - QMS 12-04: Updated Appendix A, removed names and only listed positions.
  - QMS 12-05: Added more information around the Financial Plan requirements and council endorsement process for both the Financial Plan and Operational Plan. Updated the next renewal date.

- QMS 13 – Essential Supplies and Services
  - QMS 13: Updated the Gazer-Mooney Agreement (March 1, 2019)
  - QMS 13-01: Added: Tower climbs, confined space, valves.
- QMS 14 – Review and Provision of Infrastructure
  - QMS 14: Updated Gazer Mooney agreement date.
- QMS 15 – Infrastructure Maintenance, Rehabilitation and Renewal
  - QMS 15: Updated the table to list the priority capital projects for 2019-2020.
- QMS 16 – Sampling, Testing and Monitoring
  - QMS 16: Updated the section about sampling the Glen as per the MDWL.
  - QMS 16-01: Updated to include latest sample map from August 2019. Includes new sample location in Zone 3.
- QMS 17 – Measurement and Recording Equipment Calibration and Maintenance
  - Updated Operational Checks section to reflect current colorimeter verification schedule.
- QMS 18 – Emergency Management
  - QMS 18-01: Added "cannot utilize GUDI-wef sources" as a disadvantage in Appendix B.
- QMS 21 – Continual Improvement
  - Rearranged the order of the steps so that Root-Cause Analysis is before other OFIs. Added "debriefs" to section 2. Added that root cause analysis' will be scheduled at least 10 working days after the incident.

p) Staff Suggestions

Staff suggestions are identified during: staff and operational meetings; internal and external audits; debriefs and are taken into account during annual budget processes and continual improvement meetings.

Appendix H: Summary of Staff Suggestions includes a listing of various improvement items that were presented by staff from January 1 to December 31, 2019.

q) New or Other Business

There is no further new or other business to report in 2019.

r) Next Meeting Dates

The Management Review Meeting scheduled to review the updated 2019 Annual and Summary Water Services Report was held on January 29, 2020. Review of the Internal Audit findings will take place in March 2020, review of the Risk Assessment outcomes in September 2020 and review of the External Audit findings in November 2020. Monthly QMS updates are scheduled with the management team and the Quality Management Specialist. Monthly QMS updates are communicated to all staff at scheduled staff meetings.

Appendix A: Summary of Critical Control Points and Critical Control Limits

Table 38: Summary of Critical Control Points and Critical Control Limits

Critical Control Point (CCP)	Hazard Description	Critical Control Limit (CCL)	Monitoring Process and/or Procedures	Response Procedures

Multi-Barrier Primary Disinfection
 	
To remove or inactivate pathogens potentially present in the source water.
	Low Chlorine Dosage
	• Chlorination system failure (e.g. pump, line, fitting, power, PLC, flow meter)
	• Failure of analyzers (POE or process) to alarm
	• Poor chemical quality
		<u>Free Chlorine</u>
		• Low Low and High High alarm limit range for all stations:
		  ○ 0.40 to 1.9 mg/L
		• Programmed Auto Shutdown range for all stations:
		  ○ 0.40 to 2.5 mg/L
			• Certified and competent operators
			• Continuous monitoring of control limits through SCADA
			• Daily operational sampling, testing and monitoring of control limits by Operators
			• Redundancy of system components (including equipment) & monitoring (operators, instruments); stand-by power
			• Monitoring and alarming of control limits
			• Calibration, maintenance and preventive maintenance – equipment
			• Robust communication systems
			• Receiving process for chemicals
			  ○ Certificates of Analysis required for essential chemicals
			• Free Chlorine Analyzer auto well shut off limits:
			  ○ Programmed low
			  ○ Programmed high
			  ○ Analog signal error
			  ○ Power loss
			  ○ Analyzer malfunction
				• Supply Standard Operating Procedures
				• Water Services Emergency Plan procedures
				• Facility Setpoint Labels (identify specific ranges and shutdowns for each station)

	High Turbidity
	• Sudden changes to raw water quality characteristics
	• Failure of aqueduct infrastructure
		<u>Turbidity</u>
		• Turbidity alarm ranges for all stations that monitor turbidity:
		  ○ 0.3 to 0.8 ntu
		• Auto diversion at the Glen Diversion Chamber based on turbidity
		  ○ 0.2 ntu		

	Inadequate UV Dosage
	• UV Treatment system failure (e.g. UV, UVT and Turbidity analyzers, high flow, reactor, PLC, power, flow meters)
	• High turbidity event
		<u>UV Dose</u>
		UV Dose auto shutdown alarm setpoints:
		• FM Woods
		  ○ <30 mJ/cm^2 (Trojan controller programmed low)
		• Water Street well
		  ○ <45 mJ/cm^2 (Trojan controller programmed low)
		  ○ 42 mJ/cm^2 (redundant PLC programmed low)		

Critical Control Point (CCP)	Hazard Description	Critical Control Limit (CCL)	Monitoring Process and/or Procedures	Response Procedures

		• Membro
		  ○ <25 mJ/cm^2 (Trojan controller programmed low)
		  ○ <22 mJ/cm^2 (redundant PLC programmed)
			• Chlorine Pump alarms
			  ○ Tube leak detection
			  ○ Low speed feedback
			  ○ Motor run/fail
			• Each station has the identified reservoir level, POE flow rate and minimum chlorine needed to meet CT
			• Manual CT calculations	

	Operating a Station in Manual
	• Inadequate CT (Concentration x Time)
	  ○ Low reservoir level
	  ○ Insufficient chlorine residual
	  ○ Low contact time due to POE pump flow rate
		<u>CT Calculations</u>
		• Manual calculations must show that the minimum CT achieved is 4		

Secondary Disinfection To ensure the maintenance of a disinfectant residual throughout the distribution system.	**Deterioration of Chlorine Residual** • Reduced water flows based on demand, pipe size, etc. • Occurrence of dead ends and District Metered Areas • Increased water temperature (temporary mains) • Reaction with organic matter in watermains • Water age in the distribution system • Water age in storage facilities	<u>Free Chlorine</u> Target Residual in the Distribution System: • >0.20 mg/L (operational minimum) Reportable under the SDWA: • 0.05 mg/L <u>Customer Complaints</u> • Related to water quality characteristics (taste, odour, colour, other)	• Certified and competent operators • Sampling, testing and monitoring of control limits, as applicable • Watermain flushing and swabbing programs • Installation of blow-offs in dead ends • Regular samples taken and analyzed for chlorine residual • Rechlorination at booster stations • Mixing systems in Speedvale and Clair Towers	• Supply Standard Operating Procedures • Distribution Standard Operating Procedures • Response to customer calls • Service Request tracking and monitoring • Repair and system rehabilitation • Use of appropriately certified and competent contractors and suppliers

Critical Control Point (CCP)	Hazard Description	Critical Control Limit (CCL)	Monitoring Process and/or Procedures	Response Procedures
Backflow Prevention To prevent cross-contamination that can result from the flowing back of or reversal of the normal direction of flow of water.	**System contamination from negative or reduced pressure** • Lack of backflow prevention device • Main breaks or blow-outs • Large services • Temporary connections • Firefighting drawdown • Depressurization from residential usage • Pipe failure (deterioration)	<u>System pressure</u> Alarm setpoint ranges for pressure: • 210 to 900 kPa <u>Consumer complaints</u> • Related to system pressure or water characteristics (taste, odour, colour, other)	• Backflow Prevention program • Where possible, implementation of backflow prevention devices and small mains • Proactive Watermain and substandard service replacement program • Pressure monitoring though pressure transmitters on hydrants and at stations	• Distribution Standard Operating Procedures • Response to customer calls • Service Request tracking and monitoring • Water Services Emergency Plan procedures

Appendix B: Summary of Internal and External Audit Plans

Table 39: Summary of Internal and External Audit Plans, 2018-2020

Guelph Water Services Process or Program	2018 Audit Plan		2019 Audit Plan		2020 Audit Plan	
	I[31]	E[32]	I	E	I	E
Source Water – Source Water Protection Program			X	X		
Source Water – Outdoor Water Use Program	X	X				
Source Water – Tap Water Promotion, Education & Outreach				X		
Source Water – Water Smart Business Program		X			X	
Water Supply – Source & Treated Water Sampling, Testing, Monitoring	X	X		X	X	X
Water Supply – Operational Control: Disinfection, Minimum Storage, SCADA / Security	X		X			X
Water Supply – SCADA Design, Maintenance & Upgrades		X			X	X
Water Supply – Water Supply Master Plan Program (new water sources)			X			
Maintenance – Instrumentation Calibration / Verification	X	X	X	X		X
Maintenance – Well Inspection & Rehabilitation Program	X	X			X	X

[31] I = Internal Audit

[32] E = External Audit

Guelph Water Services Process or Program	2018 Audit Plan		2019 Audit Plan		2020 Audit Plan	
	I[31]	E[32]	I	E	I	E
Maintenance – Preventative & Reactive Maintenance Program			X	X		
Maintenance – Infrastructure (facility and tower) Inspections Program		X			X	X
Distribution Construction – Watermain Maintenance & Service Connections Improvement	X			X		
Distribution Construction – Leak Detection & Water Loss Management	X			X		
Distribution Construction – No Water Response (e.g. frozen pipes)		X				X
Distribution Construction – New Watermain Construction & Reconstruction			X	X		
Distribution Construction – Temporary Watermains & Service Connections	X	X				
Distribution Appurtenance Maintenance –Hydrant Inspection Program	X			X		
Distribution Appurtenance Maintenance – Watermain Flushing & Swabbing Program	X	X			X	X
Distribution Appurtenance Maintenance – Valve Turning Program			X	X		
Distribution Appurtenance Maintenance – DMAs	X			X		
Distribution Appurtenance Maintenance – Water Meter Program		X			X	X
Distribution Appurtenance Maintenance – Infrastructure Locates Program			X	X		

Guelph Water Services Process or Program	2018 Audit Plan		2019 Audit Plan		2020 Audit Plan	
	I[31]	E[32]	I	E	I	E
Infrastructure Programs – Tech Services: New Facility Construction	X	X				
Infrastructure Programs – Tech Services: Major Facility Upgrades	X	X			X	X
Infrastructure Programs – Engineering: Infrastructure Planning	X					X
Infrastructure Programs – Engineering: Water Asset Planning & Condition Assessments		X				
Infrastructure Programs – Engineering/Water: Review of Infrastructure and Specifications	X			X		
Infrastructure Programs – Engineering: Infrastructure Reconstruction & Planning	X		X	X	X	
Infrastructure Programs – Engineering: New Construction (new subdivisions)				X		
Infrastructure Programs – Building Services: Backflow Prevention Program						X
Management – Compliance Program		X			X	X
Management – Certification Program	X			X	X	
Management – Owner Standard of Care	X			X		
Management – Customer Services (Administration, Distribution & Supply)			X	X		
Management – Human Resources & Supplier		X		X		X
Management – Communications	X	X		X		X
Management – Review and Provision of Infrastructure	X	X		X		X

Guelph Water Services Process or Program	2018 Audit Plan		2019 Audit Plan		2020 Audit Plan	
	I[31]	E[32]	I	E	I	E
QMS – Internal Audit Program	X	X	X	X		X
QMS – Risk Assessments	X	X	X	X	X	X
QMS – Continual Improvement	X	X	X	X	X	X
QMS – Emergency Management	X	X	X	X	X	X
QMS – Management Review	X	X	X	X		X
QMS – Document & Records Control	X	X	X	X	X	X
QMS – Drinking Water System	X	X				X

Appendix C: Total Water Pumped and Instantaneous Flows

This section summarizes the amount of water pumped and instantaneous flows in 2019.

Capacity is calculated by comparing the average pumped or flow value against the MDWL allowable volume or PTTW flow. Capacity is representative of the conditions of pumping for that year which may be influenced by other testing programs, maintenance or special operational conditions. Additionally, the actual capacity of the source may not be achievable with current infrastructure. Optimization efforts are included as a component of the Water Supply Master Plan with the intent to match the actual capacity of the water source with the appropriate infrastructure. Section g) Water Supply Capacity describes capacity in further detail.

City of Guelph Water Services – Pumpages to System, January 1 – December 31, 2019

Table 40 below shows the amount of water pumped to system from each facility in 2019 in cubic meters.

Table 40: Pumpages (Discharge) to System, January 1 to December 31, 2019

Facility		Burke	Calico	Dean	Downey	Emma	Helmar	Membro	Paisley Net	Park	Queensdale	University Net	Water Street	F.M. Woods	Total System Discharge
Units		m^3	m^3	m^3	m^3	m^3	m^3	m^3	m^3	m^3	m^3	m^3	m^3	m^3	m^3
Regulatory Limit		6,546	5,237	2,300	5,237	3,100	3,273	6,050	13,738	10,300	5,273	5,108	3,400	65,000	n/a
Jan	Average	0	0	1,347	4,593	2,405	792	2,183	861	4,230	0	1,522	1,872	25,750	46,297
	Maximum	0	0	1,350	4,670	2,520	800	2,337	864	5,075	752	2,323	1,915	29,066	49,815
	Total	**0**	**0**	**41,764**	**142,383**	**74,556**	**24,549**	**67,678**	**26,695**	**131,126**	**23,008**	**47,170**	**58,027**	**798,249**	**1,435,204**
Feb	Average	51	0	1,348	4,442	2,365	789	1,962	854	4,398	722	1,403	1,884	26,392	46,611
	Maximum	577	0	1,352	4,654	2,436	794	2,060	859	5,088	736	2,351	1,934	29,805	49,237
	Total	**1,428**	**0**	**37,748**	**124,388**	**66,229**	**22,088**	**54,947**	**23,920**	**123,132**	**20,220**	**39,296**	**52,750**	**738,963**	**1,305,109**
Mar	Average	5,216	0	1,392	4,427	2,400	779	1,424	843	3,530	439	1,206	1,804	24,282	47,741
	Maximum	6,243	0	1,438	4,466	2,536	790	2,252	848	4,991	897	2,368	1,940	28,582	51,438
	Total	**161,684**	**0**	**43,154**	**137,222**	**74,390**	**24,149**	**44,156**	**26,122**	**109,429**	**13,610**	**37,398**	**55,916**	**752,736**	**1,479,966**
Apr	Average	6,120	0	1,408	4,414	2,485	737	0	416	3,203	0	1,654	1,893	23,586	45,917
	Maximum	6,236	0	1,429	4,448	2,564	776	0	883	3,438	0	2,386	1,971	28,652	50,526
	Total	**183,606**	**0**	**42,239**	**132,415**	**74,563**	**22,099**	**0**	**12,473**	**96,101**	**0**	**49,633**	**56,802**	**707,579**	**1,377,510**
May	Average	6,117	0	1,406	4,392	2,391	792	0	0	2,150	384	1,414	1,686	26,173	46,905
	Maximum	6,234	0	1,430	4,432	2,610	797	0	0	3,539	674	2,381	1,971	30,992	52,991
	Total	**189,618**	**0**	**43,591**	**136,161**	**74,108**	**24,550**	**0**	**0**	**66,649**	**11,911**	**43,831**	**52,277**	**811,353**	**1,454,048**
Jun	Average	6,092	0	4,336	4,336	4,336	740	0	325	1,867	652	1,578	1,567	27,035	52,863
	Maximum	6,220	0	4,424	4,424	4,424	816	0	833	5,750	693	2,360	1,965	32,296	57,804
	Total	**182,775**	**0**	**130,066**	**130,066**	**130,066**	**22,185**	**0**	**9,758**	**56,004**	**19,569**	**47,330**	**47,021**	**811,047**	**1,585,886**
Jul	Average	6,022	0	1,121	3,772	2,546	794	0	808	1,881	565	1,554	1,565	29,566	50,194
	Maximum	6,289	0	1,439	4,439	2,619	816	0	1,090	3,545	704	2,000	1,917	32,772	54,193
	Total	**186,695**	**0**	**34,762**	**116,937**	**78,919**	**24,607**	**0**	**25,042**	**58,316**	**17,509**	**48,165**	**48,519**	**916,552**	**1,556,023**
Aug	Average	5,767	0	1,299	3,616	2,540	662	0	965	1,899	0	1,374	1,535	28,924	48,580
	Maximum	6,284	0	1,432	4,466	2,580	803	0	1,057	6,193	0	2,298	1,904	35,817	53,634
	Total	**178,775**	**0**	**40,265**	**112,090**	**78,731**	**20,524**	**0**	**29,914**	**58,855**	**0**	**42,601**	**47,586**	**896,643**	**1,505,984**

Facility		Burke	Calico	Dean	Downey	Emma	Helmar	Membro	Paisley Net	Park	Queensdale	University Net	Water Street	F.M. Woods	Total System Discharge
Units		m^3	m^3	m^3	m^3	m^3	m^3	m^3	m^3	m^3	m^3	m^3	m^3	m^3	m^3
Regulatory Limit		6,546	5,237	2,300	5,237	3,100	3,273	6,050	13,738	10,300	5,273	5,108	3,400	65,000	n/a
Sept	Average	6,221	0	1,679	2,977	2,192	757	0	1,053	2,296	0	1,355	1,833	27,550	47,913
	Maximum	6,274	0	1,988	3,379	2,615	784	0	1,055	7,944	0	2,319	1,868	31,221	52,743
	Total	**186,634**	**0**	**50,369**	**89,309**	**65,766**	**22,721**	**0**	**31,594**	**68,867**	**0**	**40,646**	**54,995**	**826,495**	**1,437,396**
Oct	Average	6,157	0	1,256	3,186	2,481	752	0	1,049	1,773	0	580	1,842	25,530	44,607
	Maximum	6,272	0	1,407	4,274	2,600	767	0	1,054	6,529	0	2,374	1,886	32,882	55,452
	Total	**190,872**	**0**	**38,926**	**98,779**	**76,923**	**23,299**	**0**	**32,514**	**54,970**	**0**	**17,994**	**57,107**	**791,423**	**1,382,806**
Nov	Average	6,195	0	1,235	3,084	2,572	726	0	1,044	839	111	1,732	1,810	26,064	45,413
	Maximum	6,267	0	1,402	4,012	2,707	783	0	1,093	5,841	736	2,361	1,933	34,903	58,441
	Total	**185,862**	**0**	**37,053**	**92,524**	**77,148**	**21,782**	**0**	**31,323**	**25,177**	**3,342**	**51,958**	**54,296**	**781,924**	**1,362,390**
Dec	Average	6,185	0	1,387	2,783	2,494	739	0	1,046	1,481	673	927	1,861	21,659	41,236
	Maximum	6,254	0	1,397	3,244	2,596	747	0	1,055	5,997	706	2,352	1,921	26,766	46,749
	Total	**191,726**	**0**	**42,993**	**86,278**	**77,308**	**22,911**	**0**	**32,435**	**45,922**	**20,865**	**28,748**	**57,706**	**671,438**	**1,278,330**
2019 Year	Average	5,012	0	1,601	3,835	2,600	755	464	772	2,462	357	1,358	1,763	26,043	47,023
	Maximum	6,289	0	4,424	4,670	4,424	816	2,337	1,093	7,944	897	2,386	1,971	35,817	58,441
	Total	**1,839,674**	**0**	**582,930**	**1,398,552**	**948,705**	**275,464**	**166,781**	**281,792**	**894,547**	**130,035**	**494,769**	**643,003**	**9,504,401**	**17,160,654**
	Average Process Capacity	**77%**	**0%**	**69%**	**73%**	**84%**	**23%**	**8%**	**n/a**	**24%**	**7%**	**n/a**	**52%**	**40%**	**n/a**

City of Guelph Water Services – Permit to Take Water Pumpages, January 1 – December 31, 2019

Table 41 and Table 42 presented below, outline the Permit to Take Water Pumpages for 2019. Table 41 includes the following sources: Admiral Well, Arkell Well 1, Arkell Well 6, Arkell Well 7, Arkell Well 8, Arkell Well 14, Arkell Well 15, Arkell Recharge Pump, Arkell Springs Glen Collector System, Burke Well, Calico Well, Carter Well 1 and 2 and Clythe Well. Table 42 includes the following sources: Dean Well, Downey Well, Edinburgh Well, Emma Well, Helmar Well, Membro Well, Paisley Well, Park Wells 1 and 2, Queensdale Well, Sacco Well, Smallfield Well, University Well and Water Street Well.

Table 41: City of Guelph Permit to Take Water Pumpages, 2019

Facility		Admiral Well	Arkell Well #1	Arkell Well #6	Arkell Well #7	Arkell Well #8	Arkell Well #14	Arkell Well #15	Arkell Wellfield (#6,7,8,14,15) Total	Arkell - Recharge Pump	Arkell Springs Glen Collector System	Burke Well	Calico Well	Carter Wells #1and #2	Clythe Well
Units		m^3	m^3	m^3	m^3	m^3	m^3	m^3	m^3	m^3	m^3	m^3	m^3	m^3	m^3
Regulatory Limit		**N/O[33]**	**3,273**	**9,600**	**9,600**	**9,600**	**9,600**	**9,600**	**28,800**	**9,092**	**25,000**	**6,546**	**5,237**	**6,547**	**N/O**
January	Average	N/O	95	3,587	7,478	1,799	2,776	4,529	20,171	0	5,604	0	0	0	N/O
	Maximum	N/O	706	5,543	7,610	5,371	6,722	6,398	23,166	0	5,725	0	0	0	N/O
	Total	**N/O**	**2,941**	**111,207**	**231,832**	**55,778**	**86,064**	**140,408**	**625,289**	**0**	**173,712**	**0**	**0**	**0**	**N/O**
February	Average	N/O	41	3,585	7,450	780	6,102	2,974	20,890	0	5,547	63	0	0	N/O
	Maximum	N/O	356	5,636	7,537	3,847	7,439	5,934	24,401	0	5,591	657	0	0	N/O
	Total	**N/O**	**1,157**	**100,376**	**208,591**	**21,829**	**170,866**	**83,262**	**584,922**	**0**	**155,319**	**1,754**	**0**	**0**	**N/O**
March	Average	N/O	79	3,371	7,498	853	5,683	951	18,356	0	6,059	5,328	0	0	N/O
	Maximum	N/O	663	5,259	7,602	3,333	6,780	3,014	21,769	0	7,221	6,364	0	0	N/O
	Total	**N/O**	**2,463**	**104,509**	**232,428**	**26,452**	**176,168**	**29,466**	**569,022**	**0**	**187,833**	**165,182**	**0**	**0**	**N/O**
April	Average	N/O	96	1,987	7,592	300	4,431	1,099	15,409	1,791	8,132	6,252	0	0	N/O
	Maximum	N/O	499	4,737	7,678	2,160	6,631	5,491	20,936	8,364	11,126	6,368	0	0	N/O
	Total	**N/O**	**2,876**	**59,624**	**227,751**	**9,014**	**132,920**	**32,969**	**462,278**	**53,718**	**243,972**	**187,558**	**0**	**0**	**N/O**

[33] N/O – not operational

Facility		Admiral Well	Arkell Well #1	Arkell Well #6	Arkell Well #7	Arkell Well #8	Arkell Well #14	Arkell Well #15	Arkell Wellfield (#6,7,8,14,15) Total	Arkell - Recharge Pump	Arkell Springs Glen Collector System	Burke Well	Calico Well	Carter Wells #1and #2	Clythe Well
Units		m^3	m^3	m^3	m^3	m^3	m^3	m^3	m^3	m^3	m^3	m^3	m^3	m^3	m^3
Regulatory Limit		**N/O[33]**	**3,273**	**9,600**	**9,600**	**9,600**	**9,600**	**9,600**	**28,800**	**9,092**	**25,000**	**6,546**	**5,237**	**6,547**	**N/O**
May	Average	N/O	96	1,153	7,685	9	2,193	1,098	12,138	8,184	14,496	6,254	0	0	N/O
	Maximum	N/O	722	3,565	7,834	150	5,889	3,476	17,926	8,350	16,673	6,364	0	0	N/O
	Total	**N/O**	**2,974**	**35,731**	**238,239**	**294**	**67,981**	**34,026**	**376,272**	**253,705**	**449,372**	**193,874**	**0**	**0**	**N/O**
June	Average	N/O	108	7,720	664	36	587	1,322	10,330	7,691	17,384	6,239	0	0	N/O
	Maximum	N/O	763	7,873	2,596	815	4,133	4,668	14,435	7,947	17,760	6,364	0	0	N/O
	Total	**N/O**	**3,254**	**231,613**	**19,929**	**1,086**	**17,616**	**39,646**	**309,890**	**230,734**	**521,512**	**187,167**	**0**	**0**	**N/O**
July	Average	N/O	1,113	388	7,114	665	2,387	1,503	12,058	7,316	16,873	6,176	0	1,330	N/O
	Maximum	N/O	1,203	7,665	7,907	4,020	7,495	4,099	15,647	7,627	17,685	6,440	0	6,275	N/O
	Total	**N/O**	**34,511**	**12,043**	**220,524**	**20,629**	**74,006**	**46,608**	**373,810**	**226,781**	**523,051**	**191,468**	**0**	**41,229**	**N/O**
August	Average	N/O	844	7,034	1,054	945	2,747	1,057	12,837	6,919	15,493	5,918	0	6,504	N/O
	Maximum	N/O	1,193	7,860	7,448	3,213	5,672	7,793	20,921	7,358	16,153	6,440	0	7,793	N/O
	Total	**N/O**	**26,175**	**218,054**	**32,681**	**29,305**	**85,149**	**32,759**	**397,949**	**214,496**	**480,277**	**183,445**	**0**	**201,632**	**N/O**
September	Average	N/O	66	5,607	5,327	1,331	2,692	0	14,957	4,172	12,676	6,386	0	6,852	N/O
	Maximum	N/O	346	7,830	7,596	3,694	6,079	0	18,805	7,282	14,974	6,440	0	7,759	N/O
	Total	**N/O**	**1,967**	**168,196**	**159,822**	**39,939**	**80,752**	**0**	**448,709**	**125,147**	**380,293**	**191,574**	**0**	**205,553**	**N/O**
October	Average	N/O	63	6,209	4,939	2,134	2,777	275	16,335	2,234	9,950	6,324	0	1,757	N/O
	Maximum	N/O	751	7,678	7,536	5,392	7,128	3,028	23,674	7,475	11,599	6,440	0	6,333	N/O
	Total	**N/O**	**1,962**	**192,481**	**153,113**	**66,166**	**86,084**	**8,531**	**506,375**	**69,266**	**308,453**	**196,059**	**0**	**54,458**	**N/O**

Facility		Admiral Well	Arkell Well #1	Arkell Well #6	Arkell Well #7	Arkell Well #8	Arkell Well #14	Arkell Well #15	Arkell Wellfield (#6,7,8,14,15) Total	Arkell - Recharge Pump	Arkell Springs Glen Collector System	Burke Well	Calico Well	Carter Wells #1and #2	Clythe Well
Units		m^3	m^3	m^3	m^3	m^3	m^3	m^3	m^3	m^3	m^3	m^3	m^3	m^3	m^3
Regulatory Limit		**N/O[33]**	**3,273**	**9,600**	**9,600**	**9,600**	**9,600**	**9,600**	**28,800**	**9,092**	**25,000**	**6,546**	**5,237**	**6,547**	**N/O**
November	Average	N/O	37	5,066	6,010	3,197	3,507	965	18,745	0	7,549	6,364	0	0	N/O
	Maximum	N/O	333	8,017	7,517	5,897	6,417	5,341	28,272	0	8,595	6,439	0	0	N/O
	Total	**N/O**	**1,099**	**151,980**	**180,294**	**95,921**	**105,209**	**28,956**	**562,360**	**0**	**226,478**	**190,927**	**0**	**0**	**N/O**
December	Average	N/O	61	4,346	7,585	887	2,362	990	16,170	0	6,540	6,356	0	0	N/O
	Maximum	N/O	359	6,824	7,820	5,100	5,900	5,039	21,177	0	6,811	6,427	0	0	N/O
	Total	**N/O**	**1,893**	**134,724**	**235,127**	**27,502**	**73,229**	**30,695**	**501,278**	**0**	**202,733**	**197,032**	**0**	**0**	**N/O**
2019 Year	Average	N/O	225	4,171	5,866	1,078	3,187	1,397	15,700	3,192	10,525	5,138	0	1,370	N/O
	Maximum	N/O	1,203	8,017	7,907	5,897	7,495	7,793	28,272	8,364	17,760	6,440	0	7,793	N/O
	Total	**N/O**	**83,271**	**1,520,537**	**2,140,330**	**393,915**	**1,156,045**	**507,326**	**5,718,153**	**1,173,847**	**3,853,004**	**1,886,039**	**0**	**502,871**	**N/O**
	Average Pumped	N/O	7%	43%	61%	11%	33%	14%	54%	11%	37%	79%	0%	21%	N/O

Table 42: City of Guelph Permit to Take Water Pumpages, 2019 - Continued

Facility		Dean Well	Downey Well	Edinburgh Well	Emma Well	Helmar Well	Membro Well	Paisley Well	Park Wells #1 and #2	Queensdale Well	Sacco Well	Smallfield Well	University Well	Water Street Well
	Units	**m3**	**m3**	**m3**	**m3**	**m3**	**m3**	**m3**	**m3**	**m3**	**m3**	**m3**	**m3**	**m3**
	Regulatory Limit	**2,300**	**5,273**	**N/O**	**3,100**	**3,273**	**6,050**	**3,200**	**10,300**	**5,237**	**N/O**	**N/O**	**3,300**	**3,400**
January	Average	1,338	4,705	N/O	2,405	772	2,156	861	4,189	744	N/O	N/O	1,522	1,872
	Maximum	1,374	4,780	N/O	2,520	795	2,315	864	5,063	782	N/O	N/O	2,323	1,915
	Total	**41,482**	**145,855**	**N/O**	**74,556**	**23,942**	**66,837**	**26,695**	**129,847**	**23,079**	**N/O**	**N/O**	**47,170**	**58,027**
February	Average	1,339	4,551	N/O	2,365	770	1,939	854	4,356	725	N/O	N/O	1,403	1,884
	Maximum	1,388	4,765	N/O	2,436	782	2,037	859	5,064	747	N/O	N/O	2,351	1,934
	Total	**37,500**	**127,419**	**N/O**	**66,229**	**21,572**	**54,295**	**23,920**	**121,960**	**20,293**	**N/O**	**N/O**	**39,296**	**52,750**
March	Average	1,383	4,533	N/O	2,400	760	2,120	843	3,499	438	N/O	N/O	1,206	1,804
	Maximum	1,460	4,572	N/O	2,536	780	2,432	848	4,955	936	N/O	N/O	2,368	1,940
	Total	**42,878**	**140,514**	**N/O**	**74,390**	**23,559**	**65,720**	**26,122**	**108,464**	**13,570**	**N/O**	**N/O**	**37,398**	**55,916**
April	Average	1,403	4,522	N/O	2,485	737	2,321	416	3,181	0	N/O	N/O	1,654	1,893
	Maximum	1,471	4,559	N/O	2,564	776	2,369	883	3,425	0	N/O	N/O	2,386	1,971
	Total	**42,102**	**135,672**	**N/O**	**74,563**	**22,099**	**69,630**	**12,473**	**95,443**	**0**	**N/O**	**N/O**	**49,633**	**56,802**
May	Average	1,419	4,503	N/O	2,391	774	2,343	0	2,129	385	N/O	N/O	1,414	1,686
	Maximum	1,470	4,543	N/O	2,610	791	2,370	0	3,496	700	N/O	N/O	2,381	1,971
	Total	**43,986**	**139,592**	**N/O**	**74,108**	**23,986**	**72,625**	**0**	**65,996**	**11,948**	**N/O**	**N/O**	**43,831**	**52,277**

Facility		Dean Well	Downey Well	Edinburgh Well	Emma Well	Helmar Well	Membro Well	Paisley Well	Park Wells #1 and #2	Queensdale Well	Sacco Well	Smallfield Well	University Well	Water Street Well
Units		**m3**	**m3**	**m3**	**m3**	**m3**	**m3**	**m3**	**m3**	**m3**	**m3**	**m3**	**m3**	**m3**
Regulatory Limit		**2,300**	**5,273**	**N/O**	**3,100**	**3,273**	**6,050**	**3,200**	**10,300**	**5,237**	**N/O**	**N/O**	**3,300**	**3,400**
June	Average	1,349	4,445	N/O	2,418	726	2,297	325	1,859	650	N/O	N/O	1,578	1,567
	Maximum	1,453	4,536	N/O	2,644	795	2,343	833	5,712	700	N/O	N/O	2,360	1,965
	Total	**40,456**	**133,338**	**N/O**	**72,532**	**21,773**	**68,908**	**9,758**	**55,766**	**19,489**	**N/O**	**N/O**	**47,330**	**47,021**
July	Average	1,119	3,867	N/O	2,546	776	2,253	808	1,860	560	N/O	N/O	1,173	1,565
	Maximum	1,460	4,554	N/O	2,619	807	2,306	1,090	3,496	697	N/O	N/O	2,404	1,917
	Total	**34,687**	**119,868**	**N/O**	**78,919**	**24,067**	**69,858**	**25,042**	**57,663**	**17,345**	**N/O**	**N/O**	**36,352**	**48,519**
August	Average	1,307	3,709	N/O	2,540	646	2,216	965	1,881	0	N/O	N/O	1,374	1,535
	Maximum	1,450	4,583	N/O	2,580	792	2,274	1,057	6,008	0	N/O	N/O	2,298	1,904
	Total	**40,509**	**114,968**	**N/O**	**78,731**	**20,019**	**68,685**	**29,914**	**58,303**	**0**	**N/O**	**N/O**	**42,601**	**47,586**
September	Average	1,380	3,062	N/O	2,192	739	2,186	1,053	2,283	0	N/O	N/O	1,355	1,833
	Maximum	1,418	3,469	N/O	2,615	779	2,192	1,055	7,879	0	N/O	N/O	2,319	1,868
	Total	**41,400**	**91,858**	**N/O**	**65,766**	**22,179**	**65,594**	**31,594**	**68,483**	**0**	**N/O**	**N/O**	**40,646**	**54,995**
October	Average	1,275	3,295	N/O	2,481	734	2,182	1,049	1,759	0	N/O	N/O	580	1,842
	Maximum	1,433	4,418	N/O	2,600	755	2,190	1,054	6,346	0	N/O	N/O	2,374	1,886
	Total	**39,515**	**102,148**	**N/O**	**76,923**	**22,761**	**67,627**	**32,514**	**54,544**	**0**	**N/O**	**N/O**	**17,994**	**57,107**

Facility		Dean Well	Downey Well	Edinburgh Well	Emma Well	Helmar Well	Membro Well	Paisley Well	Park Wells #1 and #2	Queensdale Well	Sacco Well	Smallfield Well	University Well	Water Street Well
Units		**m3**	**m3**	**m3**	**m3**	**m3**	**m3**	**m3**	**m3**	**m3**	**m3**	**m3**	**m3**	**m3**
Regulatory Limit		**2,300**	**5,273**	**N/O**	**3,100**	**3,273**	**6,050**	**3,200**	**10,300**	**5,237**	**N/O**	**N/O**	**3,300**	**3,400**
November	Average	1,251	3,192	N/O	2,572	709	2,188	1,044	829	116	N/O	N/O	1,732	1,810
	Maximum	1,428	4,150	N/O	2,707	768	2,289	1,093	5,662	737	N/O	N/O	2,361	1,933
	Total	**37,532**	**95,757**	**N/O**	**77,172**	**21,275**	**65,644**	**31,323**	**24,867**	**3,482**	**N/O**	**N/O**	**51,958**	**54,296**
December	Average	1,409	2,879	N/O	2,494	722	1,156	1,046	1,474	673	N/O	N/O	927	1,861
	Maximum	1,438	3,355	N/O	2,596	739	2,197	1,055	6,098	724	N/O	N/O	2,352	1,921
	Total	**43,668**	**89,244**	**N/O**	**77,308**	**22,372**	**35,823**	**32,435**	**45,684**	**20,867**	**N/O**	**N/O**	**28,748**	**57,706**
2019 Year	Average	1,331	3,938	N/O	2,441	739	2,113	772	2,442	358	N/O	N/O	1,327	1,763
	Maximum	1,471	4,780	N/O	2,707	807	2,432	1,093	7,879	936	N/O	N/O	2,404	1,971
	Total	**485,715**	**1,436,233**	**N/O**	**891,195**	**269,604**	**771,245**	**281,792**	**887,019**	**130,073**	**N/O**	**N/O**	**482,956**	**643,003**
	Average Pumped	58%	75%	N/O	79%	23%	35%	24%	24%	7%	N/O	N/O	40%	52%

City of Guelph Water Services – Instantaneous Flows Summary (PTTW), January 1 – December 31, 2019

Table 43 and Table 44 presented below, outline the Instantaneous Flow Summary for 2019. Table 43 includes the following sources: Admiral Well, Arkell Well 1, Arkell Well 6, Arkell Well 7, Arkell Well 8, Arkell Well 14, Arkell Well 15, Arkell Recharge Pump, Arkell Springs Glen Collector System, Burke Well, Calico Well, Carter Well 1 and 2 and Clythe Well. Table 44 includes the following sources: Dean Well, Downey Well, Edinburgh Well, Emma Well, Helmar Well, Membro Well, Paisley Well, Park Wells 1 and 2, Queensdale Well, Sacco Well, Smallfield Well, University Well and Water Street Well.

Table 43: City of Guelph - Instantaneous Flow Summary, 2019

Facility		Admiral Well	Arkell Well #1	Arkell Well #6	Arkell Well #7	Arkell Well #8	Arkell Well #14	Arkell Well #15	Arkell Wellfield (#6,7,8,14,15)	Arkell -Recharge System	Arkell Springs Glen Collector System	Burke Well	Calico Well	Carter Wells	Clythe Well
Units		**L/s**	**L/s**	**L/s**	**L/s**	**L/s**	**L/s**	**L/s**	**L/s**	**L/s**	**L/s**	**L/s**	**L/s**	**L/s**	**L/s**
Regulatory Limit		**n/a**	**37.9**	**111.0**	**111.0**	**111.0**	**111.0**	**111.0**	**n/a**	**157.8**	**290.0**	**83.7**	**60.6**	**90.9**	**n/a**
January	Average	N/O	1.1	41.6	86.4	20.8	32.1	52.4	234.5	0.0	0.3	0.0	0.0	0.0	N/O
	Maximum	N/O	13.1	91.2	89.5	86.2	92.5	93.6	466.0	0.0	64.1	0.0	0.0	0.0	N/O
February	Average	N/O	0.5	41.4	86.1	9.1	70.6	34.5	242.1	0.0	64.2	1.2	0.0	0.0	N/O
	Maximum	N/O	12.9	89.9	89.4	84.9	93.2	93.1	463.5	0.0	66.4	69.6	0.0	0.0	N/O
March	Average	N/O	0.9	87.0	39.2	9.9	65.8	11.0	213.8	0.0	68.8	61.7	0.0	0.0	0.9
	Maximum	N/O	12.9	90.0	90.1	84.8	94.0	92.7	464.5	0.0	85.6	75.5	0.0	0.0	12.9
April	Average	N/O	1.1	23.0	88.3	3.5	51.3	12.7	180.1	20.7	94.1	72.3	0.0	0.0	N/O
	Maximum	N/O	13.0	91.3	90.2	87.2	94.8	94.3	470.9	115.8	132.6	74.3	0.0	0.0	N/O
May	Average	N/O	1.1	13.4	89.3	0.1	25.4	12.7	142.0	94.8	163.9	72.4	0.0	0.0	N/O
	Maximum	N/O	14.6	96.9	90.4	86.4	93.6	94.6	476.5	97.3	197.0	75.7	0.0	0.0	N/O

Facility		Admiral Well	Arkell Well #1	Arkell Well #6	Arkell Well #7	Arkell Well #8	Arkell Well #14	Arkell Well #15	Arkell Wellfield (#6,7,8,14,15)	Arkell -Recharge System	Arkell Springs Glen Collector System	Burke Well	Calico Well	Carter Wells	Clythe Well
Units		**L/s**	**L/s**	**L/s**	**L/s**	**L/s**	**L/s**	**L/s**	**L/s**	**L/s**	**L/s**	**L/s**	**L/s**	**L/s**	**L/s**
Regulatory Limit		**n/a**	**37.9**	**111.0**	**111.0**	**111.0**	**111.0**	**111.0**	**n/a**	**157.8**	**290.0**	**83.7**	**60.6**	**90.9**	**n/a**
June	Average	N/O	1.3	7.7	89.5	0.4	6.8	15.3	121.0	89.0	195.3	72.2	0.0	0.0	N/O
	Maximum	N/O	14.5	91.2	90.3	86.4	92.1	94.0	468.6	92.7	211.5	74.4	0.0	0.0	N/O
July	Average	N/O	12.6	82.5	4.5	7.5	27.6	17.4	152.2	84.7	193.0	71.5	0.0	15.4	N/O
	Maximum	N/O	14.3	92.3	91.0	86.1	91.5	93.3	468.5	89.0	208.8	75.2	0.0	75.8	N/O
August	Average	N/O	9.8	81.8	12.2	10.9	31.8	12.3	158.7	80.1	179.3	68.5	0.0	75.3	N/O
	Maximum	N/O	14.1	91.3	92.1	85.9	90.9	92.2	466.6	85.8	191.1	75.3	0.0	90.7	N/O
September	Average	N/O	0.8	65.2	61.8	15.4	31.1	0.0	174.3	48.3	146.7	73.9	0.0	79.3	N/O
	Maximum	N/O	19.6	91.4	91.4	85.5	88.7	0.0	376.7	85.6	177.6	75.2	0.0	92.2	N/O
October	Average	N/O	0.7	72.0	56.7	24.7	32.1	3.2	189.4	24.8	107.4	73.2	0.0	20.3	N/O
	Maximum	N/O	13.7	91.9	91.5	86.8	89.3	85.6	458.8	87.6	136.6	75.6	0.0	73.5	N/O
November	Average	N/O	0.4	58.5	69.4	37.1	40.5	11.1	217.0	0.0	85.7	73.7	0.0	0.0	N/O
	Maximum	N/O	13.5	91.7	92.5	88.9	88.4	87.1	462.0	0.0	102.3	75.3	0.0	0.0	N/O
December	Average	N/O	0.7	50.4	88.1	10.3	27.3	11.5	188.3	0.0	63.6	73.5	0.0	0.0	N/O
	Maximum	N/O	13.4	91.0	91.0	85.9	86.5	86.4	454.1	0.0	81.4	75.3	0.0	0.0	N/O

Table 44: Instantaneous Flow Summary, 2019 - Continued

	Facility	Dean Well	Downey Well	Edinburgh Well	Emma Well	Helmar Well	Membro Well	Paisley Well	Park Wells	Queensdale Well	Sacco Well	Smallfield Well	University Well	Water Street Well
	Units	L/s	L/s	L/s	L/s	L/s	L/s	L/s	L/s	L/s	L/s	L/s	L/s	L/s
	Regulatory Limit	39.9	90.9	n/a	40.9	37.9	105.0	42.0	127.2	60.6	n/a	n/a	57.3	59.0
January	Average	15.6	55.6	N/O	27.9	9.1	24.9	10.0	48.4	10.9	N/O	N/O	17.6	21.7
	Maximum	19.3	61.0	N/O	27.5	9.1	22.4	9.9	50.4	10.5	N/O	N/O	27.9	26.7
February	Average	15.6	53.8	N/O	30.4	12.9	30.2	10.0	60.5	13.0	N/O	N/O	16.2	21.9
	Maximum	19.3	61.6	N/O	37.5	14.0	0.0	10.0	111.3	17.6	N/O	N/O	28.6	25.5
March	Average	16.1	53.7	N/O	27.9	8.9	24.6	9.8	40.7	6.4	N/O	N/O	14.0	20.9
	Maximum	20.9	59.0	N/O	30.2	12.9	29.8	10.2	61.8	16.0	N/O	N/O	28.2	28.4
April	Average	16.3	53.5	N/O	28.9	8.7	26.9	4.7	36.9	0.0	N/O	N/O	19.2	21.9
	Maximum	20.0	55.7	N/O	31.1	15.6	28.8	10.3	62.3	0.0	N/O	N/O	28.6	26.9
May	Average	16.3	53.3	N/O	27.9	9.1	27.1	0.0	24.7	5.6	N/O	N/O	16.4	22.1
	Maximum	20.2	60.2	N/O	32.4	12.7	28.7	0.0	82.8	14.9	N/O	N/O	28.8	37.6
June	Average	15.6	52.6	N/O	28.1	8.5	26.6	3.8	21.5	9.5	N/O	N/O	19.0	18.1
	Maximum	20.1	54.9	N/O	32.5	12.7	27.2	10.1	119.5	12.7	N/O	N/O	28.5	31.3
July	Average	12.9	45.8	N/O	29.5	9.1	26.1	9.3	21.5	8.2	N/O	N/O	13.6	18.1
	Maximum	20.2	60.6	N/O	31.8	12.6	26.8	13.2	118.6	15.0	N/O	N/O	28.7	31.0
August	Average	15.1	44.0	N/O	29.5	7.6	25.6	11.2	21.8	0.0	N/O	N/O	15.9	17.8
	Maximum	29.1	60.1	N/O	31.3	13.2	26.9	13.2	117.7	0.0	N/O	N/O	29.0	29.2

Facility		Dean Well	Downey Well	Edinburgh Well	Emma Well	Helmar Well	Membro Well	Paisley Well	Park Wells	Queensdale Well	Sacco Well	Smallfield Well	University Well	Water Street Well
Units		L/s	L/s	L/s	L/s	L/s	L/s	L/s	L/s	L/s	L/s	L/s	L/s	L/s
Regulatory Limit		39.9	90.9	n/a	40.9	37.9	105.0	42.0	127.2	60.6	n/a	n/a	57.3	59.0
September	Average	15.9	36.3	N/O	25.5	8.7	25.3	12.2	26.4	0.0	N/O	N/O	15.7	21.3
	Maximum	19.0	59.5	N/O	32.1	11.8	25.4	13.0	118.2	0.0	N/O	N/O	28.8	24.7
October	Average	14.7	39.0	N/O	28.9	8.6	25.2	12.1	20.2	0.0	N/O	N/O	20.2	21.4
	Maximum	18.4	61.8	N/O	31.7	11.7	25.5	12.3	117.6	0.0	N/O	N/O	28.5	29.9
November	Average	14.4	37.9	N/O	29.9	8.3	25.3	12.1	9.6	1.7	N/O	N/O	15.9	21.0
	Maximum	27.5	56.6	N/O	32.1	11.8	25.7	12.9	118.8	30.6	N/O	N/O	27.7	25.5
December	Average	16.3	34.1	N/O	29.0	8.5	13.4	12.1	17.0	9.9	N/O	N/O	10.7	21.6
	Maximum	20.1	60.7	N/O	32.2	11.7	25.6	13.4	117.8	13.7	N/O	N/O	28.4	25.5

Appendix D: Treated Water Quality Statistics

O. Reg. 170/03 Schedule 23, 13-2b – "Three Year" Results Summary (Jan. 1 – Dec. 31, 2019)

Table 45: O. Reg. 170/03 Schedule 23, 13-2b - "Three Year" Results Summary

Parameter	ODWQS MAC mg/L	½ MAC mg/L	Total Samples	Samples Above MDL	# Above ODWQS Criteria	Min (mg/L)	Max (mg/L)	Average (mg/L)
Antimony	0.014	0.007	24	5	0	< 0.0001	0.00092	0.00065
Arsenic	0.025	0.0125	24	5	0	< 0.0002	0.0043	0.002
Barium	1.0	0.5	24	24	0	0.035	0.11	0.0672
Boron	5.0	2.5	24	24	0	0.014	0.043	0.028
Cadmium	0.005	0.0025	24	5	0	0.00009	0.00013	0.00011
Chromium	0.05	0.025	24	2	0	0.008	0.015	0.0079
Mercury	0.001	0.0005	12	0	0	< 0.0001	< 0.0001	n/a
Selenium	0.01	0.005	24	0	0	< 0.002	< 0.002	n/a
Uranium	0.02	0.01	24	22	0	< 0.00010	0.0017	0.00107

O. Reg. 170/03 Schedule 24, 13-4b – "Three Year" Results Summary (Jan. 1 – Dec. 31, 2019)

Table 46: O. Reg. 170/03 Schedule 24, 13-4b - "Three Year" Results Summary

Parameter	ODWQS MAC mg/L	½ MAC mg/L	Total Samples	Samples Above MDL	# Above ODWQS Criteria	Min (mg/L)	Max (mg/L)	Average (mg/L)
Alachlor	0.005	0.0025	12	0	0	< 0.0005	< 0.0005	n/a
Atrazine + N-dealkylated metabolites	0.005	0.0025	12	0	0	< 0.001	< 0.001	n/a
Azinphos-methyl	0.02	0.01	12	0	0	< 0.002	< 0.002	n/a
Benzene	0.005	0.0025	66	0	0	< 0.0001	< 0.0001	n/a
Benzo(a)pyrene	0.00001	0.000005	12	0	0	< 0.000005	< 0.000005	n/a
Bromoxynil	0.005	0.0025	12	0	0	< 0.0005	< 0.0005	n/a
Carbaryl	0.09	0.045	12	0	0	< 0.005	< 0.005	n/a
Carbofuran	0.09	0.045	12	0	0	< 0.005	< 0.005	n/a
Carbon Tetrachloride	0.005	0.0025	66	0	0	< 0.0001	< 0.0001	n/a
Chlorpyrifos	0.09	0.045	12	0	0	< 0.001	< 0.001	n/a
Diazinon	0.02	0.01	12	0	0	< 0.001	< 0.001	n/a

Parameter	ODWQS MAC mg/L	½ MAC mg/L	Total Samples	Samples Above MDL	# Above ODWQS Criteria	Min (mg/L)	Max (mg/L)	Average (mg/L)
Dicamba	0.12	0.06	12	0	0	< 0.001	< 0.001	n/a
1,2-Dichlorobenzene	0.2	0.1	66	0	0	< 0.0002	< 0.0002	n/a
1,4-Dichlorobenzene	0.005	0.0025	66	0	0	< 0.0002	< 0.0002	n/a
1,2-Dichloroethane	0.005	0.0025	66	0	0	< 0.0002	< 0.0002	n/a
1,1-Dichloroethylene	0.014	0.007	66	0	0	< 0.0001	< 0.0001	n/a
Dichloromethane	0.05	0.025	66	0	0	< 0.0005	< 0.0005	n/a
2,4-Dichlorophenol	0.9	0.45	12	0	0	< 0.00025	< 0.00025	n/a
2,4-Dichlorophenoxy-acetic acid (2,4-D)	0.1	0.05	12	0	0	< 0.0001	< 0.0001	n/a
Diclofop-methyl	0.009	0.0045	12	0	0	< 0.0009	< 0.0009	n/a
Dimethoate	0.02	0.01	12	0	0	< 0.0025	< 0.0025	n/a
Diquat	0.07	0.0035	12	0	0	< 0.007	< 0.007	n/a
Diuron	0.15	0.075	12	0	0	< 0.01	< 0.01	n/a
Glyphosate	0.28	0.14	12	0	0	< 0.01	< 0.01	n/a
Malathion	0.19	0.095	12	0	0	< 0.005	< 0.005	n/a

Parameter	ODWQS MAC mg/L	½ MAC mg/L	Total Samples	Samples Above MDL	# Above ODWQS Criteria	Min (mg/L)	Max (mg/L)	Average (mg/L)
2-Methyl-4-chlorophenoxyacetic acid	0.1	0.05	12	0	0	< 0.00012	< 0.00012	n/a
Metolachlor	0.05	0.025	12	0	0	< 0.0005	< 0.0005	n/a
Metribuzin	0.08	0.04	12	0	0	< 0.005	< 0.005	n/a
Chlorobenzene	0.08	0.04	66	0	0	< 0.0001	< 0.0001	n/a
Paraquat	0.01	0.005	12	0	0	< 0.001	< 0.001	n/a
Pentachlorophenol (PCP)	0.06	0.03	12	0	0	< 0.0005	< 0.0005	n/a
Phorate	0.002	0.001	12	0	0	< 0.0005	< 0.0005	n/a
Picloram	0.19	0.095	12	0	0	< 0.005	< 0.005	n/a
Polychlorinated Biphenyls (PCB)	0.003	0.0015	12	0	0	< 0.00005	< 0.00005	n/a
Prometryn	0.001	0.0005	12	0	0	< 0.00025	< 0.00025	n/a
Simazine	0.01	0.005	12	0	0	< 0.001	< 0.001	n/a
Terbufos	0.001	0.0005	12	0	0	< 0.0005	< 0.0005	n/a

Parameter	ODWQS MAC mg/L	½ MAC mg/L	Total Samples	Samples Above MDL	# Above ODWQS Criteria	Min (mg/L)	Max (mg/L)	Average (mg/L)
Tetrachloroethylene (PCE)	0.03	0.015	66	0	0	< 0.0001	< 0.0001	n/a
2,3,4,6-Tetrachlorophenol	0.1	0.05	12	0	0	< 0.0005	< 0.0005	n/a
Triallate	0.23	0.115	12	0	0	< 0.001	< 0.001	n/a
Trichloroethylene	0.005	0.0025	66	24	0	< 0.0001	0.00167	0.00046
2,4,6-Trichlorophenol	0.005	0.0025	12	0	0	< 0.0005	< 0.0005	n/a
Trifluralin	0.045	0.0225	12	0	0	< 0.001	< 0.001	n/a
Vinyl Chloride	0.002	0.001	66	0	0	< 0.0002	< 0.0002	n/a

Operational VOC Scan Results Summary (Jan. 1 – Dec. 31, 2019)

Table 47: Operational VOC Scan Results Summary

Parameter	ODWQS MAC mg/L	½ MAC mg/L	Total Samples	Samples Above MDL	# Above ODWQS Criteria	Min (mg/L)	Max (mg/L)	Average (mg/L)
1,1-Dichloroethane	n/a	n/a	135	0	n/a	< 0.0001	< 0.0001	n/a
1,1-Dichloroethylene	0.014	0.007	148	0	0	< 0.0001	< 0.0001	n/a
1,1,1-Trichloroethane	n/a	n/a	135	0	n/a	< 0.0001	< 0.0001	n/a
1,1,2-Trichloroethane	n/a	n/a	135	0	n/a	< 0.0002	< 0.0002	n/a
1,1,2,2-Tetrachloroethane	n/a	n/a	135	0	n/a	< 0.0001	< 0.0001	n/a
Ethylene Dibromide	n/a	n/a	135	0	n/a	< 0.0002	< 0.0002	n/a
1,2-Dichlorobenzene	0.2	0.1	148	0	0	< 0.0002	< 0.0002	n/a
Cis-1,2-Dichloroethylene	n/a	n/a	135	54	n/a	< 0.0001	0.00361	0.00162
Trans-1,2-Dichloroethylene	n/a	n/a	135	0	n/a	< 0.0001	< 0.0001	n/a

Parameter	ODWQS MAC mg/L	½ MAC mg/L	Total Samples	Samples Above MDL	# Above ODWQS Criteria	Min (mg/L)	Max (mg/L)	Average (mg/L)
1,2-Dichloropropane	n/a	n/a	135	0	n/a	< 0.0001	< 0.0001	n/a
1,3-Dichlorobenzene	n/a	n/a	135	0	n/a	< 0.0002	< 0.0002	n/a
1,4-Dichlorobenzene	0.005	0.0025	148	0	0	< 0.0002	< 0.0002	n/a
Acetone	n/a	n/a	135	0	n/a	< 0. 01	< 0. 01	n/a
Benzene	0.005	0.0025	148	0	0	< 0.0001	< 0.0001	n/a
Bromodichloromethane	0.1	0.05	135	47	0	< 0.0001	0.0103	0.00283
Bromoform	0.1	0.05	135	45	0	< 0.0002	0.00484	0.00119
Carbon Tetrachloride	0.005	0.0025	148	0	0	< 0.0001	< 0.0001	n/a
Chloroethane	n/a	n/a	135	0	n/a	< 0.0002	< 0.0002	n/a
Chloroform	0.1	0.05	135	65	0	< 0.0001	0.0143	0.00266
Dibromochloromethane	0.1	0.05	135	49	0	< 0.0002	0.0103	0.00328

Parameter	ODWQS MAC mg/L	½ MAC mg/L	Total Samples	Samples Above MDL	# Above ODWQS Criteria	Min (mg/L)	Max (mg/L)	Average (mg/L)
Dichloromethane	0.05	0.025	148	0	0	< 0.0005	< 0.0005	n/a
Ethylbenzene	0.0024	n/a	148	2	0	< 0.0001	< 0.00035	0.00029
Methyl Ethyl Ketone	n/a	n/a	135	0	n/a	< 0.0005	< 0.0005	n/a
Styrene	n/a	n/a	135	0	n/a	< 0.0002	< 0.0002	n/a
Tetrachloroethylene (PCE)	0.03	0.015	148	0	0	< 0.0001	< 0.0001	n/a
Tolulene	0.024	n/a	148	0	0	< 0.0002	< 0.0002	n/a
Trichloroethylene	0.005	0.0025	148	54	0	< 0.0001	0.00199	0.00063
Trichlorofluoromethane	n/a	n/a	135	0	0	< 0.0002	< 0.0002	n/a
Vinyl Chloride	n/a	n/a	148	0	0	< 0.0002	< 0.0002	n/a
o-Xylene	n/a	n/a	148	3	0	< 0.0001	0.00051	0.00033
m- + p- Xylene	n/a	n/a	148	3	0	< 0.0001	0.00144	0.00090

Parameter	ODWQS MAC mg/L	½ MAC mg/L	Total Samples	Samples Above MDL	# Above ODWQS Criteria	Min (mg/L)	Max (mg/L)	Average (mg/L)
Total Xylene	0.09	n/a	147	2	0	<0.0001	0.00195	0.00126
Trihalomethanes	0.100	n/a	135	58	0	< 0.0002	0.0365	0.00835

General Chemistry Results Summary (Jan. 1 – Dec. 31, 2019)

Table 48: General Chemistry Results Summary

Parameter	ODWQS MAC	ODWQS AO	ODWQS OG	Total Samples	Samples Above MDL	# Above Criteria	Min (mg/L)	Max (mg/L)	Average (mg/L)
Aluminum	n/a	n/a	0.1	14	0	0	< 0.005	< 0.005	n/a
Alkalinity (as $CaCO_3$)	n/a	n/a	30-500	12	12	0	250	330	286
Ammonia-N	n/a	n/a	n/a	12	2	n/a	< 0.05	0.18	0.16
Anion Sum	n/a	n/a	n/a	12	12	n/a	7.02[34]	16.1[24]	12.4[24]
Antimony	0.014	n/a	n/a	24	5	0	<0.0001	0.00092	0.00065

[34] Units in Milliequivalents Per Litre (mEq/L)

Parameter	ODWQS MAC	ODWQS AO	ODWQS OG	Total Samples	Samples Above MDL	# Above Criteria	Min (mg/L)	Max (mg/L)	Average (mg/L)
Arsenic	0.025	n/a	n/a	24	5	0	<0.001	0.002	0.0043
Barium	1.0	n/a	n/a	24	24	0	0.035	0.11	0.0672
Beryllium	n/a	n/a	n/a	23	0	n/a	<0.0005	<0.0005	n/a
Boron	5.0	n/a	n/a	24	24	0	0.014	0.043	0.028
Cadmium	0.005	n/a	n/a	24	5	0	0.00009	0.00013	0.00011
Calcium	n/a	n/a	n/a	23	23	n/a	90	160	120.9
Cation Sum	n/a	n/a	n/a	12	12	n/a	7.24[21]	16.1[21]	12.4[21]
Chloride	n/a	250	n/a	12	12	0	39	280	160
Chromium	0.05	n/a	n/a	24	2	0	0.0008	0.015	0.0079
Cobalt	n/a	n/a	n/a	23	12	n/a	<0.0005	0.0023	0.00145
Copper	n/a	1	n/a	23	11	0	< 0.001	0.2	0.0470
Dissolved Organic Carbon (DOC)	n/a	5	n/a	12	12	0	0.65	2.9	1.36
1,4 Dioxane	n/a	n/a	n/a	12	0	n/a	<0.0001	<0.0001	n/a
Hardness (Calculated as $CaCO_3$)	n/a	n/a	80-100	12	12	12	330	570	448

Parameter	ODWQS MAC	ODWQS AO	ODWQS OG	Total Samples	Samples Above MDL	# Above Criteria	Min (mg/L)	Max (mg/L)	Average (mg/L)
Ion Balance (% difference)	n/a	n/a	n/a	12	12	n/a	0.12[35]	3.13[25]	1.634[25]
Iron	n/a	0.3	n/a	24	6	6	< 0.005	1.8	0.56
Langalier's Index at 4°C	n/a	n/a	n/a	12	12	n/a	0.391[36]	0.894[26]	0.623[26]
Langalier's Index at 20°C	n/a	n/a	n/a	12	12	n/a	0.639[26]	1.14[26]	0.87[26]
Lead	0.01	n/a	n/a	23	2	0	0.00006	0.0014	0.00073
Magnesium	n/a	n/a	n/a	23	23	n/a	26	48	39.196
Manganese	n/a	0.05	n/a	24	19	0	0.0006	0.037	0.0088
Molybdenum	n/a	n/a	n/a	23	21	n/a	<0.0005	0.0039	0.00189
Nickel	n/a	n/a	n/a	23	21	n/a	<0.001	0.013	0.0056
o-Phosphate	n/a	n/a	n/a	12	0	n/a	<0.01	<0.01	n/a
pH	n/a	n/a	6.5-8.5	12	12	0	7.69	8.20	7.85

[35] Units in %

[36] Units in Langalier's Index

Parameter	ODWQS MAC	ODWQS AO	ODWQS OG	Total Samples	Samples Above MDL	# Above Criteria	Min (mg/L)	Max (mg/L)	Average (mg/L)
Phosphorus	n/a	n/a	n/a	22	0	n/a	<0.1	<0.1	n/a
Potassium	n/a	n/a	n/a	23	23	n/a	1.5	3.1	2.130
Saturation pH at 4°C	n/a	n/a	n/a	12	12	n/a	7.13	7.33	7.22
Saturation pH at 20°C	n/a	n/a	n/a	12	12	n/a	6.88	7.08	6.98
Selenium	0.01	n/a	n/a	24	1	0	<0.002	0.002	0.002
Silicon	n/a	n/a	n/a	14	14	n/a	3.7	8.8	5.2
Silver	n/a	n/a	n/a	23	0	n/a	<0.0001	<0.0001	n/a
Sodium	n/a	20 and 200	n/a	38	38	14	23	170	91
Strontium	n/a	n/a	n/a	23	23	n/a	0.178	5.2	2.657
Sulphate	n/a	550	n/a	12	12	0	43	220	102
Thallium	n/a	n/a	n/a	23	5	n/a	<0.00005	0.000068	0.000064
Titanium	n/a	n/a	n/a	23	0	n/a	<0.005	<0.005	n/a
Total Dissolved Solids	n/a	n/a	n/a	12	12	n/a	390	920	692
Uranium	0.02	n/a	n/a	24	22	0	<0.0001	0.0017	0.00107

Parameter	ODWQS MAC	ODWQS AO	ODWQS OG	Total Samples	Samples Above MDL	# Above Criteria	Min (mg/L)	Max (mg/L)	Average (mg/L)
Vanadium	n/a	n/a	n/a	23	0	n/a	<0.0005	<0.0005	n/a
Zinc	n/a	5	n/a	23	21	0	<0.005	0.15	0.0675

Appendix E: Legal and Other Requirements Table

Table 49: Legal and Other Updates that Could Affect the Drinking Water System or the Quality Management System, 2019

Date - 2019	Source	Title of Legal & Other Requirement Highlights of posting	Action and Status Update
Jan. 21	MECP Email	2015 Watermain Disinfection Procedure The first regulation proposal (ERO #013-1840) is being made under the Safe Drinking Water Act, 2002. A second proposal (ERO #013-1839) outlines proposed amendments to the 2015 Watermain Disinfection Procedure are due by January 24, 2019.	Email sent to the Supervisors of Distribution, Water Compliance Specialist, Manager of Operations and distribution staff.
Jan. 21	City of Guelph News Release	The City has received silver level recognition from the Alliance for Water Efficiency (AWE) for its water efficiency programs. Guelph is the first Canadian municipality to achieve such recognition.	No action required.
Feb. 1	MECP Email	The Ministry released the draft Terms of Reference: Determination of Minimum Treatment for Residential Drinking Water Systems using Subsurface Raw Water Supplies for comments. If adopted, this will replace the 2001 GUDI Terms of Reference document. Comments are due by April 3, 2019.	Email sent to Water Services Management team.

Feb. 19	Guelph Today.com	Schreiner to table Guelph drinking water protection as first-ever Green legislation in Ontario.	The news story was sent to Water Services Management.
Mar. 8	Gov't of Canada	Based on the latest science, Health Canada has updated the drinking water guideline to reduce the maximum acceptable concentration of lead from 0.01 mg/L, which was set in 1992, to 0.005 mg/L. The guideline was updated in collaboration with the provinces, territories and other federal departments.	Guideline sent to the Water Services Management team and the Water Supply Technician.
Mar. 22	Ontario News	Ontario Convening Leaders to Discuss Great Lakes, Water Protection.	No action required.
Apr. 2	City of Guelph News Release	The City of Guelph has won an Exemplary Source Water Protection Award from the American Water Works Association (AWWA). The City received this award for its excellent work to protect local water sources. The AWWA will present the award to the City at this year's AWWA Annual Conference and Exposition in Denver, Colorado in June.	No action required.
Apr. 5	ERO	The MECP is proposing to introduce amendments to the *Conservation Authorities Act*, which if passed, would help conservation authorities focus and deliver on their core mandate, and to improve governance.	Sent the EBR posting to the Source Water Protection Program Manager and Manager of Technical Services.

Apr. 25	Ontario News email	The government has released a discussion paper that outlines a more modern environmental assessment process, including immediate, short-term fixes to reduce burden and serve the interest of Ontario families and communities.	Email sent to Project Managers and Manager of Technical Services.
Apr. 29	Guelph.ca	The City has hired Neptune Technology Group Inc. to complete mandatory replacements of residential water meters in about 8,000 homes. Water meter replacements begin May 6, 2019.	No action required.
Apr. 29	Guelph.ca	The City has announced that Jennifer Rose is the new General Manager of Environmental Services, replacing Peter Busatto who is retiring after 35 years with the City.	No action required.
May 2	Ontario News email	Ontario is proposing to introduce changes that will make it safer and easier for more excess soil to be reused locally. This will be achieved through a new excess soil regulation and consequential amendments to O. Reg. 153/04 (Record of Site Condition Regulation) and Regulation 347 (General - Waste Management) under the Environmental Protection Act (EPA). Ontario is also introducing changes O. Reg. 153/04 under the EPA to clarify rules and remove unnecessary barriers to redevelopment and revitalization of historically contaminated lands.	Email sent to Water Compliance Specialist, Supervisor of Distribution, Distribution Technician and the Manager of Operations.
May 10	Health Canada	Health Canada has released the Guidelines for Canadian Drinking Water Quality: Guideline Technical Document – Manganese. The maximum acceptable concentration (MAC) for total manganese in drinking water is 0.12 mg/L (120 µg/L). The aesthetic objective (AO) for total manganese in drinking water is 0.02 mg/L (20 µg/L).	New guideline sent to the Management Team, the Water Compliance Specialist and the Water Supply Technician.

May 15	Guelph.ca	Security upgrades at Arkell Spring grounds begin May 20 The City is making security upgrades at the Arkell Spring grounds to enhance the protection of Guelph's drinking water source and to improve public safety.	No action required.
May 16	MECP	The Ministry of the Environment, Conservation and Parks has recently released an updated version of "Taking Care of Your Drinking Water": A Guide for Members of Municipal Councils".	Updated Guide was sent to Members of Guelph Council.
June 5	OMWA Newswire	'Lackadaisical,' 'Inefficient' Vaughan water services uncovered by city auditor 32 recommendations cite poor oversight, lack of accountability but city says water is safe.	Report sent to Management Team for information. Quality Management Specialist incorporated relevant recommendations as a Best Management Practice for Guelph Water Services.
June 5	Guelph.ca	Burke well upgrades improve water service to 13,000 homes City staff and council celebrated the opening of the upgraded Burke well house last week. The City made upgrades to remove iron and manganese from the water, and to improve service delivery and reliability of the 44-year-old well located on the north side of Arkell Road near Summerfield Drive.	No action required.

July 5	Guelph.ca	Sleeman Saves Over 5,000 Kegs Worth of Water a Day with Upgrades The Sleeman Brewery in Guelph is saving about 298,000 litres, or over 5,000 kegs worth of water every day, thanks to the results of a Water Smart Business audit from the City of Guelph.	No action required.
July 30	Guelph.ca	Dry conditions move outside water use level up to yellow The City is enforcing watering restrictions for level 1 yellow of the outside water use program because a sustained period of no steady rain and little relief is anticipated in the forecast ahead.	No action required.
Aug. 2	Guelph.ca	The City of Guelph is offering rebates to help property owners decommission (permanently remove and seal) unused, private water wells and septic systems on residential and agricultural lands in Guelph. Property owners can apply for rebates that would include $1,500 per private well (to a maximum of two per property) and $15,000 per septic system decommissioned.	No action required.
Aug. 23	TheRecord.com	New drinking water protections in place for Grand River watershed The updated Grand River Source Protection Plan was approved by Environment Minister Jeff Yurek on Aug. 16 and took effect that day.	No action required.

Sept. 20	ERO	The Ministry of Natural Resources and Forestry is proposing changes to the Aggregate Resources Act, which would strengthen protection of water resources by creating a more robust application process for existing operators that want to expand to extract aggregate within the water table, allowing for increased public engagement on applications that may impact water resources. This would allow municipalities and others to officially object to an application and provide the opportunity to have their concerns heard by the Local Planning Appeal Tribunal.	ERO posting sent to the Water Supply Program Manager, Manager of Technical Services and Hydrogeologist.
Sept. 23	Guelph.ca	The inspection and maintenance of the Arkell aqueduct, where 60 to 80 per cent of Guelph's water comes from, is underway.	No action required.
Oct. 1	Guelph.ca	City and Dolime Quarry owners reach proposal to protect Guelph's drinking water. Proposed solution would replace quarry with residential neighbourhood.	No action required.
Oct. 3	Wellington Advertiser	Puslinch Township is considering options to provide water and wastewater services to residents in Aberfoyle. One of the options is to connect to the Guelph Water System.	News article forwarded to top management for information.
Oct. 7	Guelph.ca	The City has initiated a Schedule B Municipal Class Environmental Assessment (EA) for Robertson booster pump station (Robertson station) upgrades. As part of the 2008 Water and Wastewater Servicing Master Plan, upgrades are required to bring the station to current standards and increase the pump's capacity in anticipation of future demands.	No action required.

Oct. 8	CBC	Dolime Quarry in Guelph may close early, become residential neighbourhood. The city says the quarry uses roughly 11 million litres of water on a daily basis. It says it would build a system to protect the groundwater from exposure to surface water contamination that could damage the aquitard.	No action required.
Oct. 24	Orangeville Today	Orangeville to explore water softener rebate to cut salt discharge into the Credit River.	News story forwarded to the Manager of Technical Services, Supervisor of Water Efficiency, Source Water Protection Program Manager and Coordinator.
Oct. 31	Ontario News email	Ontario taking action to protect the environment and hold polluters accountable Environmental violations where administrative monetary penalties may be used under the new proposal include illegal sewage discharges into waterways, selling pesticides without a permit, failing to have a certified operator when operating a drinking water system, or violating terms of a permit to take water.	News release sent to the GM Environmental Services, Manager of Operations, Manager of Technical Services and Water Compliance Specialist.
Oct. 31	Guelph.ca	Notice of study commencement: City of Guelph Municipal Class Environmental Assessment for the Water Supply Master Plan Update. The City of Guelph is updating the 2014 Water Supply Master Plan (WSMP) to review our municipal water supply sources and identify priorities, including sustainable water supply options from now until 2041.	No action required.

Nov. 7	ERO	This proposal is to renew Permit To Take Water No. 5142-AQ2L8Q for Victoria Park Village Inc. for dewatering purposes in Guelph, Ontario.	Link sent to the Manager of Technical Services, Water Supply Program Manager and Hydrogeologist.
Nov. 14	Canadian Council of Ministers of the Environ. email	Draft Canadian Groundwater Quality Guidelines for the Protection of Environmental and Human Health for 101 contaminants of concern are available for public review and comment until January 10, 2020.	Email forwarded by the Manager of Technical Services to the Water Compliance Specialist, Quality Management Specialist, Supervisor of Water Treatment, Water Supply Program Manager.
Dec. 4	ERO	Excess Soil Management Regulatory Proposal Ontario has finalized and is implementing new regulatory changes that will make it safer and easier for more excess soil to be reused locally and will reduce barriers to revitalize historically contaminated lands.	Link sent to the Supervisors of Distribution, Distribution Technician, Hydrogeologist and Water Compliance Specialist.
Dec. 9	ERO	Amendment to the Record of Site Condition (Brownfields) Regulation related to the Requirement to Sample Ground Water Ontario is proposing changes to *O. Reg. 153/04* that would provide flexibility for a qualified person (a licensed professional engineer or geoscientist) to exercise professional judgement regarding the need for ground water testing where there is no soil and under key conditions.	Link sent to the Manager of Technical Services, Hydrogeologist and Source Water Protection Program Manager.

Dec. 19	ERO	Final Decision: Ministry is holding polluters accountable by expanding the use of administrative monetary penalties for environmental contraventions.	Link sent to Management Team.
Dec. 20	MECP Email	Today, the Ministry of the Environment, Conservation and Parks released the Minister's Annual Report on Drinking Water 2019 and the 2018-2019 Chief Drinking Water Inspector Annual Report.	Report emailed to the Water Services Management Team.
Dec. 20	ERO	Amendments to the Wells Regulation to come in effect January 1, 2020.	Updates forwarded to Supervisor of Water Treatment, Hydrogeologist and Water Compliance Specialist.

Appendix F: Action Items from Management Review

Table 50: Action Items from the 2019 (Items 1-12) and 2020 (Items 13-17) Management Review Meetings

Item #	Status	Description
1	CIR #878 Closed: 2019-03-28	For the A&S Report: Include 2018 consumption data in Figure 4 when it is available.
2	CIR # 879 Closed: 2019-01-25	For the A&S Report: Consider well field permits for Arkell in Table 3 (as we often pump more than 66l/s).
3	CIR #880 Closed: 2019-01-25	For the A&S Report: For the Table 5, remove Logan and Speedvale should be Verney.
4	CIR #881 Closed: 2019-01-25	For the A&S Report: Add Calico work to the infrastructure section.
5	CIR #882 Closed: 2019-05-22	For the A&S Report: Review if we should add information describing that the water quality values may be an average and can depend on the location of the sample.
6	CIR #883	The procedure for documenting calls needs to be reviewed as a lot of calls aren't being logged properly.
7	CIR #884 Closed: 2019-01-25	For the A&S Report: Add Arkell 14 generator section to section n.
8	CIR #885 Closed: 2019-01-25	For the A&S Report: Add Emma and Water contact chamber projects to the infrastructure section.

Item #	Status	Description
9	CIR #886 Closed: 2019-11-22	For the A&S Report: Add Energy work being done in 2019 report (reported in 2020).
10	CIR #887 Closed: 2019-01-25	For the A&S Report: Confirm the backflow numbers are accurate.
11	CIR #888 Closed: 2019-01-25	Put the Water Efficiency Communications Strategy on EDMS.
12	CIR #889 Closed: 2019-01-25	For the A&S Report: Change the picture of the water wagon picture frame to one with people in it.
13	CIR #1089	Investigate using J-Plugs on the drop tubes in the production wells.
14	CIR #1090	Consider adding water loss data to the Annual and Summary Report for 2020.
15	CIR #1091	Perform additional analysis on the frozen services program, specifically the running tap program, and how it relates to water consumption and water production.
16	CIR #1092	Look at adding a line for performance testing to Table 6 for next year's annual report.
17	CIR #1093	Have the SCADA group provide C3 Water with copies of facility P&ID, PFD and equipment layout drawings so that the hydraulic model can be adjusted to take into account pipe friction factors within treatment facilities.

Appendix G: Status of Management Action Items Identified between Reviews

Action items identified through internal audits, external audits, emergency debriefs and root-cause analysis meetings are described below.

Table 51: Management Action Items Identified Between Management Review Meetings, 2019

Item #	Status	Description
1	CIR #895 Closed: 2019-05-22	Look at the minimum UVT value at Woods – is it really 93.5% or could it be lower? Verify the setpoints for UVT on SCADA.
2	CIR #894 Closed: 2019-07-25	Consider adding more of the "whys" to SOPs to link the relationships for example, the relationship between UV dosage, UVT, etc.
3	CIR #893	Consider prioritizing SOPs (for example all SOPs for disinfection get more attention). Consider adding a physical component to the review of Priority SOPs (i.e. go to the stations and see how the work is done).
4	CIR #892 Closed: 2019-11-28	Review with the Management Team the need for an annual SOP review. Could we review priority SOPs every year and go to a less frequent schedule for the other SOPs, WIs, Reference Documents?
5	CIR #891 Closed: 2019-05-22	Put the UVT values on the station tags and taped onto the UVT meter. (UVT value requirements have already been added to the logbooks and WaterTrax.)

Item #	Status	Description
6	CIR #890	Consider having more technical training for Operators from internal staff. For example, have the Hydrogeologist give a presentation on Membro and talks with the Ministry, etc. and the importance of the data that is being collected by Operators. Have the Water Compliance Specialist give training on compliance requirements for primary disinfection. Consider developing an annual training session on primary disinfection and how the Operator's duties relate to achieving primary disinfection. Include on-site manual operations in this training.
7	CIR #925 Closed: 2019-03-25	The well level low shutdown interlock for Queensdale is set too low.
8	CIR #942 Closed: 2019-05-22	In order to ensure that records are easily accessible and protected, consider adding the Reference Document: "Supply Maintenance Critical Equipment Inventory" to EDMS. Consideration could be given to combining the information from the draft "Standardized Equipment List" on what supplier is used to obtain each part listed in the RD. Consider removing the "available stock" section to a working document for inventory tracking.
9	CIR #941	With the implementation and increased use of WAM in both Maintenance and Distribution, consideration could be given to looking at increasing staff support to help with the implementation and development of the program for the whole department.
10	CIR #940 Closed: 2019-10-03	Consider reviewing the process for prioritizing SCADA Work Orders to include Operational staff in determining the priority.
11	CIR #939 Closed: 2019-05-22	Consideration should be given to determine the need for the date field on each training topic on the Operator On-the-Job training record as it is not being consistently recorded.

Item #	Status	Description
12	CIR #938 Closed: 2019-05-22	The training program for new Operators as identified in QMS 10-03 should include training on chemical receiving as it is a high risk activity from both a treatment perspective and a health and safety perspective.
13	CIR #937 Closed: 2019-07-19	In order to ensure that documents are properly stored and easily accessible, consider putting the Source Water Protection Risk Management Plans on EDMS. This will also help with version control.
14	CIR #936	Conduct an assessment (gap analysis) of the Emergency Plan to ensure that it is up-to-date and captures all of the potential emergencies that could impact Water Services.
15	CIR #935	In order to ensure that Water Services maintains a state of emergency preparedness at all times, consideration should be given to conducting an annual review and update (if necessary) of the Emergency Plan. This review schedule should be captured in the QMS 18 document of the Operational Plan. This is a best management practice as recommended by Emergency Management Ontario.
16	CIR #934 Closed: 2019-12-12	When the External Auditor arrives on site to perform the annual audit, past OFIs are reviewed to determine if they have been implemented or are on their way to implementation. If they have not, it generally leads to a non-conformance. As identified as an OFI in the 2017 Internal Audit and as an OFI in the 2018 External Audit, Meter Shop SOPs and WIs need to be finalized from draft form, properly stored in EDMS and reviewed by staff. The development of a formalized SOP for installation of backflow devices used at hydrants was also identified in the 2018 External Audit. This has yet to be completed.

Item #	Status	Description
17	CIR #933	If there is a deviation to an already approved construction plan, the changes to the plan need to be properly reviewed and approved by Water Services staff to ensure that risks are identified and monitored throughout the construction project. Consider developing a communication plan with Engineering so that Water Services staff are kept aware of the changes to plans. For example, on Starwood Drive, the location of the dig changed and contractors were digging dangerously close to a 12” watermain requiring an emergency response from a Distribution Operator.
18	CIR #932 Closed: 2019-11-28	Standardize a commissioning plan for all contractors to use. Detail out the procedure for disinfection and commissioning and what is required by the contractor. Include in this a requirement of tracking and/or measuring wasted water. This will ensure disinfection and commissioning consistency among contractors and will benefit Water Services staff to confirm that everything has been done properly.
19	CIR #931 Closed: 2019-07-25	A concern was expressed to determine if hydrants should be used to feed temporary watermains in reconstruction projects. If the drain holes in a hydrant aren’t sealed properly, and if there was a low pressure event causing a backflow/back-siphonage, it may be possible that contaminants (groundwater) could enter the distribution system from the drain holes in the hydrant. It is suggested that a review of using hydrants to supply water to temporary watermains is conducted to determine the risk to water quality.
20	CIR #930	Consider modifying the warranty checklist for new construction so that it includes locate verification of tracer wire. Currently a checklist exists for valves, hydrants, etc. The Locate department can perform Continuity Testing and sign off at the same time that Distribution Operators complete the warranty inspections on new infrastructure.

Item #	Status	Description
21	CIR #929 Closed: 2019-07-25	Consider upgrading the quality of service boxes specified (i.e. stainless steel) for new construction and service line maintenance. They will last longer and reduce maintenance requirements on broken infrastructure.
22	CIR #928 Closed: 2019-12-09	To ensure that customer service training for new administration employees is consistent amongst all employees and covers all pertinent work instructions and procedures, consider creating an on-the-job training checklist similar to what exists for Operators, Locators and Meter Installers, which is documented in QMS 10 - Competencies.
23	CIR #927 Closed: 2019-09-27	To improve communications between administration staff and other Water Services work areas, the "on-call" phone for each work area (Distribution, Meters and Locates) should assigned during normal business hours to ensure that someone can always be easily reached. This would also help with the facilitation of work requests, or general inquiries within the department. For example, the "treatment on-call" phone number is answered 24/7, so if someone from Water Services needs help from a Water Treatment Operator, they will be assured that they will always reach someone when they call that number regardless of who is on vacation, away at training, or out of the office.
24	CIR #1007 Closed: 2019-07-16	From the Emergency Evacuation Debrief: Investigate the possibility of having an emergency beacon somewhere on site.
25	CIR #1006 Closed: 2019-11-22	From the Emergency Evacuation Debrief: Add the org chart to the emergency binder and keep it updated.
26	CIR #1005 Closed: 2019-12-12	From the Emergency Evacuation Debrief: Determine what supplies and equipment are needed for the sheds. Put all required supplies and information in the sheds for Marshalling Areas A and B. Add a flashlight/chem line and safety vest to the box, or some other location.

Item #	Status	Description
27	CIR #1004 Closed: 2019-07-23	From the Emergency Evacuation Debrief: Add our safety and evacuation procedures to the Safety Meetings with contractors pre-construction. Provide them with a printed copy. Have a "safety minute" at ongoing meetings during construction. This will be added to the kick-off meeting agenda templates.
28	CIR #1003 Closed: 2019-12-12	From the Emergency Evacuation Debrief: Add transit information to the plan to get a bus to use as shelter.
29	CIR #999 Closed: 2019-12-12	From the Emergency Evacuation Debrief: Add TSSA, Spills Action, Owens Corning, Utilities, Outdoor School, Lyon's Pool contact information to the Emergency Evacuation (Fire) Plan.
30	CIR #1011 Closed: 2019-09-26	Verify each reservoir/tower's overflow elevation and communicate to the SCADA Specialist to update the iFix screens.
31	CIR #1009 Closed: 2019-05-27	Modify the T-RD Reservoir Cleaning Form to detail out a protocol for filling a reservoir/elevated tank to overflow.
32	CIR #1000 Closed: 2019-10-03	From the Emergency Evacuation Debrief: Add the process to transfer the phones to Extend to the Emergency Binders.
33	CIR #1036 Closed: 2019-07-25	Supervisor of Water Treatment needs to review the S-SOP Procedure for Returning Wells to Service with the Treatment Operators at a morning meeting.
34	CIR #1035 Closed: 2019-09-26	Add to the S-SOP Procedure for Returning Wells to Service a box to ensure that the sampling record has been updated to reflect when samples were taken when a well is being put back into service.

Item #	Status	Description
35	CIR #1034 Closed: 2019-09-26	Separate out the tasks in Section 7 of the S-SOP Procedure for Returning Wells to Service so each task has its own box and sign off.
36	CIR #1033 Closed: 2019-09-26	Add the Water Compliance Specialist to the S-SOP Procedure for Returning Wells to Service for final review and sign off.
37	CIR #1032 Closed: 2019-07-25	Look at eliminating reminder WaterTrax alerts, as there are WOs that are generated as well to remind operators to take samples.
38	CIR #1031 Closed: 2019-09-26	Explore other (better) software options to replace WaterTrax that has better solutions for sampling schedules, possibly alerts before we're out of compliance.
39	CIR #1029 Closed: 2019-09-26	Ensure that the WaterTrax response process is being followed consistently by reviewing the process and updating. Consider looking at the type of alert and what response that generates. Also, look at how many alerts are being received.
40	CIR #1028 Closed 2019-07-25	Separate the raw and treated samples onto their own Chains of Custodies.
41	CIR #1038 Closed: 2019-09-26	Add information to the Woods Generator SOP that details out the procedure if the generator is not working, is in fault mode, etc. as this is deemed an emergency and requires immediate response.
42	CIR #1041 Closed: 2019-09-26	Update the job planning form to include a new checkbox if there was a new valve installation or watermain re-route and that a Form 2 needs to be filled out.
43	CIR #1052	Work with the Health unit to come up with a communications plan for emergencies.

Item #	Status	Description
44	CIR #1051	Have an identified plan for setting up temporary water lines in an emergency. Work with customers so they have their own plans for these situations (may include having an emergency waterline setup inside their business).
45	CIR #1050	Identify the most critical mains in the system to ensure we are prepared if they fail.
46	CIR #1049 Closed: 2019-09-27	Have a meeting before major works like this to go over the plan, ensuring staff are trained in the plan, emergency contingencies, etc. and ensure that all appropriate staff are included from treatment, distribution, compliance, etc. Consideration should also be given to staffing (extra on-call staff) during the works.
47	CIR #1047 Closed: 2019-10-02	Review the M-SOP Incident Notification Procedure to determine if it will be used in incidents like the Silvercreek main breaks.
48	CIR #1046 Closed: 2019-11-27	Update after-hours contact information (home phone numbers, personal cell numbers) for all staff. Ensure that all management staff know where to find the information.
49	CIR #1045	Consider installing soft-starts on the Paisley ATL pumps
50	CIR #1044	Add to the SOP for Operating Zone 2 as a closed pressure system: Check that the DMAs are open prior to taking the Speedvale Tower offline.
51	CIR #1073	Sampling and monitoring processes were found to be effectively implemented. An opportunity exists to clarify the required sampling in the event of a category 2 watermain break, i.e.: - D-SOP Watermain Disinfection (Rev. 2019-11-08) - states 3 samples required - S-WI Category 2 Watermain Repair Sampling (Rev. 2018-07-24) - states 2 samples required. (See also OFI relating to document linkages.)

Item #	Status	Description
52	CIR #1071	Processes to record watermian breaks were found to be generally effective. An opportunity exists to review the use of multiple watermain break forms to track operator hours and materials. E.g. September 13-16, 2019 - Silvercreek.
53	CIR #1067	Consideration could be given to: 1) referencing EDMS Document numbers within controlled documents 2) clearly linking related documents (e.g. Operation Plan - element 12 reference to "Administration's instructions" - could specify "SD-104165 To Monitor and Close Calls in Access") 3) clearly indicating / highlighting details of most recent revision within controlled documents
54	CIR #1064	Customer complaint / response processes were found to be generally effective. An opportunity exists to ensure follow-up activities are promptly recorded in the Service Request (SR) database. E.g.: SR 10162 - September 19, 2019 SR 10183 - September 24, 2019
55	CIR #1063	The continual improvement process was found to be effectively implemented. An opportunity exists to expedite closure of Continual Improvement Reports (CIRs). At the time of the audit, there were more than 30 CIRs which have been open for more than one year.
56	CIR #1070 Closed: 2019-12-10	T-WI Treatment Chemical Delivery (Rev. October 3, 2019) "Receiving Sodium Hypochlorite at Woods Station from Flo-Chem...The Operator is to: - Confirm on the paperwork provided by the driver that the delivery is for 12% sodium hypochlorite. - CONFIRM THERE IS A CERTIFICATE OF ANALYSIS provided by the driver and verify that the lot numbers are the same; sign the lot number on the bill of lading. - Confirm the NSF Certification; sign the NSF indication on the bill of lading…" Processes to ensure the quality of essential supplies are not fully effective.

Item #	Status	Description
57	CIR #1069 Closed: 2019-12-10	An obsolete version of "Region of Waterloo and Area Municipalities - Design Guidelines and Supplemental Specifications for Municipal Services" was available for use by operators (Revision January 2017 - hardcopy binder); current version is January 2019 (updated annually).
58	CIR #1068 Closed: 2019-12-10	S-WI - Calibration / Verification of Colorimeters (rev. 2016-05-16) does not reflect current practices, e.g. references "Tested" sticker which is no longer used.
59	CIR #1066 Closed: 2019-12-10	Hand-held colorimeters in the stations have old green verification tags on them (from 2017). Recommend removing all old tags from all hand-held colorimeters.
60	CIR #1065	The Standby Power Generator Maintenance Log sheet was found to be out of date. The generator ranges were from 2012 and it was questioned what the ranges are for the new Burkes generator and the Downey generator was not listed.
61	CIR #1055	Update the D-WI Hydrant-Checking to include the WAM process.
62	CIR #1056	Complete the Draft Valve Truck Operation WI.
63	CIR #1053	Add a revision date to the Training Handbook. Add page # of page # as well.
64	CIR #1086	Add to the WS-SOP Procedure Creation, Update, Review that Technicians will check for edits required on the review sheets prior to uploading them to EDMS annually.
65	CIR #1083 Closed: 2019-12-10	Have an on-the-job training session during the next chlorine delivery (Wednesday Dec. 4, 2019).
66	CIR #1082 Closed: 2019-12-10	Post the chemical receiving reference document on the wall in the hypo receiving area.

Item #	Status	Description
67	CIR #1081 Closed: 2019-12-10	Separate the Chemical Receiving WI into a SOP and a posted reference document. Ensure the instructions are more clear and easier to follow. Paperwork will be handed into the supervisor for review and then to the technician for payment and filing. Add this to the WI.
68	CIR #1080 Closed: 2019-12-10	Add an Outlook appointment requirement to the QMS 05-04 Table of Essential Documents for the Design Specifications (Regional and City). Include in this the requirement for upload onto EDMS.
69	CIR #1078 Closed: 2019-11-29	Put Design Specifications in EDMS (maybe in a folio), filed by year and have the title page indicate that they are for projects for that year.
70	CIR #1077 Closed: 2019-12-10	Operators will use/reference the digital (online) copy of the Design Specifications and will dispose of the 2017 printed copy. There is no need to have a printed copy.
71	CIR #1076 Closed: 2019-12-10	The Revision Log that is located at the bottom of our procedures is not working. Transcription errors have been noted and there are times when the revision log is missed during updates. Recommend removing the revision log from the procedures as the log is kept on EDMS as part of the version control.
72	CIR #1075	Should the analyzer at Burkes and Clair Booster Station have a tag that outlines the alarm setpoints?
73	CIR #1074	The Turbidimeter Maintenance Kit at Burkes has expired calibration vials.

Appendix H: Summary of Staff Suggestions

Table 52: Suggestions Provided by Staff, 2019

Item #	Status	Description of Staff Suggestion
1	CIR #998 Closed: 2019-05-16	For the Procedure Review Form, add comments/edits provided (Y/N) and comments/edits incorporated (Y/N) columns.
2	CIR #960 Closed: 2019-07-19	Consider including more front line staff in the annual Risk Assessment process and rotate staff through the process.
3	CIR #961 Closed: 2019-07-19	Consideration should be given to adding the following risks to the annual Risk Assessment process for the Locate section: the risk of tracer wire not being installed, or not being installed properly; and incorrect or not updated GIS data.
4	CIR #962 Closed: 2019-05-22	The process to which the QMS rep is notified of changes to the drinking water system needs to be re-evaluated.
5	CIR #963	For the Operational Plan endorsement, create a "top risk background and synopsis" similar to what was created in 2019 to accompany the Risk Assessment element of the Operational Plan to help facilitate understanding amongst Councilors.
6	CIR #964 Closed: 2019-09-26	Compare the risks identified in the Water Supply Master Plan to ensure they are captured in the Risk Assessment.
7	CIR #965	Consider providing more computer training to Distribution Operators, such as: Excel, Outlook (including Calendar), GIS and WAM.

Item #	Status	Description of Staff Suggestion
8	CIR #966 Closed: 2019-07-31	There is a need to revisit the value of the printed map books for when the GIS is not accessible.
9	CIR #967 Closed: 2019-12-03	Consider establishing a centralized storage location in Distribution for all of the on-call required resources (laptop, map book, SOP binder, etc.).
10	CIR #968 Closed: 2019-09-26	Create a checklist of what should be included in the Distribution on-call bag so that Operators can quickly verify they have everything they need when they go on-call.
11	CIR #969 Closed: 2019-09-26	A request has been made for more consistently scheduled Distribution meetings to improve communication. Have the Leads from each work area in distribution provide updates on their programs and any issues or interesting events that are happening.
12	CIR #970 Closed: 2019-07-31	Consider getting Distribution Operators certified in Backflow Prevention, which would be helpful for new watermain construction projects.
13	CIR #971 Closed: 2019-07-31	During the new watermain construction season, consider allotting one Lead Hand and two Operators to the projects to ensure there is coverage for vacations. Consider a training program for all Distribution staff in New Construction.
14	CIR #972 Closed: 2019-07-31	Backflow prevention devices used at new construction sites are double check valves. It would be beneficial to consider upgrading the requirement to reduced pressure zones (RPZs) which are rated for high hazards.

Item #	Status	Description of Staff Suggestion
15	CIR #973 Closed: 2019-12-01	New Construction progress reports should be created and shared with Distribution staff at an appropriate frequency that allows for transition into the role when necessary (e.g. vacations, sick, etc.).
16	CIR #974 Closed: 2019-09-26	A post-construction meeting should be held to bring everyone up to speed on the new infrastructure, which will ensure that Operators know where the infrastructure is and can operate the system.
17	CIR #975 Closed: 2019-04-24	For the new construction process, tender drawings should be made available as early as possible in the process to ensure that maintenance of the system has been fully considered, for example ensuring there are enough valves and their placement to accommodate maintenance. Perhaps a pre-construction meeting to compliment the post-construction meeting.
18	CIR #976 Closed: 2019-07-25	Consider requiring locking-out access to super chlorinated water during the disinfection process on new watermains for health and safety and to prevent the failure of the disinfection process.
19	CIR #977	It would be helpful if there was a way to see customer history in one place and know which addresses must be kept off due to backflow non-compliance or meter non-compliances after hours. Further to this, consideration should be given to ensuring Distribution staff are notified that these turn-offs have happened and for health and safety reasons, a second Operator should attend if staff are responding to these calls.
20	CIR #978 Closed: 2019-09-26	Staff need clarification on how to track time in WAM dealing with investigations because this is not asset work.

Item #	Status	Description of Staff Suggestion
21	CIR #979 Closed: 2019-07-25	Engineering has identified that Water Services representation is important at monthly Engineering coordination meetings and project meetings. It was suggested that attendance be assured via a designate if the Supervisor or Lead Hand of new construction is not available. To help ensure required attendance, it is suggested that each project have an assigned Distribution Operator to attend the meetings.
22	CIR #980 Closed: 2019-11-28	Engineering has suggested that construction standards at Water Services mirror the same standards that Engineering has, when applicable. For example, the use of Denso tape to wrap valves.
23	CIR #981 Closed: 2019-09-26	In the summer months, it is very difficult for Locate staff to attend the monthly staff meetings due to the volume of work. It is suggested that the Supervisor review the meeting minutes with staff who are unable to attend the monthly meeting so that they are kept informed of what is happening at Water Services.
24	CIR #982 Closed: 2019-12-12	Basic water courses would be beneficial for Locators for them to understand the criticality of the infrastructure that they are locating.
25	CIR #983	Consider having Locators shadow a Distribution dig crew so that they can better understand how underground infrastructure is laid out.
26	CIR #984	It was suggested that there should be a requirement for tracer wire to be installed on sanitary and storm sewers. This could be captured in tenders.

Item #	Status	Description of Staff Suggestion
27	CIR #985 Closed: 2019-07-25	Consider sending the Lead Hand of Locates along with a Locator to the quarterly Ontario Regional Common Ground Alliance meetings, as they are very beneficial to share best management practices among municipalities.
28	CIR #986	Consider having locate vendors (e.g. Vivax) come in to give the Locators training in the field on our own infrastructure.
29	CIR #987 Closed: 2019-12-12	Locators would benefit from more computer training: EDMS, Outlook (including calendar), Excel and PowerPoint.
30	CIR #988 Closed: 2019-04-19	It was noted that the hydro database is very difficult to use. A suggestion was made to implement our own database for meters.
31	CIR #989 Closed: 2019-09-25	Look at increasing social media presence to further promote Source Water Protection.
32	CIR #990 Closed: 2019-07-19	Review the information that is being shared with the public at water wagon events around water supply and treatment to ensure that it is accurate with all of the recent changes.
33	CIR #991	It was suggested that Maintenance receive more training on specialized valves (e.g. pressure sustaining and pressure reducing), such as the training offered by Cla-Val.
34	CIR #992 Closed: 2019-07-25	Consider adding critical station valves to the PM Program, as currently only POE valves are included.
35	CIR #993 Closed: 2019-05-22	Consider cross-training tradespeople, for example: millwright and electricians cross-trained with instrumentation. Consider Instrumentation training and licencing for Maintenance Operators.

Item #	Status	Description of Staff Suggestion
36	CIR #943	Create "speaking notes" for the Customer Service Reps on typical customer inquiries (e.g. discoloured water, water with odour, curb stop maintenance, lead, etc.) so that messaging to the public is consistent and correct.
37	CIR #944	Consider more front-line training for Customer Service Clerks, specifically Dealing with Difficult Customers.
38	CIR #945	Emails from Administration that involve mainbreak investigations should also be accompanied by a phone call to ensure there is a timely response from Distribution Operators.
39	CIR #946	Communicate with Distribution staff the flat-fee charge for after-hours call-outs and include a list of all activities that would be charged back to the customer (i.e. turn offs, frozen meter, etc.). This should also be posted on the website along with the water rates for transparency.
40	CIR #947	Verify that Distribution Operators can still help Treatment Operators in an emergency based on the new drinking water system classifications and the different licences that the Operators have. For example, there are times (i.e. a SCADA outage) where Distribution staff are used to help take chlorine residuals at treatment facilities. Are there certain activities that a Distribution Operator could not perform at a treatment facility? Should Distribution staff obtain Treatment OIT licences for these situations? Is there a compliance risk if a Distribution only certified Operator is helping at a treatment facility?
41	CIR #948	The On-the-Job training forms, as documented in QMS 10 require updating to ensure that they are up-to-date and accurate and are being consistently used for new staff.

Item #	Status	Description of Staff Suggestion
42	CIR #949	Consider sending the Incident Report and Status Update Form to all Water Services staff during an incident (unless it contains personal information or is confidential) to promote staff awareness of issues/emergencies happening in the department and to promote learning of other work areas and processes.
43	CIR #950 Closed: 2019-05-24	Consider if all Operations staff should be included in the annual review of the critical SOPs for each work area to promote learning amongst all staff.
44	CIR #951	A suggestion was made to bring back the staff suggestion box so that people can make suggestions anonymously.
45	CIR #952 Closed: 2019-12-12	SOPs/WIs for Health and Safety should be kept in one place (i.e. EDMS folio) and the formal WS-SOP for creation and review of procedures should be used. This includes all relevant Corporate Health and Safety Policies and Procedures.
46	CIR #953	It would be beneficial for non-operational staff to participate in training to increase awareness of our facility and its functions. For example, basic treatment, primary vs. secondary disinfection, etc.
47	CIR #954 Closed: 2019-07-03	The current Contractor Evaluation Form is construction based. It would be very beneficial if there was a similar form that would be service based to properly evaluate consultants or other agencies providing services.
48	CIR #955 Closed: 2019-07-03	Consider having a designated alternate Risk Management Official (RMO), as appointed by the DCAO, to be available for Source Water Protection issues when the RMO is absent (holidays or other extended absences).

Item #	Status	Description of Staff Suggestion
49	CIR #956 Closed: 2019-07-31	Look into artificial recharge projects as part of the Water Supply Master Plan.
50	CIR #957 Closed: 2019-11-26	Consider a way to improve data management for water quality and environmental monitoring data.
51	CIR #958 Closed: 2019-07-23	Consider adding a training session for Distribution when facility upgrades change where distribution infrastructure is. For example: the new valves at Water and Emma since the contact chamber installation; and the new landscape at Burkes, as Distribution's current drawings are measured off of the old building. This could be added to the Project Management Project Map process.
52	CIR #959 Closed: 2019-07-03	It was suggested that Water Services consider purchasing a hydro-vac truck.
53	CIR #923 Closed: 2019-04-23	Now that Burkes Treatment System is up and running, we should consider draining and cleaning the Clair Tower to remove all manganese that has settled in the tower.
54	CIR #924	Now that Burkes Treatment Plant is up and running, consideration should be given to ensuring that watermain cleaning occurs in the Burke zone of influence in the distribution system this spring to remove any built up iron and manganese in the distribution system.
55	CIR #1087	It was recommended that a formal procedure be developed that outlines Operator's responsibilities when overseeing Contractors working on the drinking water system, specifically repairing watermain breaks.

Appendix I: Water Efficiency Program – 2019 Annual Progress Report

Background

The City of Guelph is a leader in water conservation and efficiency. As one of Canada's largest communities reliant on a finite groundwater supply for our drinking water needs, our ability to reclaim water and wastewater serving capacity through conservation initiatives offers numerous benefits to our community and local ecosystem.

Between 2006 and 2014, 9,520 cubic metres per average day of water and wastewater capacity was reclaimed due to the successful uptake of the City's 2009 Water Conservation and Efficiency Strategy. This reclaimed supply allowed the City to delay the need for over $41 million in additional water and wastewater infrastructure with an investment of approximately $11.3 million in water conservation programming, during that timeframe. Further, the reduction in water use across the city has resulted in a cumulative daily operational savings of over $625,000 per year in electricity and treatment chemical costs, creating a significant financial benefit to water rate payers, over the same period. As a result, the City's water and wastewater rates remain close to the median of Council-approved Ontario comparator municipalities responsible for the provision of water and wastewater services.

In July 2014, Guelph City Council endorsed an updated Water Supply Master Plan (WSMP). Water servicing capacity reclaimed through conservation and efficiency continued to be a top priority in achieving a sustainable and cost effective community water supply. The WSMP established a new reduction target of 9,147 cubic metres in average daily production by 2038 to guide the City's water efficiency programming.

In support of the new reduction target, staff initiated an update in 2015 to the 2009 Water Conservation and Efficiency Strategy, which was later approval by Guelph City Council in 2016. The 2016 Water Efficiency Strategy defines the programs, policies and resources that will help Guelph meet WSMP reduction targets.

The following sections provide an update of the water conservation and efficiency program activities and successes of the 2016 Water Efficiency Strategy for the period of January 1 to December 31, 2019. For more information on the City's Water Efficiency Program and individual program resources please visit guelph.ca/ourstoconserve.

Water Reduction Target Progress

Building off the data analysis completed for the 2014 Water Supply Master Plan, the 2016 Water Efficiency Strategy (WES) identified a ten-year water savings goal of 6,265 cubic metres per day between 2017 and 2026. The updated Strategy anticipates a considerable amount of supply capacity can be reclaimed through water loss management (i.e. Leak Detection and District Metered Areas) and efficiencies realized within the industrial, commercial and institutional sector.

Based on community uptake and participation in new and enhanced water efficiency programs, the total water savings achieved for 2019 was 658.5 cubic metres per day, surpassing this year's target set in the WES. Based on reductions in energy needed for water treatment and distribution, it is anticipated that 47.7 tonnes of greenhouse gas emissions and over $48,000 in electricity costs will be avoided through this year's water savings. Since the implementation of the 2016 WES, the cumulative water savings achieved to date is 1,105 cubic metres per day.

Figure 6 presents the anticipated volumetric production values as presented in the 2014 Water Supply Master Plan and the 2016 Water Efficiency Strategy. The City continues to experience a positive differential between projected and actual production values. Actual average daily production tracks below that expected through the Water Supply Master Plan. This is due, in part, to the successful implementation of the 2016 WES and 2009 Water Conservation and Efficiency Strategy Update.

Figure 6: Water Supply Master Plan (2014) and Water Efficiency Strategy (2016) Production Rates

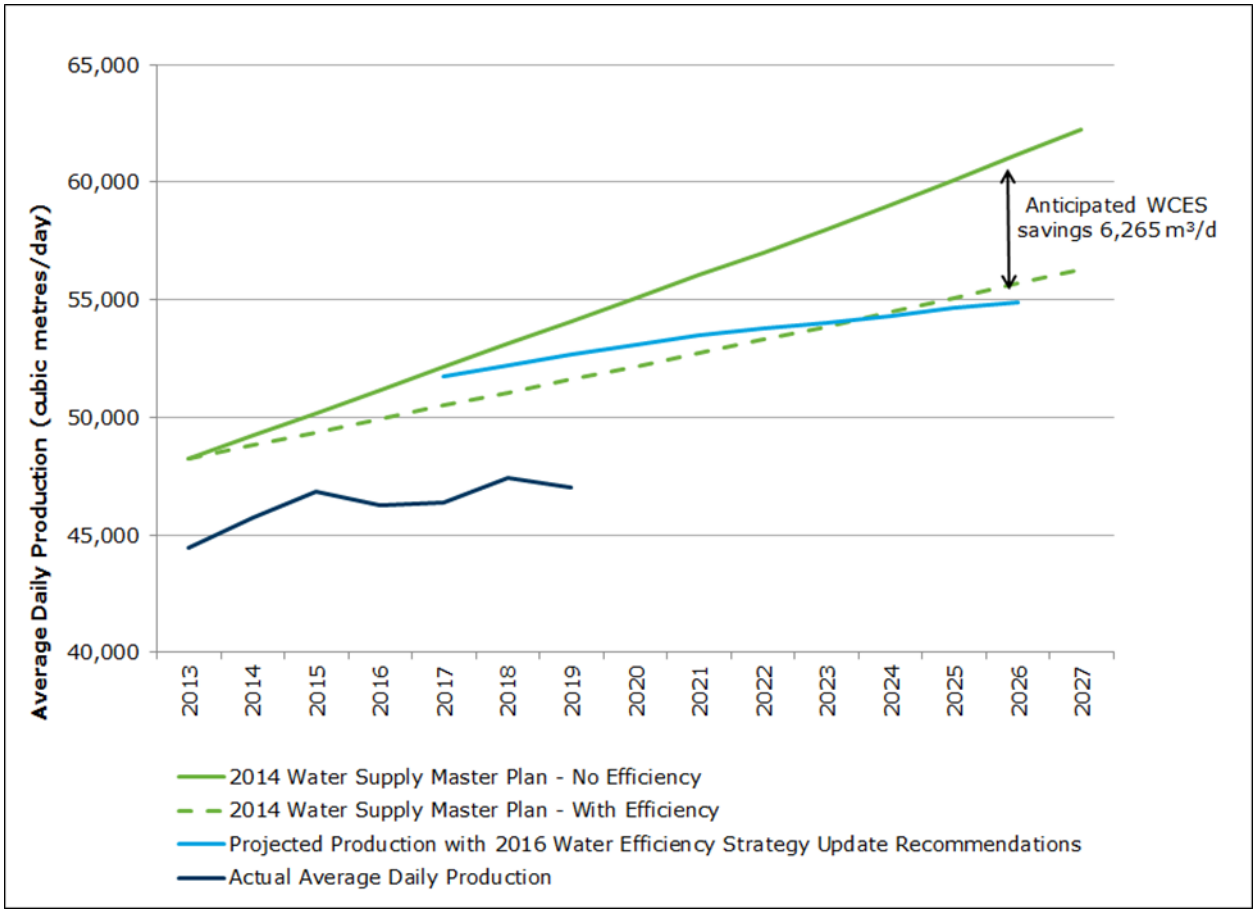
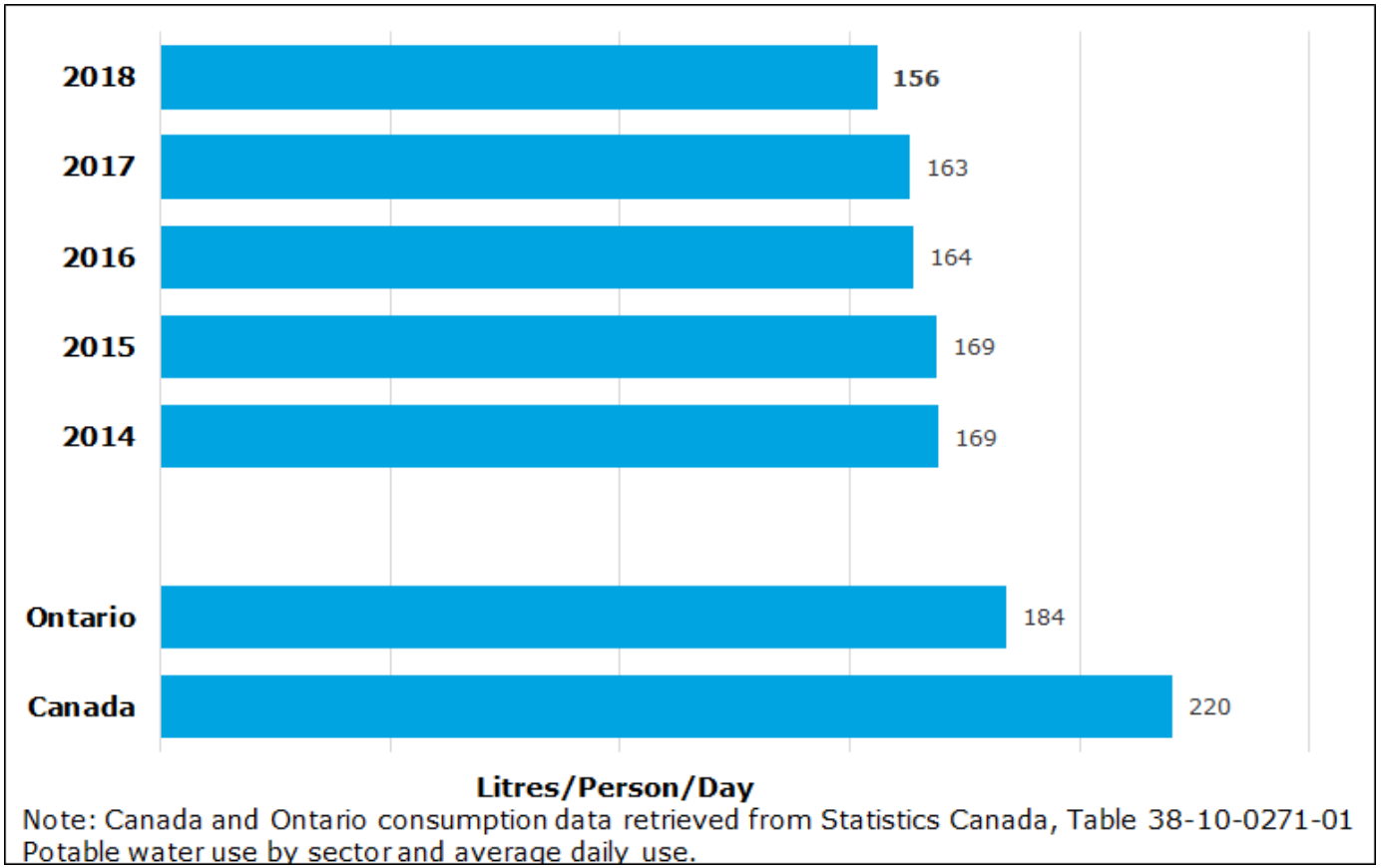


Figure 7 presents the City of Guelph's residential water use between 2014 and 2018, calculated using the volumetric consumption of water of all residential properties – low, medium and high density. During this period the City of Guelph's residential water use has been on a downwards trend, at an approximate rate of 3.25 litres per person per day annually. That is enough water to fill 66 Olympic swimming pools each year.

Average daily residential water use in Guelph continues to remain below the provincial and national averages. In 2018, the average water use was 156 litres per person per day, whereas the most recently published average for Ontario is 184 and Canada is 220 litres per person per day.

Figure 7: Residential Water Use



Note: Canada and Ontario consumption data retrieved from Statistics Canada, Table 38-10-0271-01 Potable water use by sector and average daily use.

The following sections outline the individual program successes for 2019, as identified in the 2016 WES.

Water Efficiency Incentive and Rebate Programs

During 2019, 984 rebate applications and audits were completed through the City's residential rebate programs. An additional 38 incentives for municipal and business upgrades were processed. For more information on the individual water efficiency programs available, visit guelph.ca/rebates.

Royal Flush Toilet Rebate Program

The Royal Flush Toilet Rebate Program offers households a $50 rebate per toilet (up to two toilets) when 6 litre per flush or higher flush volume toilets are replaced with a model using only 4.8 litres per flush or less. This program encourages residents to upgrade older homes to meet current building code standards and reduce their actual water use permanently through fixture exchanges. A total 668 toilet rebates were claimed in 2019, achieving an in-year water savings of 26 cubic metres per day. This meets the Strategy's 2019 goal for the program savings.

Residential Sub-Water Meter Rebate Program

Sub-water meters identify water leaks and high water-using behaviours, creating awareness of water use and potential cost savings for property owners (i.e. homeowners, landlords, property managers). Sub-water meters provide specific information on water use at properties and help in creating measurable conservation challenges and goals for property owners and tenants. This offers significant opportunities for motivating behaviour change since a knowledge gap often exists in regards to how much water residents actually use.

The Residential Sub-Water Meter Rebate program offers up to half the cost of a qualified meter to a maximum of $100 per sub-meter installed. In 2019 the program participation rates were low, seeing only four eligible applications. Of the participants, three were for multi-residential buildings and one for single family detached home.

Since January 2018, associated water savings for program participants is on average a 12 per cent reduction in total water use. These measured savings are in range with industry expectations (ten per cent) and significantly above the three per cent average savings witnessed in the program pilot. While program participation was down in through 2019, the

program has saved approximately 7.8 cubic metres per day. This is ahead of the five-year target of five cubic metres per day.

A robust and innovative approach to program promotion is scheduled for Spring 2020 to increase enrollment and meet program water-saving goals.

Water Use Home Visit and Audit Program

The home audit program provides a unique opportunity to engage Guelph residents one-on-one to understand water using behaviours and habits. These visits assist homeowners in verifying water use of fixtures and appliances and provide individualized feedback on tools, techniques and behaviour changes to become more water efficient in their home.

Since November 2013, eMERGE has made the Home Tune-up program available to Guelph residents. The Home Tune-up program is an innovative collaboration between eMERGE Guelph Sustainability, the City of Guelph and other local partners. This service offers a free one-hour home audit by trained advisors, a complimentary retrofit of common home water use fixtures (such as water efficient showerheads and faucet aerators), and toilet leak detection. Each participating household receives an Action Plan; a personalized electronic report that provides information and suggestions to help reduce home resource use. The action plan directs Home Tune-up participants to further resources and tools, including City programs, to assist with the implementation of recommended improvements.

In verifying the household water consumption data, homeowners who receive the visit have reduced their average water consumption by up to 10 per cent depending on the retrofit measures taken. To date, eMERGE home visits have engaged 1,659 households with a home audit since 2013.

The eMERGE Home Visit service engaged 109 single-family households and eight multi-residential buildings, comprised of a total 185 units in 2019, for a total 292 Home Tune-ups. The single-family homes achieved an average in-year household water savings of 4.73 cubic metres per day. This value is down from the 13 cubic metre per day goal outlined in the Strategy. However, this does not account for savings from multi-residential properties. As Home Tune-up's for multi-residential properties occurred later in the year, work is ongoing to determine water savings from these property types.

In 2020, staff will continue to promote the Home Tune-up program alongside Blue Built Home to boost both programs by feeding off each other's success.

Blue Built Home Water Efficiency Standards and Rebate Program

The Blue Built Home (BBH) Water Efficiency Standards and Rebate Program is a voluntary construction and retrofit standard designed to outperform the plumbing and water–using fixture requirements of the Ontario Building Code. The installation of water efficient technologies contributes to reduced water use in single-family detached homes and multi-residential properties. Residents with certified Blue Built Homes will save water and reduce utility bills by 15 to 62 per cent. From launch in 2010 until year-end 2017, 50 new homes were Blue Built Home certified in one of three tiers: 44 Bronze, 4 Silver and 2 Gold.

In 2018, Blue Built Home was updated and relaunched. Program changes included a transition to a single-tier program and certification and associated rebates were made available to existing, new homes and the multi-residential community. With these program modifications, eleven single-family homes (ten retrofit and one new build) were Blue Built Home certified within the year.

In 2019, six single-family homes (two new build and four retrofits) were Blue Built Home certified. Together these homes are saving 0.27 cubic metres per day or 97.8 cubic metres each year. However, significant water savings are achieved by an additional four new multi-residential buildings that were Blue Built Home certified as a pilot, which together save a total of 6.9 cubic metres per day. This makes the total water savings for Blue Built Home in 2019 7.17 cubic metres per day, more than triple our water savings goal for 2019.

In Q1 2020, it is planned that staff will officially launch the Blue Built Home program for new-build multi-residential properties and continue to pursue the significant savings associated with sustainable growth.

Multi-Residential Water Audit Program

The Multi-Residential Water Audit program offers a no-cost water audit of Guelph’s multi-residential apartment and condominium buildings completed by a third party consultant. The audit includes an assessment of the whole building’s water use and verification of specific water using processes, such and pools, central cooling and irrigation systems. A proportionate number of units of each building are audited to identify water saving opportunities across the remainder of the suites.

Building owners or property managers are provided a final report cataloguing all water using fixtures, appliances and processes with tailored recommendations to help reduce their water bill. Staff meet with property owners and/or condominium boards to review available

rebates to achieve the noted savings. In 2019, eligibility for the Multi-Residential Water Audit Program was updated to expand eligibility to properties using an average of 130 cubic metres or more per unit, per year.

This year, the Multi-Residential Water Audit Program had ten participants, an increase from three the previous year. The main findings from all audits performed in 2019 were as follows:

Leaks

- Detected in 90 per cent of buildings audited
- Accounted for 2.5 to 16.3 per cent of buildings' total water use
- 9,130 cubic metres of leaks detected collectively in 2019
- Estimate 25.0 cubic metres per day in water savings would result from implementation of audit recommendations

Water Savings Opportunities (including leaks)

- Account for 13.9 to 31.8 per cent of total building water use
- 22,258 cubic metres of water savings potential was identified across ten participating properties in 2019
- Estimate 61.0 cubic metres per day in water savings would result from implementation of audit recommendations

In order to calculate savings associated with the program, an annual assessment of consumption is completed, which requires data from the following year. With this in mind, the three program participants of 2018 achieved a verified water savings of 24.3 per cent, or 15.84 cubic metres per day. This significant savings may be attributable to "early adopters" and may not reflect the true average of all possible multi-residential building potential.

Staff have taken a conservative approach to estimating savings associated with 2019 program participants. Assuming a ten per cent decrease in water use (as per the WES), 29.4 cubic metres of water per day have been reclaimed through 2019 participation. This provides a combined water savings of 45.24 cubic metres per day since launch of the program in 2018, eight cubic metres more than the anticipate program goal to-date. The estimated savings will be confirmed and reflected in subsequent annual reports.

Water Smart Business Program

The Water Smart Business program offers support to local businesses toward completion of a detailed water efficiency review, and offers incentives for the completion of third-party

water audits and funding for capital retrofits that permanently reduce water demand. The audit benchmarks the water consumption of the businesses and provides a report with recommendations that include estimated payback on investment in upgrades. Once the business undertakes a recommendation that achieves water savings, the savings are then verified and an incentive is issued (where qualifications met).

In 2019, Water Smart Business program actively engaged seven program participants through either a water review, audit and/or capital project incentive. The following are the summarized results:

Leaks

- Detected in 29 per cent of businesses visited
- Accounted for 17.5 to 53.5 per cent of business' total water use
- 3,910 cubic metres of leaks detected collectively in 2019
- Estimate 10.2 cubic metres per day in water savings

Water Savings Opportunities (including leaks)

- Account for 6.9 to 25.3 per cent of total facility's water use
- 10,442 cubic metres of water savings potential was identified across seven participating businesses in 2019
- Estimate 28.6 cubic metres per day in water savings would result

One program participant in 2019 was incentivized through the Water Smart Business program for an ice-machine upgrade, which has resulted in 3.5 cubic metres per day of verified water savings through process upgrades.

Outside the formal scope of the Water Smart Business program, two additional program touch-points realized significant water savings associated with leaks for two industrial facilities in Guelph. These included:

- Sourcing a ten-year private side leak resulted in a 47.1 cubic metres per day in consumptive savings; and
- Cooling tower leak that, had it gone unresolved, would have resulted 4.98 cubic metres of water per day.

Further to that, staff hosted an event for local businesses in December to learn more about the Water Smart Business program. Water Smart for Guelph Restaurants and Hospitality Sector lunch-and-learn was hosted at a local restaurant. Twenty-one representatives spanning various hospitality businesses confirmed their attendance despite this busy time of year for the sector. Meetings with those who expressed interest but could not attend will be

held in Q1 2020 and indicate a high probability of sector interest in program participation through 2020.

Staff continue to consider enhancements to the program to entice businesses, including commercial plaza water users – a sector typically bulk-metered where by individual businesses within are not accountable for their water use directly. Since the launch of the Residential Sub-Water Meter Rebate program staff have received inquiries and requests related to sub-water metering primarily from the commercial sector. In 2019, staff commenced preliminary research to evaluate the water saving potential (if any) of this technology within this sector. Evaluation includes assessing municipal examples of similar programs, determining value for parties involved, participation and program costs to establish a business case for Guelph to pursue. This research will be completed by Q2 2020.

Overall, Water Smart Business program water savings since the 2016 Water Efficiency Strategy have resulted in 65.87 cubic metres per day; 15 per cent of the cumulative five-year program goal. Staff are committed to finding new and unique ways to see water saving projects come to fruition. In 2020, staff will be focusing efforts on key business and industry types in the community (i.e. food, beverage, hospitality and commercial plazas) where messaging can be tailored to increase program participation.

Cooling Tower Research

The 2016 Water Efficiency Strategy recommended City staff assess participation, cost and water savings associated with a cooling tower audit, conductivity censor and meter rebate pilot. A sample size of at least five buildings were recommended to be studied in order to verify savings and costs effectiveness of the program. The following sections describe research conducted in 2019 in support of program development:

The Water Efficiency Strategy includes a proposed multi-year budget of $120,000 CAD (2021 to 2026) to establish the parameters of a program as well as fund the completion of cooling tower audits and offer an incentive for upgrading.

Alliance for Water Efficiency Cooling Tower Research Project

In 2017, the Alliance for Water Efficiency (AWE) commenced a Cooling Tower Research project. The overall purpose of this study is to gain foundational knowledge needed to create an effective, targeted, and appealing incentive and outreach program to achieve greater efficiency in industrial cooling systems. As part of AWE’s broader effort to explore

the potential for water conservation in urban areas, the research effort is intended to have multiple phases.

Phase I has five broad goals:

- Develop best practices for identifying water-cooled facilities in urban areas.
- Develop best practices for estimating consumptive and non-consumptive water demands for cooling.
- Determine the conservation potential for improvements to traditional cooling technologies, such as cooling towers.
- Determine the conservation potential of alternative cooling technologies.
- Develop practical guides to increase understanding of cooling technologies.

Thirteen municipalities and utilities from across North America have signed on including Denver Water, Southern Nevada Water Authority and San Antonio Water System in this multi-tasked project.

In 2019, initial data collection was completed and modelling commenced to develop best practices for identifying water cooled facilities in urban centres. This research component is intended to be available for the municipal and utility project team to test in early 2020.

The results of this research will provide the framework for the proposed cooling tower audit and rebate program. While the timeline has been accelerated from that outlined in the WES, the City's total investment of $28,000 in this leading North American research project will provide a well-researched, value-for-dollar scope for local programming (a total project budget of $530,000CAD; $400,000USD). Due to issues in sourcing a research facility to complete the work, this project is now scheduled for completion in early 2021 in line with the WES update and timing for recommended program roll-out.

Legionella

Further to the research being completed through the Alliance for Water Efficiency, industry-leading technical associations and working groups are beginning to explore the implications of properly managed cooling towers, reuse and concerns around public health related to stagnant heated water. As such, staff commenced preliminary research related to the effects of cooling tower water efficiency, specifically water age and quality, in industrial, commercial and institutional buildings. These two things can be contributing factors that lead to micro bacterial growth with one of those being Legionella.

Staff attended the National Legionella Conference (United States of America) to provide a clearer definition of the municipal role in managing for Legionella bacteria, the relationship

between water efficiency and legionella, and any potential nexuses that exists. Through the update to the Water Efficiency Strategy commencing in 2021, a larger evaluation will need to be considered related to water reuse in cooling towers to ensure program recommendations appropriately evaluate risk and protect public health.

Municipal Facility Water Efficiency

In support of the Water Efficiency Strategy, the City continues to lead by example with water efficiency within its own facilities. Recreation centre and facility managers and maintainers participated with staff in seven water use reviews, audits and capital infrastructure upgrades to improve the efficiency of their buildings.

In 2019, the River Run Centre, Guelph Farmer's Market, John McCrae House and the Civic Museum each completed a water review with program staff. In support of facility upgrades completed by Parks and Recreation and Corporate Energy program staff completed two additional water-using process reviews: Norm Jary Splash Pad and West End Recreation Centre. Lastly, a third-party engineering consulting firm was hired to complete a water audit of the Sleeman Centre. The following are the cumulative results:

Leaks

- Detected in 50 per cent of municipal facilities visited
- Accounted for 7.1 to 11.1 per cent of buildings' total water use
- 1,167 cubic metres of leaks detected collectively in 2019
- Estimate 3.1 cubic metres per day in water savings

Water Savings Opportunities (including leaks):

- Account for 6.1 to 60.1 of total facilities water use
- 7,553.7 cubic metres of water savings potential per year was identified across seven municipal locations
- Estimate 65.69 cubic metres per day in water savings would result if audit recommendations were implemented.

In 2019, 46.22 cubic metres per day of verified water savings through process upgrades were achieved across four of the municipal facilities and locations. 2019's municipal water efficiency upgrades were:

- Norm Jary Splash Pad recirculation system
- West End Recreation Centre pool heat recovery system
- River Run Centre toilet and faucet aerator upgrades
- Guelph Farmer's Market faucet aerator installation.

These upgrades have exceeded the annual program savings goal for 2019, and the program is on track to exceed the five-year goal.

Leak Detection Program

The City's leak detection program started in the spring of 2011 and aims to reduce the amount of water lost between the point of treatment and delivery to customers. The 2019 Leak Detection Program included sounding and correlation of all 342 kilometers of metallic watermains within the City's distribution system. In total, 33 possible leaks were identified through this survey, including 14 main breaks and the rest consisting of hydrant, service, or valve repair/replacements, or no leaks were found. The average daily volume of servicing capacity reclaimed through the location and remediation of these leaks equate to approximately 534 cubic metres per day, enough to fill almost 78 Olympic swimming pools in 2019. The water loss management program savings goal for the year was exceeded.

It is anticipated that further recoveries in reclaimed treated water lost to the distribution system will be achieved with the continued optimization of the City's district metered areas (DMAs). The objective of the DMA program is enhance operational understanding of water demand patterns and to recognize water demand changes early to address non-revenue water loss in the water distribution system. In recognition of benefits offered through continuous water demand monitoring as proactive water loss management, staff will be continuing to refine the DMAs and develop associated trend analysis tools through 2020.

Peak Season Water Demand Management

Reduction of peak season (summer) water demand continues to be a primary objective of the City's water efficiency programming. The ability to reduce or minimize variations in seasonal water use limits the impact on our finite groundwater supply during times of environmental stress and creates operational efficiencies by reducing capital and operational investment to service our community for only a few days a year.

Outside Water Use Program

Since 2002, the City's Outside Water Use Program (OWUP) has helped to manage peak season (summer) water use through regulatory controls with complementary programs, such as Healthy Landscapes, working to proactively manage potential peak demands by assisting residents and local businesses in establishing low outdoor water use environments. The following activities were completed as part of this program in 2019.

There was limited precipitation in June and July of 2019. Even with the large rain event on July 17, precipitation was 60 per cent of 30 year precipitation average for the month. Because of this sustained dry spell, the Outside Water Use Program moved to Level 1 (Yellow) on July 29. The remainder of the summer was dry, however conditions improved into the fall season, which finished the season in Level 0 (Blue) on October 2.

Rain barrels offer homeowners the benefit of capturing free volumes of water for outside use but also assist in managing stormwater impacts on private property. This year's annual rain barrel truckload sale was held at Water Services' open house in May and yielded the sale of 950 rain barrels – the largest number of rain barrels sold during any of the previous years. This year's sale was in partnership with Stormwater Engineering. The Engineering department through the Stormwater utility subsidized the cost of the barrels and the first 850 barrels were sold to residents for $10.

Please visit the City of Guelph Webpage for more information on the Outside Water Use Program.

Healthy Landscapes

The Healthy Landscapes Program continues to offer various public resources to proactively manage peak season demand.

The annual Healthy Landscapes Workshops and Seminar Series featured numerous free talks on time–of–year appropriate outdoor water conservation topics including water efficient landscape design, plant selection, and proactive maintenance best practices to manage the impact of drought and common turf pests. It is estimated over 500 Guelph residents took part in this Workshop and Seminar series. Further, 100 individuals participated in the annual four-part Landscape Design Course.

Healthy Landscapes visits continue to be a popular resource, with 300 complimentary one hour visits completed by trained staff this year. This service offers a complementary site-based consultation aiming to educate residents on garden design and maintenance practices to significantly curb outdoor water demand at their home.

Healthy Landscapes visits continued to add the Blue Built Home Landscape Visit to the programming. Homeowners sign up for this specialized visit to complete one of three qualifying water saving options to become Blue Built Home certified. Twenty Healthy Landscape visits of this type were completed in 2019.

In 2019, Healthy Landscapes also collaborated with the Stormwater Engineering to pilot a Residential Rain Garden Rebate program. Two workshops were organized that required participants to attend to be a part of the program. A total of 50 participants attended the workshops. Through the workshop, 30 residents were prequalified for the pilot program and given a rain garden visit with a professional landscape consultant. With this site visit, a resident could determine how best to install his or her own rain garden. Once the rain garden was completed and a final verification visit was given, a one-time rebate from the City was awarded. Out of these 30 residents, 16 completed the installation of a rain garden and received their rebates. This resulted in:

- a combined capacity of over 39,800L of stormwater captured with an average rain gardens capacity of approximately 2,490L;
- the potential garden and lawn watering offset typically relied on for municipal supply;
- over $13,800 in rebates provided with an average rebate of $867.

In anticipation for the program to be offered again in 2020, there are 71 residents on a contact list. It is anticipated for the program to be offered again in 2020.

Visit the City of Guelph webpage for more information on the Healthy Landscapes Program.

Peak Season Water Demand Research

Staff continue to pursue collaborative research opportunities where resources can be leveraged to garner greater products. This year, staff collaborated in a project with the University of Guelph to find alternative plants to use as groundcover to traditional grass seed and sod. This three-year research project will evaluate alternative groundcovers and varieties of turf grass to determine their water use requirements and suitability for use in local urban residential lawn areas. The first season (2019) of research results were inconclusive due to weed encroachment, low germination rate of some species, and a rain-out shelter was not constructed in time for the growing season. These issues will be addressed moving forward, data collected and reported to inform future peak season demand programming for Guelph. This research project will be ongoing until 2022.

Youth and Public Outreach and Education Programming

Education is a fundamentally important tool to engage and motivate action. The commitment to increasing local water literacy is a complimentary piece to changing toilets, or completing water audits, or installing water meters, to ensure the wise use of the resource. Staff continue to offer a variety of very successful programs to increase awareness, influence people’s attitudes and habits regarding water use, and inform public

on how the City invests their rate dollars. Investment in Guelph's water future includes education and outreach programming.

Curriculum-Linked Education Programming

The City's curriculum-based Grade 2 and Grade 8 in-class, water conservation programming continues to be a popular resource for local educators in both the Upper Grand District School Board and the Wellington Catholic District School Board. In 2019, staff provided 70 interactive school presentations to 1,459 students. Since the inception of this in-class, curriculum-linked program eight years ago, the City has provided a total of 411 school presentations to over 14,620 students.

In addition to in-class presentations, Water Services hosted 32 classes and over 690 students and teachers to tour the F.M. Woods Water Treatment Plant in 2019.

H2Awesome

After a one-year break, this award-winning water event for Guelph's Grade 8 students reconvened in 2019. This curriculum-based learning event hosted in partnership with the local school boards is an opportunity to celebrate water, encourage conservation of the resource, and provide focus to the importance of water in our daily lives.

The 2019 event saw H2Awesome take place in 2 phases. Phase 1 took place on April 30, gathering approximately 570 students and teachers to War Memorial Hall on the University of Guelph campus. The event was co-hosted by two students representing both the Catholic and Public School Boards. Local Anishinaabe Metis, Jan Sherman, opened and closed the event with a traditional aboriginal acknowledgement, followed by keynote speakers Emily De Sousa, marine conservation educator, and The Water Brothers, Tyler and Alex Mifflin.

Phase 2 of H2Awesome included a half-day workshop hosted in their schools from May 1 through May 15, for each of the 222 classes registered for the event. Workshops were designed for grade 8 students and were participatory activities linked to water through art, science and technology.

Splitting this event into separate phases was a departure from past H2Awesome events typically held over the course of a single school day at one venue. The planning committee felt that the logistics and delivery of the water conservation and protection message was well suited to this approach. The event received positive feedback from participating teachers.

Planning has begun for H2Awesome in 2020, and will look to use the same format.

Planet Protectors

Since 2016, Water Services has partnered with Engineering and Transportation Services and the Office of Climate Change to offer a curriculum-focused, interactive and activity-based online program called Planet Protectors. This program helps students understand the basics of climate change, the impact of our actions, as well as the importance of energy and water conservation, and transportation choices. Through 'missions', Planet Protectors solicits personal commitments from students and encourages sharing them with their family members - commitments such as shortening shower time.

The 2018/19 school-year witnessed a reduction in participation, however still saw the program utilized in 26 classrooms, reaching 566 students in both the Upper Grand District School Board and the Wellington Catholic District School Board.

As program use stagnates it will be prudent to determine whether the program offers the best value per dollar spent. At this time other educational program offerings have not demonstrated additional value or capacity above and beyond what Planet Protectors Academy offers. Staff continue to evaluate value for dollar.

In 2019 Planet Protectors created H2Whoa, a four part program focusing solely on water – decoupling water content from the broader program offering. Water Services will continue their relationship with the Planet Protectors through the H2Whoa program in 2019/2020 school year, with the intent of monitoring appetite and delivery of the new, water focused material.

Other Outreach and Engagement Programming

H2O Go Festival

2019 H2O Go Festival (hosted by the City) celebrated its seventh year of programming. This Festival is a community celebration of water, hosting a variety of educational and interactive displays aimed at connecting audiences of all ages with water. The Festival runs in tandem with the eMERGE Guelph EcoMarket – a sustainability expo.

This year's H2O Go hosted nine organizations, collaborating with local not-for-profits, businesses and institutions. Hosted at the Old Quebec Street Shoppes, attendance has continued to grow each year. This year's event attracted over 3,000 participants of all ages (800 more than the year prior).

Coordinated planning for the 2020 event has begun with the event to take place at the Old Quebec Street Shoppes in downtown Guelph on Saturday, March 21, 2020.

Waterloo Wellington Children's Groundwater Festival

Celebrating its 24th year, the long-standing Waterloo Wellington Children's Groundwater Festival was held from May 24 to May 30 in 2019. Water Services is proud to be an ongoing partner, sponsor, contributor and organizer of the Festival. In 2019, the Festival engaged 4,898 students Grades 2 through 5 from the City of Guelph, Wellington County, and the Region of Waterloo. Upwards of 900 students participate from Guelph on an annual basis.

Since 1996, over 95,000 students have participated in the Festival, which features fun and interactive activities designed to inform students of the importance of water protection and conservation in their daily lives. In partnership with Guelph's school boards, staff have worked to increase local awareness and participation in this Festival annually.

Outreach to New Canadians in Guelph

To build trust in governments' management of drinking water amongst new Canadians and introduce new Guelph residents to the City's unique water supply and constraints, continued public education programming is encouraged within the community.

Two Linamar facilities implemented an initiative to reduce the amount of disposable plastic water bottles purchased and used by their staff in 2019. Reducing plastic water bottle use minimizes Linamar's environmental impact and promotes a safe and clean working environment by eliminating workstation clutter within the plants due to empty, or partially empty, plastic bottle accumulation. Linamar approached Water Services about providing an educational presentation about Guelph's water to support this project. Linamar staff demographics are highly multicultural and are largely comprised of new community members to Canada and Guelph. Linamar believed this educational component would be a key to the success of their project.

The two locations installed additional water fountains to improve accessibility to tap water and provided each staff member with their own reusable, stainless-steel water bottle. To enhance the initiative's success, Water Services gave a 15-minute presentation to all staff members at participating facilities on Guelph's water supply during their monthly staff meetings. Presentation content included the role of Water Services in the community and our drinking water's source, treatment, safety, and quality. In total, 840 staff members received the presentation.

Our tap water presentation built confidence in our tap water's safety and quality and was an important component in the success of Linamar's initiative. There is significant potential for this initiative to have spillover effects into the personal lives of Linamar's staff. Ideally, Linamar staff will confidently choose to drink tap over bottled water at home as well as at work, and encourage family members and friends to do so.

Water-Energy Nexus Research

Collectively, Water and Wastewater utilities (i.e. treatment and conveyance) are among the largest energy consumers by sector in Ontario. Water requires energy intensive treatment and pumping to maintain a reliable water supply while protecting public health and the environment. Consequently, water conservation and efficiency presents significant energy saving opportunities. Furthermore, the cost to expand water and energy infrastructure emphasizes that conservation and efficiency are among the most cost effective sources of water and energy. As electricity costs continue to rise and population growth increases water resource demands, conservation is important for Ontario municipalities to limit the increasing cost to produce safe clean drinking water and meet energy needs in a time when climate resilience is required. The water-energy nexus offers new opportunities to save water, energy and money through reduced infrastructure costs, greenhouse gas emissions, and operational and maintenance costs.

In 2019, Water Services began to apply the water-energy nexus concept to communicate associated water, energy and cost savings as identified in the Water Efficiency Strategy. The intent in doing so could lead to further decreases in water use.

Further to this, staff commenced the practical assessment of renewable energy applications to the infrastructure related to pumping, treating and distributing water, in alignment with the City's Community Energy Initiative. Renewable energy applications for water infrastructure are rapidly evolving and have the potential to reduce the water sector's dependency on fossil fuel–based electricity use.

As a continuation from the 2018 work, Water Services continued to assess energy optimization opportunities within the drinking water system. In doing so, this information informs budget forecasting, proposed water rate changes, and to assess the efficacy of water conservation and efficiency programs. The Water Efficiency Strategy challenges staff to evaluate opportunities to strategically implement technologies to maximize the use of available water supply. Staff currently utilize a suite of tools such as water audits, acoustic leak detection and district metered areas to recover water losses. Water loss management is known to be a highly cost effective water conservation and efficiency measure for

municipalities as they defer the associated costs of water infrastructure expansion. This evaluation is anticipated to continue through the 2020 Water Supply Mater Plan update process.

Guelph Water Wagon

In support of the City's 2009 Public Promotion Action Plan for City Drinking Water Consumption, the Guelph Water Wagon has been providing tap water to attendees of large, outdoor community events during the summer months for seven years. The Water Wagon provides access to tap water where water fountains or taps are not readily available. Continually growing in demand year-after-year, the Water Wagon attended 33 events in 2019 and provided 22,332 litres of water to event attendees. The Water Wagon continues to provide staff an excellent opportunity to engage with the public. Staff engage with Guelph residents about:

- the value of Guelph's water;
- the need for water conservation and source protection;
- questions and concerns regarding municipal tap water;
- Water Services-based public processes, programs and studies; and
- promote tap water consumption over other beverages.

In 2019, staff developed a Water Wagon Communication Plan that will undergo implementation in 2020. The Communication Plan was developed using insights from the 2018 Water Efficiency Public Education and Communication Strategy and associated market research, as well as Community Based Social Marketing principles. The Communication Plan:

- identifies specific goals and objectives for public engagement at the Water Wagon,
- clarifies key messages and target audiences,
- details how the Water Wagon Program Coordinator interacts with the public and set-up their display,
- outlines communication material development, and
- provides direction for monitoring public engagement.

This formal, strategically developed communication plan will be an important guide moving forward to ensure public engagement efforts via the Water Wagon program remain consistent, on-point, and contribute to our overarching goals. This resource will be especially advantageous for assisting the Water Wagon Program Assistant, who is a new staff member each summer, quickly and successfully navigate their role.

Water Softener Alternatives Testing and Market Research

With high levels of naturally occurring hardness in the City's groundwater source, the use of residential ion-exchange (salt-based) water softener technologies is quite common amongst Guelph households. It is estimated that approximately 77 per cent of local households, as part of a 2009 residential call survey, use a water softener.

The Region of Waterloo and the City of Guelph financed ground-breaking research in 2015 to assess the performance of an alternative to ion-exchange softening technology that treats hard water without the need for salt and recharge water. This technology referred to as salt and water free technology through the use of: media induced crystallization (nucleation assisted crystallization (NAC) and template assisted crystallization (TAC)); electromagnetic water treatment (MWT); chemical conditioning with complexing; or chelating agents. Salt and water free technology employs a combination of processes to prevent scale buildup in household water heaters and appliances. However, these technologies do not allow for the same lathering effect as salt-based water softeners provide.

In June 2017, the City of Guelph again collaborated with the Region of Waterloo to continue the research, trialling the NAC/TAC technology in real life scenarios. The aim of this study was to assess the field performance and user benefits associated with salt and water free residential water softener treatment technology.

Through this study, social research in both communities were completed (phone surveys, focus groups) to generate a technology test group of 18 homes, to install a single technology in their home for testing of user experience.

The technology was installed in participating homes by December 2017. Use of the systems continued throughout 2018. Participants were engaged to provide feedback through subsequent focus groups and an online discussion board. The final focus group concluded in January 2019.

The final report was completed in September. The results of the Water Conditioner Study were posted to the joint website, watersoftenerfacts.ca in November. The results of the study will be used to inform the update to the Water Efficiency Strategy moving forward.

Appendix J: Water Services Committees

Water Conservation and Efficiency Public Advisory Committee – Annual Report

The Water Conservation and Efficiency Public Advisory Committee (WCEPAC) – a Guelph Committee of Council – was formed in 2009 through Council approval. Council recommitted to this Committee in 2016 with the approval of the Water Efficiency Strategy update. This committee provides a forum for community input and guidance throughout the City's implementation of the Water Efficiency Strategy.

The WCEPAC met four times in 2019. The WCEPAC continues to provide valued insights on opportunities for continued enhancement of current and developing water conservation programming, policy and education, engagement and outreach resources. In alignment with Council reporting requirements outlined in the committee's Terms of Reference, this Annual Report details activities of the WCEPAC within 2019.

Water Conservation and Efficiency Public Advisory Committee continued to provide invaluable citizen feedback and recommendations to enhance the City of Guelph's successful water efficiency program, including:

- Feedback on the following water efficiency programs that were updated or developed as directed through the 2016 Water Efficiency Strategy:
  - Blue Built Home Water Efficiency Standard and Rebate Program,
  - Residential Sub-meter Rebate Program,
  - Integrated Water Mapping Project, including key performance indicators, and
  - Residential Rain Garden Pilot Project
- Comment on various innovative research, study and pilots including the residential water conditioner study (related to residential water softener impacts) and the Assimilative Capacity and Reclaimed Water Feasibility Studies which were conducted in partnership with Wastewater and Source Water Protection.
- Participation in discussions on how best to utilize and enhance the committee's capacity to provide advantageous and quality input.
- Learning opportunities to support member's role on the committee. This was especially important in 2019 with four new members joining the committee, and a new member and City Staff who had joined the committee in 2018. Members received presentations on WCEPAC roles, responsibilities, policies and procedures; 2016 Water Efficiency Strategy; Water Supply Master Plan update; Stormwater Management

Master Plan update; Water and Wastewater Servicing Master Plan update; Guelph's Wastewater Treatment operations; and Water Services' operations.

In 2020, the WCEPAC will continue to be engaged to solicit input throughout continued implementation of the 2016 Water Efficiency Strategy recommendations including, but not limited to the following:

- Present an updated Terms of Reference for the Committee, in line with Clerk's policies and procedures for Committees of Council (last update in 2009);
- Commencing an update to the Water Efficiency Strategy, contingent upon completing the Water Supply Master Plan in 2020;
- Outreach and engagement strategies for City of Guelph's conservation programming and tap water promotion;
- Development, update, or enhancement to Water Efficiency programs;
- Feedback on the pursuit and application of study results in regards to water reuse, water energy nexus, and alternative water softening technology; and
- Water Supply Master Plan update.

Visit the Water Conservation and Efficiency Public Advisory Committee webpage for a full list of the WCEPAC members, meeting minutes and agendas.

The WCEPAC possesses no annual budget. Funding for the City's Water Efficiency Program is provided within the Council-approved Non-Tax Supported Water and Wastewater Services Capital and Operating Budgets as well as through Development Charges.

Well Interference Committee

The Well Interference Committee is a specially arranged—or ad hoc—committee that is brought together to address well interference complaints resulting from the City's water takings.

The committee was established in 2004 to address concerns voiced during the City's Class Environmental Assessment for the Arkell Springs Ground Water Supply Strategy. During the Environmental Assessment, private well owners expressed concern that City water taking may interfere with or reduce the amount of water available for their wells.

No complaints have gone to the Well Interference Committee since it was established. It is worth nothing that the Committee convened on May 29, 2019 in order to facilitate an overview of the City's Well Interference Standard Operating Procedure, Permit to Take Water Requirements, upcoming water supply projects and the Terms of Reference for the Committee. The purpose of the review was to inform new members who may not have been

familiar with the duties or function of the Committee as these members were recently elected to council.

Visit the Well Interference Committee webpage for more information.

Appendix K: Source Water Protection

The third annual report summarizes information requested from the Risk Management Official by the Source Protection Authorities, as required under section 81 of the Clean Water Act, 2006 (CWA). The report outlines activities undertaken by the City of Guelph in 2019 to protect municipal drinking water sources. Source Protection is one component of the multi-barrier approach to ensure clean safe drinking water.

The Lake Erie Source Protection Region is one of 19 in Ontario created to implement drinking water source protection planning under the Clean Water Act, 2006. The region includes four watersheds, called Source Protection Areas (SPAs) in the Act:

- Catfish Creek
- Grand River
- Kettle Creek
- Long Point Region

The City of Guelph is part of the Grand River SPA and has a representative who sits on the 24 member Lake Erie Region Source Protection Committee (SPC). The SPC meets about four times a year to discuss and implement matters related to program implementation. The City of Guelph is an active participant along with other municipal representative who have a stake in drinking water issues.

The Grand River Source Protection Authority will receive this information in the format they have requested by February 1, 2020. This information may also be requested by the Director of the Ministry of Environment, Conservation and Parks (MECP).

City of Guelph internationally recognized for Source Protection

In 2019, the City of Guelph was awarded the American Water Works Association Exemplary Source Water Protection Award. Award winners "establish and maintain source water protection programs that account for their unique local conditions, incorporate the interests of local stakeholders, and reflect sustainable long-term commitments to the process by all parties." Established in 1881, the American Water Works Association (AWWA) is the largest and oldest non-profit, scientific and educational association dedicated to managing and treating water. There are approximately 50,000 members worldwide.

Figure 8: City Staff Receiving AWWA Award along with Guelph Mayor and Councillors.

Risk Management Official Update

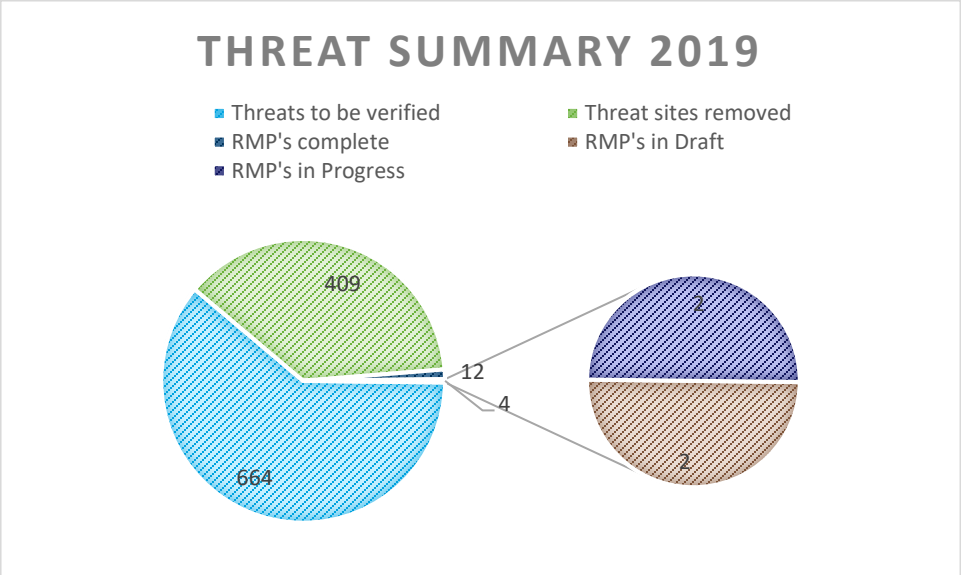
The RMO represents the City of Guelph as a municipal member of the Grand River Source Protection Committee. The Risk Management Official (RMO), Peter Rider, was appointed under subsection 47(6) of the Clean Water Act on May 27, 2016. The Risk Management Inspector (RMI) Kristin Pressey, was appointed on December 19, 2017.

Threat Verification and Negotiating Risk Management Plans

The City of Guelph continued to work with a number of property owners and businesses to verify and manage threat activities at their sites. Threats identified in the 2010 Assessment Report total 942 within the City of Guelph. Threat verification has been completed for 409 sites, resulting in the completion of 12 Risk Management Plans (RMPs) and an additional 4 in progress. City staff continue to develop RMPs for sites with threats, including evaluating existing practices and identifying potential missing gaps in drinking water protection. A template developed by the City was used to make the Risk Management Plan negotiation process less onerous for business and property owners.

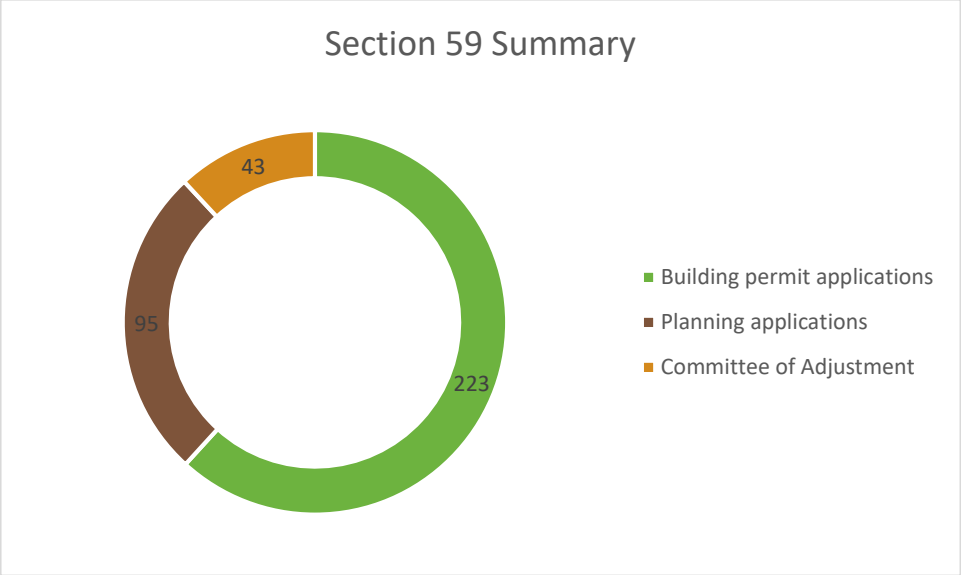
Information related to the Source Protection Program is managed in the Local Source Water Information Management System (LSWIMs), a data management system. This program is used by several other municipalities in southern Ontario to manage data associated with the Source Protection Program. The application is being updated regularly with additional functionality as requested by the collaborating partners.

Figure 9: Risk Management Official Summary, 2019



The CWA requires a section 59 Notice for development within the Wellhead Protection Areas (WHPAs) to determine if an application has a potential to introduce a new threat to drinking water. A notice is required before planning and building applications can be deemed complete. In 2019, Source Water Protection staff reviewed 361 applications and issued 167 Section 59 Notices.

Figure 10: Clean Water Act, Section 59 Summary



Policy Implementation

The City of Guelph is the implementing body responsible for a range of Source Protection Policies, from prohibition to negotiating Risk Management Plans (RMPs) and providing education and outreach. There are 72 policies in the City of Guelph's section of the Grand River Source Protection Plan. Of these, 48 are identified as the City's responsibility to implement. As of January 2019, we currently have 28 policies fully implemented and 18 that we have made some progress on. Efforts are underway to implement the remaining policies, however, there may be certain triggers required (e.g. upon the next Official Plan update) which will determine the pace at which some of the policies will be implemented.

Protecting Water Quantity

The City of Guelph is working closely with the Townships and staff from the Lake Erie Region Source Protection Authority to develop a set of water quantity threat policies for the identified WHPAs. Meetings are ongoing and it is anticipated that public consultation will be completed by the end of 2020. The draft policies will then be submitted to the Minister of Environment, Conservation and Parks for approval before implementation.

Education and Outreach

In the second half of 2019 moving into 2020, Source Water started an ad campaign to bring awareness to the program. The campaign consisted of Guelph Transit advertisements: both on the back and side of the bus; along with posters up at various bus shelters throughout the City. Advertisements were also posted through various social media sites and the Guelph Chamber of Commerce. Figure 11 below is an example of source water public communication.

Figure 11: Source Water Protection Advertisement to Reduce Your Winter Salt Use

Staff from the Sourcewater Protection Team have worked collaboratively with the City of Guelph Operations department staff to sponsor and support the purchase of new and enhanced road salting equipment. The goal of this initiative is to improve the management of road salt application within the City and to obtain a better understanding of how much road salt is being applied throughout the City. The purchase of this state-of–the-art equipment will allow the Operations department to develop more accurate records. This will greatly assist both departments in developing a better understanding of water quality trends and potential impacts to our drinking water system.

Staff from the Sourcewater Protection Team have also been actively involved in providing input to a joint committee lead by Ontario Good Roads Association and Conservation Ontario, whose mandate is to raise awareness at the provincial level of increasing chloride trends in groundwater and the need to evaluate the effectiveness of current legislation and best practices for winter maintenance.

Moving Forward in 2020

Efforts will continue to develop Risk Management Plans and carry out threat verifications, as required. We anticipate ramping up efforts to educate the public about road salting and how

everyone can play a part in reducing the amount of road salt that is applied to hard surfaces.

The Source Water Protection team will continue to pursue opportunities to educate the public and various stakeholders on the benefits of protecting our water resources. This will be accomplished through meetings, seminars and conferences when opportunities present themselves.

Appendix L: Glossary

Included below is an index of terms used throughout this report.

Term	Description
<	Less than (used in reference: less than lower detection limit shown)
µg/L	Micrograms per litre = 1 part per billion
½ MAC	half of the maximum allowable concentration
Above Detection Limit	Means the result can be detected using the current level of technology.
AMP	Adaptive Management Plan
AO	Aesthetic Objective
AODA	Accessibility for Ontarians with Disabilities Act
A&S	Annual and Summary
AWQI	Adverse Water Quality Incident
Background	Indicator bacteria group used to monitor general water quality (non - regulatory)
BBH	Blue Built Home program
CAO	Chief Administrative Officer
CAPS	Capital Asset Prioritization System
CCL	Critical Control Limit. The point at which a Critical Control Point response procedure is initiated.
CCP	Critical Control Point. An essential step or point in the Subject System at which control can be applied by the Operating Authority to prevent or eliminate a Drinking Water Health Hazard or to reduce it to an acceptable level.
CELP	Community Environmental Leadership Program
CIR #	Continual Improvement Report Number. Refers to the number assigned to an item in the Continual Improvement Database.
cfu	colony forming unit

Term	Description
Cubic metre (m^3)	1 Cubic metre = 1,000 litres water
Distribution Samples	Samples taken within the distribution system, post primary disinfection.
Distribution System	The part of a drinking water system that is used in the distribution, storage or supply of water and that is not part of a treatment system.
DMA	District Metered Area
Drinking Water System	A system of works, excluding plumbing, that is established for the purpose of providing users of the system with drinking water and includes, (a) any thing used for the collection, production, treatment, storage, supply or distribution of water, (b) any thing related to the management of residue from the treatment process or the management of the discharge of a substance into the natural environment from the treatment system, and (c) a well or intake that serves as the source or entry point of raw water supply for the system.
DWQMS	Drinking Water Quality Management Standard
DWS	Drinking Water System
DWWP	Drinking Water Works Permit
EC	E. coli (Escherichia coli)
E. coli	Escherichia coli, indicator bacteria used to determine the presence of fecal contamination
EDMS	Electronic Document Management System
EHV	Efficient Home Visit
Eng.	Engineering Services
EOCG	Emergency Operations Control Group
EPA	Environmental Protection Act
ERO	Environmental Registry of Ontario
Form 1	Form 1 – Record of Watermains Authorized as a Future Alteration

Term	Description
Form 2	Form 2 – Record of Minor Modification or Replacements to the Drinking Water System
GUDI-WEF	Groundwater Under the Direct Influence of surface water – With Effective Filtration
HAAs	Haloacetic acids (HAAs) are a type of chlorination disinfection by-product that are formed when the chlorine used to disinfect drinking water reacts with naturally occurring organic matter in water.
HPC	Heterotrophic Plate Count, indicator bacteria group used to monitor general water quality (non-regulatory).
ICI	Industrial, Commercial, Institutional
In-situ filtration	Refers to the filtration achieved as river water migrates through the ground and into the Arkell Springs Glen Collector System.
km	Kilometre
Langelier Index	An approximate indicator of the degree of saturation of calcium carbonate in water. It is calculated using the pH, alkalinity, calcium concentration, total dissolved solids, and water temperature of a water sample collected at the tap.
LESP	Lake Erie Source Protection
LRP	Lead Reduction Plan
LSL	Lead Service Lines
LSWIMs	Local Source Water Information Management System
L/s	Litres per second
m	Metres
m^3	Cubic metres = 1 m^3 = 1,000 litres water
m^3/day	Cubic metres per day = 1 m^3/day = 1,000 litres per day
MAC	Maximum Allowable Concentration
MCC	Motor Control Centre
MDL	Minimum Detection Limit
MDWL	Municipal Drinking Water Licence
MECP	Ontario Ministry of the Environment, Conservation and Parks

Term	Description
mEq/L	Milliequivalents Per Litre
mg/L	Milligrams per litre = 1 part per million
n/a	Not Applicable
NDOG	Non-Detect Overgrown
N/O	Non-Operational
NSF 60	NSF/ANSI Standard 60: Drinking Water Treatment Chemicals -- Health Effects
NSF 61	NSF/ANSI Standard 61: Drinking Water System Components -- Health Effects
ntu	nepholometric turbidity unit
O. Reg. 170/03	Ontario Regulation 170/03 Drinking Water Systems
OA	Operating Authority
ODWQS	O. Reg. 169/03 Ontario Drinking Water Quality Standards
ODWSP	Ontario Drinking Water Stewardship Program
OG	Operational Guideline
OIC	Operator-in-Charge
OP	Operational Plan
ORO	Overall Responsible Operator
OTP	Operational Testing Plan
OWRA	Ontario Water Resources Act
OWUP	Outside Water Use Program
OWWCO	Ontario Water Wastewater Certification Office
Pb	Lead
PDDW	Procedure for Disinfection of Drinking Water in Ontario
PLC	Programmable Logic Controller
POE	Point of Entry, the point at or near which treated water enters the distribution system.
ppm	Parts per million (mg/L)

Term	Description
ppb	Parts per billion (µg/L)
PTTW	Permit to Take Water
Q1	Quarter One (aka first quarter), Q2 (second quarter), etc.
QMS	Quality Management System
Raw water	Water in its natural state, prior to any treatment for drinking.
RMPs	Risk Management Plans
RCAp	Rapid Chemical Analysis Package
SAC	Spills Action Centre
SAN	Storage Area Network
SCADA	Supervisory Control and Data Acquisition
SDS	Subdivision Distribution System (as in Gazer Mooney SDS)
SDWA	Safe Drinking Water Act, 2002
TC	Total Coliform, indicator bacteria group used to determine presence of contamination.
TCE	Trichloroethylene
THM	Trihalomethane
TOMRMS	The Ontario Municipal Records Management System
Total Coliform	Indicator bacteria group used to determine presence of contamination.
Treated	Refers to samples that have received disinfection, for example treated sources.
UGDSB	Upper Grand District School Board
UV	Ultraviolet
VOC	volatile organic compound
WCDSB	Wellington Catholic District School Board
WCES	Water Conservation and Efficiency Strategy
WCWC	Walkerton Clean Water Centre
WDGPH	Wellington-Dufferin-Guelph Public Health
WES	Water Efficiency Strategy

Term	Description
WHPA	Wellhead Protection Area
WSMP	Water Supply Master Plan