Document:	Document No:
Operational Plan for the Sydenham Drinking Water System	W-OP-03

Operational Plan

for the

SOUTH FRONTENAC

Prepared by Utilities Kingston

(1425445 Ontario Limited)

for

The Township of South Frontenac

Approval

Heather Roberts, Director, Water/Wastewater **Date:**

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Definitions

Accredited Operating Authority – a person or entity that is given responsibility by the owner for the management, operation, maintenance, or alteration of a drinking water system and has been accredited after demonstrating conformance to the requirements of the Drinking Water Quality Management Standard to the satisfaction of the accreditation body authorized by the Ministry of Environment.

Action Item - a deficiency of the QMS identified through management review which requires corrective action.

Annually - A period of one year beginning and ending with the dates conventionally accepted as marking the beginning and end of a year (January 1st to December 31st).

Audit – a systematic and documented verification process that involves objectively obtaining and evaluating documents and processes to determine whether a quality management system conforms to the requirements of the Drinking Water Quality Management Standard.

Authority – official permission or approval to carry out tasks and make decisions regarding the drinking water system.

Calendar Year - A period of one year beginning and ending with the dates conventionally accepted as marking the beginning and end of a year (January 1st to December 31st).

Competence – the combination of observable and measurable knowledge, skills and abilities which are required for a person to carry out assigned duties.

Compliance – the fulfillment of a regulatory requirement.

Conformance – the fulfillment of a Drinking Water Quality Management Standard requirement

Customer – the drinking water end user.

Control Measure – includes any processes, physical steps, or other contingencies that have been put in place to prevent or reduce a hazard.

Control Point (CP) – a step in the drinking water system process where primary control is applied to prevent or reduce the likely occurrence of a hazardous event with associated drinking water health hazards.

Corrective Action – 1) action to eliminate the cause of a detected non-conformity with the Drinking Water Quality Management Standard, Quality Management System, or other undesirable situations 2) action taken in response to reported adverse water quality identified under Schedule 16 of Ontario Regulation 170/03 to immediately restore proper drinking water disinfection or treatment including any actions taken as directed by the Medical Officer of Health.

Critical Control Limit (CCL) – the point at which a critical control point response procedure is initiated.

Critical Control Point (CCP) – an essential step in the drinking water system process where primary control measures can be applied, and the results measured to ensure the safety of drinking water delivered to the customer by preventing or eliminating a drinking water health hazard or reducing the hazard to an acceptable level.

Document – information recorded or stored by means of any device which is revised to remain current. For the Drinking Water Quality Management System, they include policies, operational plans, procedures, GIS/network drawings, legislation, regulations, and standards, but not records. (See Records).

Drinking Water Emergency – a situation or service interruption that may result in the loss of the ability to maintain a supply of safe drinking water to consumers.

Drinking Water System – the system of connected works, excluding plumbing, which is established for the purpose of providing users of the system with drinking water.

Duty – an authorized task or decision regarding the drinking water system that is required to fulfill responsibilities identified in the Operational Plan and associated procedures.

DWQMS – Drinking Water Quality Management Standard.

Emergency – a situation which requires immediate action to protect and preserve the health, safety and welfare of persons and to limit or prevent damage and destruction of property, infrastructure and the environment.

Emergency Response – the effort to mitigate the impact of an emergency on customers.

Hazard – a source of danger or a property that may cause drinking water to be unsafe for human consumption. The hazard may be biological, chemical, physical, or radiological in nature.

Hazardous Event – an incident or situation that can lead to the presence of a hazard.

Infrastructure – the set of interconnected structural elements that provide the framework for supporting the operation of the drinking water system, including buildings, workspace, process equipment, hardware and software, and supporting services, such as transportation or communication.

Major Drinking Water Emergency – an emergency which is adversely affecting or will adversely affect the supply of safe drinking water to a significant portion of the system or to critical facilities such as hospitals, nursing homes and medical clinics.

Minimum Critical Control Point (Minimum CCP) – an essential step in the drinking water system process where control measures must be applied to meet minimum treatment requirements for primary and secondary disinfection as outlined in the Procedure for Disinfection of Water in Ontario.

MECP – Ministry of Environment, Conservation and Parks.

Monitoring – checks or systems that are available to detect hazards or the potential for hazards

Non-compliance – the failure to fulfill a regulatory requirement.

Non-conformance – the failure to fulfill a Drinking Water Quality Management Standard or quality management system requirement**.**

Operating Authority – Utilities Kingston, as authorized by the owner to undertake the management, operation, maintenance or alteration of the drinking water system.

Owner – The Township of South Frontenac.

Potential Major Drinking Water Emergency – an emergency with the potential to adversely affect the supply of safe drinking water to a significant portion of the system or to critical facilities such as hospitals, nursing homes and medical clinics.

Preventative Action – Action to prevent the occurrence of nonconformity of the QMS with the requirements of the DWQMS or another undesirable situation).

Quality Management System (QMS) – a system to establish policy and objectives, achieve those objectives, and direct and control an organization with regard to quality.

Record – information recorded or stored by means of any device which provides proof of activities performed and results achieved. For the Drinking Water Quality Management System, they include log books, laboratory test results, water quality data, system performance data, completed operation and maintenance forms, photographs, audio/video recordings, and “As Built”/record drawings.

Responsibility – an overarching requirement, identified in the Operational Plan, for which persons having duties and authorities impacting the safe and reliable supply of drinking water to the customer are held accountable.

Role – a management or staff position within Utilities Kingston for which responsibilities, duties, and authorities have been identified.

The Standard – the Drinking Water Quality Management Standard.

1. Introduction to the Quality Management System

This document is the Drinking Water Quality Management System Operational Plan for the Sydenham Drinking Water System. It has been developed in response to legislated requirements resulting from recommendations contained within the Report of the Walkerton Inquiry.

In Part Two, Report of the Walkerton Inquiry, Justice Dennis R. O'Conner recommended that municipal water providers adopt a "quality management" approach for the operation of drinking water systems in Ontario. Also recommended by Justice O'Conner was the development of a quality management standard specific to drinking water systems and the accreditation of operating agencies based on the implementation of quality management systems conforming to that standard. These recommendations have been mandated through the Safe Drinking Water Act.

The Safe Drinking Water Act requires the owner of a municipal residential drinking water system to ensure that the system is operated by an Accredited Operating Authority. To become accredited, an Operating Authority must establish and maintain a Quality Management System, documented in an Operational Plan, which meets the requirements of the Drinking Water Quality Management Standard for Ontario.

The Ministry of Environment, with assistance from water industry stakeholders, has developed the Drinking Water Quality Management Standard specifically to meet the needs of municipal residential drinking water systems in Ontario. The Drinking Water Quality Management Standard contains elements of both the International Organization for Standardization's ISO 9001 quality management system standard and the Hazard Analysis and Critical Control Point (HACCP) standard.

The Standard specifies minimum requirements to facilitate an Operating Authority's ability to consistently produce and deliver drinking water that meets legislative, regulatory and owner requirements, and to enhance consumer protection through the effective application and continual improvement of a Quality Management System.

The process to develop, implement and maintain the Quality Management System required by the Drinking Water Quality Management Standard is divided into three steps; PLAN/DO, CHECK, and IMPROVE. These steps are cyclic which enables the continuous evolution and improvement of the Quality Management System.

The Drinking Water Quality Management Standard is comprised of

twenty-one elements; eighteen PLAN/DO elements, two CHECK elements, and one IMPROVE element. PLAN/DO elements deal with the development and implementation of an Operational Plan; CHECK elements deal with reviewing the effectiveness of the Quality Management System through internal audits and management reviews; and the IMPROVE element requires an Operating Authority to strive to continually improve its Quality Management System through the use of corrective and preventative actions in addition to the review and consideration to applicable best management practices published by the Ministry of the Environment, Conservation and Parks.. Each of the numbered sections in this document corresponds to a required element in the Standard.

As the Operating Authority for the Sydenham Drinking Water System, owned by the Township of South Frontenac, Utilities Kingston has developed this Operational Plan to meet the requirements of the Drinking Water Quality Management Standard and to ensure the continued safe and reliable supply of drinking water to the community through the efficient and effective use of resources.

2. Quality Management System Policy

The Quality Management System Policy for the Sydenham Drinking Water System – W-P-04 has been reviewed and approved by Top Management.

Quality Management System Policy for the Sydenham Drinking Water System

Utilities Kingston is a community based corporation dedicated to the responsible management of safe and reliable integrated services. Our mission is to manage, operate and maintain community infrastructure to deliver safe, reliable services and a personal customer experience, guided by our values of safety, integrity, innovation and reliability. Our vision is to advance the unique multi-utility model to benefit our customers and build better communities.

Utilities Kingston, acting as the Operating Authority for the Sydenham Drinking Water System, owned by the Township of South Frontenac, is committed to providing a safe and reliable supply of drinking water to our customers.

Through the development, implementation, maintenance, and continual improvement of a Quality Management System, the management and staff of Utilities Kingston will ensure the continued safety and security of the drinking water supply by meeting or exceeding the requirements of all relevant legislation and regulations, and the Drinking Water Quality Management Standard.

3. Commitment and Endorsement

This Operational Plan has been endorsed by Utilities Kingston Top Management and the Township of South Frontenac. The Owner and Top Management Endorsement of the Operational Plan for the Sydenham Drinking Water System – W-P-05 has been signed by the Township of South Frontenac's representatives and Utilities Kingston Top Management.

Owner and Top Management Endorsement of Operational Plan for the Sydenham Drinking Water System

The Township of South Frontenac, the Owner, and Utilities Kingston, the Operating Authority, support the implementation, maintenance, and continual improvement of a Quality Management System for the Sydenham Drinking Water System as documented in the Sydenham Drinking Water System Operational Plan.

This endorsement of the Operational Plan by the Owner's representatives and by the Operating Authority's top management acknowledges their commitment to fulfill the responsibilities, duties, and authorities as defined in the Operational Plan, the Drinking Water Quality Management Standard, and the Safe Drinking Water Act.

4. Quality Management System Representatives

A Quality Management System Representative(s) and an alternate are appointed and authorized by Top Management to administer the Drinking Water Quality Management System. The responsibilities of the QMS Representatives are:

- ensuring that processes and procedures for the Drinking Water QMS are established and maintained,
- reporting to Top Management on the performance of the Drinking Water QMS and any need for improvement,
- promoting awareness of the Drinking Water QMS throughout the Operating Authority
- ensuring that current versions of documents required by the Drinking Water QMS are being used at all times,

- at least annually, reviewing the Drinking Water QMS policies to ensure that they remain current and appropriate for the QMS and the subject system, and recommending any required changes to the QMS policies to Top Management for approval,
- ensuring that the Operational Plans and associated procedures are reviewed at least annually to verify that they remain consistent with current legislation, regulations, and operational conditions and processes,
- ensuring that new and revised QMS controlled documents are reviewed by personnel most familiar with the affected processes prior to recommending approval,
- review and recommend approval of revisions to the Operational Plan and associated procedures to the Director of Engineering, Human Resources and Treatment Operations, and the Director, Operations,
- ensuring that annual internal audits are completed as described in this operational plan,
- preparing an annual report which includes all information required for annual Management Reviews of the Drinking Water QMS
- external audit liaison

The Alternate QMS Representative provides assistance to meet these responsibilities and performs all duties of the QMS Representatives should the QMS Representatives be unavailable.

The designated QMS Representative(s) and Alternate QMS Representative have acknowledged their responsibilities, duties, and authorities as described in this Operational Plan by signing the Quality Management System Representative for the Sydenham Drinking Water System Acknowledgement of Responsibilities – W-P-06.

5. Document and Records Control

5.1 Documents

Documents provide the foundation for the development and ongoing maintenance of the quality management system. They include QMS policies, operational plans, procedures, GIS/network drawings, legislation, regulations, standards, and records. Documents other than records must be revised to reflect current legislation, regulations, and operational conditions and processes. Consistent control ensures that documents remain current and accurate, and are available and accessible for use when and where required.

The Document Control Procedure – W-G-01 describes the methods used to control the creation, approval, distribution, and revision of internal and external documents related to the Drinking Water QMS.

5.2 Records

Records are documents which provide proof of activities performed and results achieved. Unlike other documents which must be revised to reflect current conditions, records provide historical evidence and must not be changed. They include log books, laboratory test results, water quality data, system performance data, completed operation and maintenance forms, photographs, audio/video recordings, and “As Built”/record drawings.

The Records Control Procedure – W-G-02 describes the methods used to ensure that records are sufficiently maintained to demonstrate compliance with legislative, regulatory, and Drinking Water Quality Management Standard requirements, Drinking Water QMS requirements and to provide historical information that is accessible for operational and planning purposes.

6. Drinking Water System Description

6.1 General

The Sydenham Drinking Water System, owned by the Township of South Frontenac and operated by Utilities Kingston, provides safe drinking water to the Village of Sydenham. The system is comprised of a Class 2 water treatment plant supplying water to a Class 1 distribution system which includes one elevated storage tank.

6.2 Source Water Overview

The source of water treated by this water treatment facility is Sydenham Lake. The intake is located 128m east of the treatment plant, at approximately 6m of water depth.

The tributary water sources to Sydenham Lake are granite based to the north and limestone based to the south, resulting in a unique raw water chemistry for treatment.

The raw water drawn from this location is slightly elevated in dissolved solids, organic carbon and alkalinity. The water is slightly basic and marginally hard with an average hardness of 134 mg/l as CaCo3. Seasonal changes and wind direction can greatly affect raw water turbidities which can range from 0.3 to 10 NTU.

Seasonal raw water temperature fluctuations are significant. Raw water temperatures at the Sydenham Water Treatment Plant have ranged from as low as 1 degree Celsius in the winter months to as high as 22 degrees Celsius in the summer months.

Chemical, physical and bacteriological raw water quality data indicates a raw water source of good quality.

6.2.1 Events

Seasonal changes in raw water quality during the spring thaw can cause an increase in organic loading within Sydenham Lake. This event typically referred to as the spring runoff, can last a few days or even weeks depending on weather and temperature.

Summer and fall water quality can also fluctuate due to algae growth, wind direction and strength, and recreational traffic resulting in elevated water turbidities. Operators must be prepared to make appropriate process adjustments to treat the elevated turbidities during these events.

Changes in water temperature will also impact treatment process performance (coagulation and disinfection). Optimal treatment requires timely adjustments to treatment chemical dosages in response to temperature fluctuations.

6.2.2 Threats

Sydenham Lake is subject to seasonal recreation traffic and indirect discharges from agricultural runoff which are potential sources of contamination. While the risk of source water contamination is ever present the immediate risk of contamination of the drinking water system as a result is considered to be minimal due to the following factors:

- Ongoing monitoring of raw water quality
- Continuously monitored water treatment processes

The potential for toxin producing cyanobacteria algae blooms is present in lakes with high phosphorus and nitrogen levels and warming water temperatures that can increase their frequency and size. As a result, a Harmful Algal Bloom monitoring, reporting, and sampling plan has been implemented.

6.2.3 Intake Protection Zones

The Cataraqui Source Protection Plan has identified Intake Protection Zones for the Sydenham Water Treatment Plant. An intake protection zone (IPZ) shows where surface water is coming from to supply a municipal intake at a water treatment plant and how fast it is travelling toward the intake. The size and shape of each zone represents either a set distance around the intake, or the length of time water that could be carrying a contaminant would take to reach the intake over land or water: IPZ 1 is a set area, generally a one-kilometre radius around the intake; IPZ 2 is defined by the movement of water and is sized to encompass a two-hour time of travel for a contaminant to reach the intake; IPZ 3 is an area of special interest. For the Sydenham intake, IPZ 3 is defined based on the lakes and streams that contribute water to the intake. The Intake Protection Zones are shown in Figure 1 – Intake Protection Zones.

6.2.4 Operational Challenges

Raw water drawn from Sydenham Lake is generally low in bacteriological contamination and turbidity. During seasonal turbidity and temperature fluctuations as well as during spring runoff, operational changes are required to maintain optimal coagulant dosages to ensure adequate turbidity removal while also maintaining filter performance and minimizing aluminum residual carryover.

Operational challenges during seasonal events may require deviations from normal operations. With these seasonal events, the operator may be required to increase the frequency and/or duration of filter backwashes to reduce filter clogging.

6.3 Multiple Barrier Approach

A multiple barrier approach to preventing drinking water contamination is employed by Utilities Kingston to ensure that drinking water supplied by the system is both safe and of high quality. Barriers employed within the supply system include source water treatment by chemically assisted filtration, primary disinfection through UV light application and chlorination, secondary disinfection through chlorination, continuous monitoring and automated control of treatment processes and distribution system facilities, and the utilization of system redundancies and standby equipment.

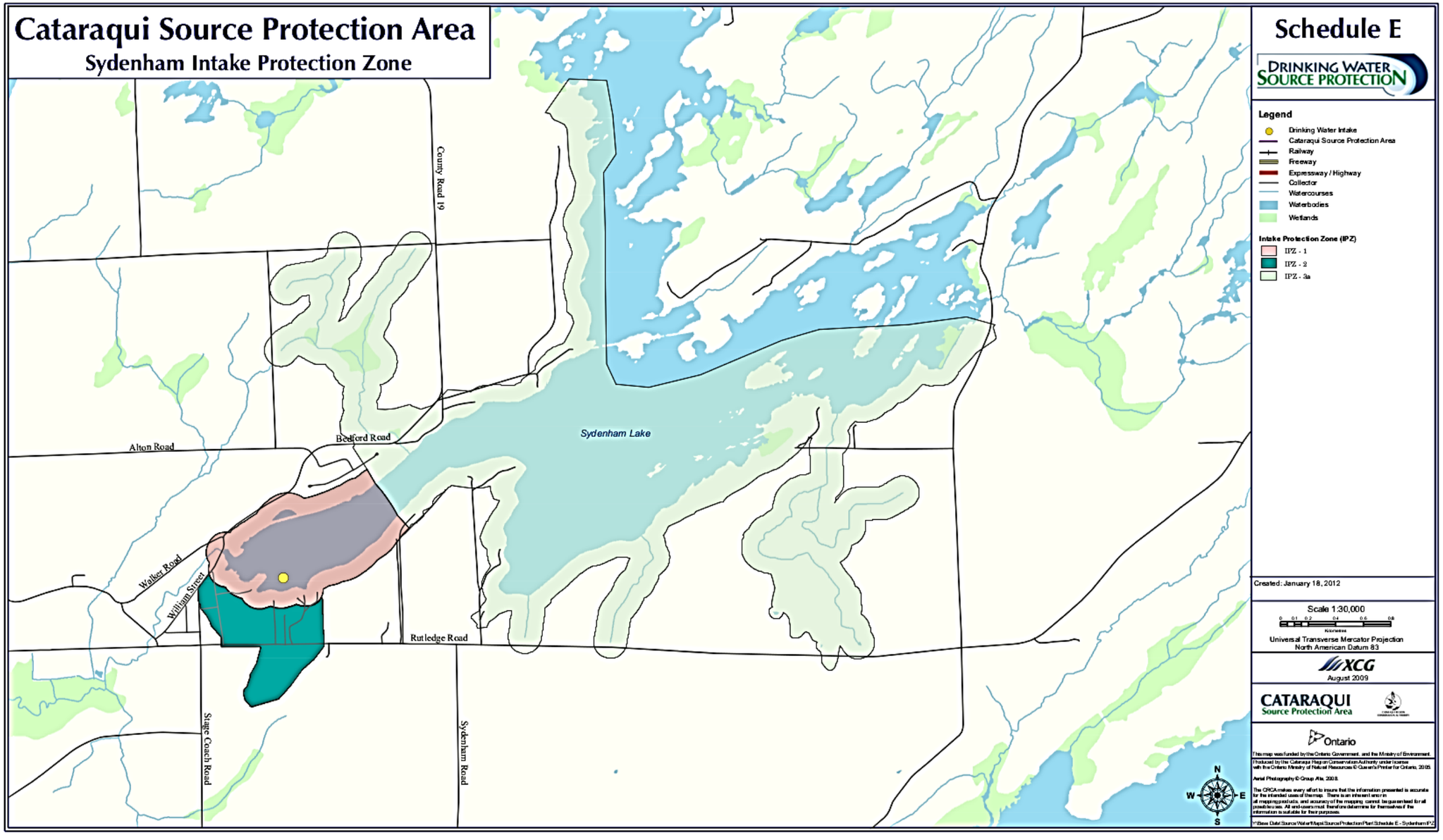
6.4 Critical Upstream and Downstream Processes

Utilities Kingston does not currently rely upon any critical processes upstream or downstream of the Sydenham Drinking Water System to ensure the provision of safe drinking water.

6.5 Connections to Other Drinking Water Systems

The Sydenham Drinking Water System is not connected to any other drinking water system.

6.5.1 Figure 1 – Intake Protection Zones



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6.6 Water Treatment Facility

6.6.1 Sydenham Water Treatment Plant

Drinking water is supplied to the distribution system by the Sydenham Water Treatment Plant which is a Class 2 water treatment facility with a rated capacity of 1,290m3/day. The water treatment plant is located at 4410 Point Road. Figure 2 – Sydenham Water Treatment Plant Process Flow Diagram provides a graphic representation of the water treatment process.

6.6.1.1 Raw Water Source

The source of water treated by this water treatment facility is Sydenham Lake. The intake is located 128m east of the treatment plant, at approximately 6m of water depth. Water flows by gravity from the lake through a 400mm intake pipe to the low lift pumping well.

6.6.1.2 Zebra Mussel Control

Chloraminated (treated) water is conveyed through a 25mm polyethylene tube installed inside the intake pipe and injected through a diffuser at the raw water intake for zebra mussel control.

6.6.1.3 Screening

Two stationary screens located in the low lift pumping well remove objects such as weeds, fish, sticks, and other debris from the water.

6.6.1.4 Low Lift Pumping

Three submersible low lift pumps (two duty pumps and one standby pump) lift water from the low lift pumping well to the process building through the low lift discharge header. The flow rate of raw water pumped through the low lift discharge header is continuously monitored

6.6.1.5 Pre-Chlorination

While not typically practiced, a Sodium Hypochlorite application point in the low lift discharge header allows for pre-filtration disinfection.

6.6.1.6 Coagulation / Flocculation

A liquid coagulant, Polyaluminum Chloride (PACl), is added to the raw water in the low lift discharge header as it enters the process building just prior to passing through the in-line static mixer. PACl promotes flocculation (the clumping together of very fine particles and their subsequent grouping to form larger particles). The formation of these ‘floc’ masses improves the plant’s filtration process. Water flows through the static mixer in a spiral motion ensuring proper mixing of the PACl with the water for effective flocculation.

6.6.1.7 Filtration

Water flows from the static mixer to three pressure filtration tanks containing a ceramic filtration media. The filters remove particulate impurities from the water. Water flows through the filters into two baffled contact tanks.

Filters are backwashed at a minimum of every 48 hours to remove the particulates they have collected. Clean water from the clear well (high lift pump chamber) is pumped backwards through the filters, and the filters are agitated by air scouring the filter media to break up any large particles.

6.6.1.8 GAC Contactors

During periods of high dissolved organic content in the source water, filter effluent water is directed to two pressure filtration tanks containing granular activated carbon (GAC). The GAC contactors assist

in the removal of dissolved organics which react with chlorine to produce chlorination byproducts. The GAC contactors are periodically backwashed to remove the particulates they have collected.

6.6.1.9 Process Waste Management

Effluent water from the backwash process is directed to a backwash storage tank for further settling. The supernatant (the clear water at the top of the tank after settling) is directed back to Sydenham Lake and the settled sludge is mechanically removed and sent for further treatment.

6.6.1.10 Primary Disinfection

Primary disinfection of the filtered water is achieved via UV light and free chlorine residual. 2 UV reactors (duty/standby) each using 12 low pressure high output lamps, provide the UV light disinfection. Free chlorine disinfection follows the UV process with the use of two chemical metering pumps (duty/standby) which provide sodium hypochlorite to an application point downstream of the UV reactors at the entrance to the detention piping. Diversion to waste valves, located upstream of the treated water reservoirs, operate automatically to divert water to the process waste tanks at process start up and whenever residual or log removal targets are not met.

6.6.1.11 Secondary Disinfection

Secondary disinfection is the maintenance of a disinfectant residual throughout the distribution system which is achieved with chloramines. Following the free chlorine disinfection process, ammonium sulphate is added with the use of two chemical metering pumps (duty/standby), at an approximate rate of 4:1 ratio (chlorine/ammonia), to react with the free chlorine residual to form chloramines. The application dosages of sodium hypochlorite and ammonium sulphate is adjusted to produce a sufficient in plant combined chlorine residual to ensure that minimum residuals are maintained in the distribution system.

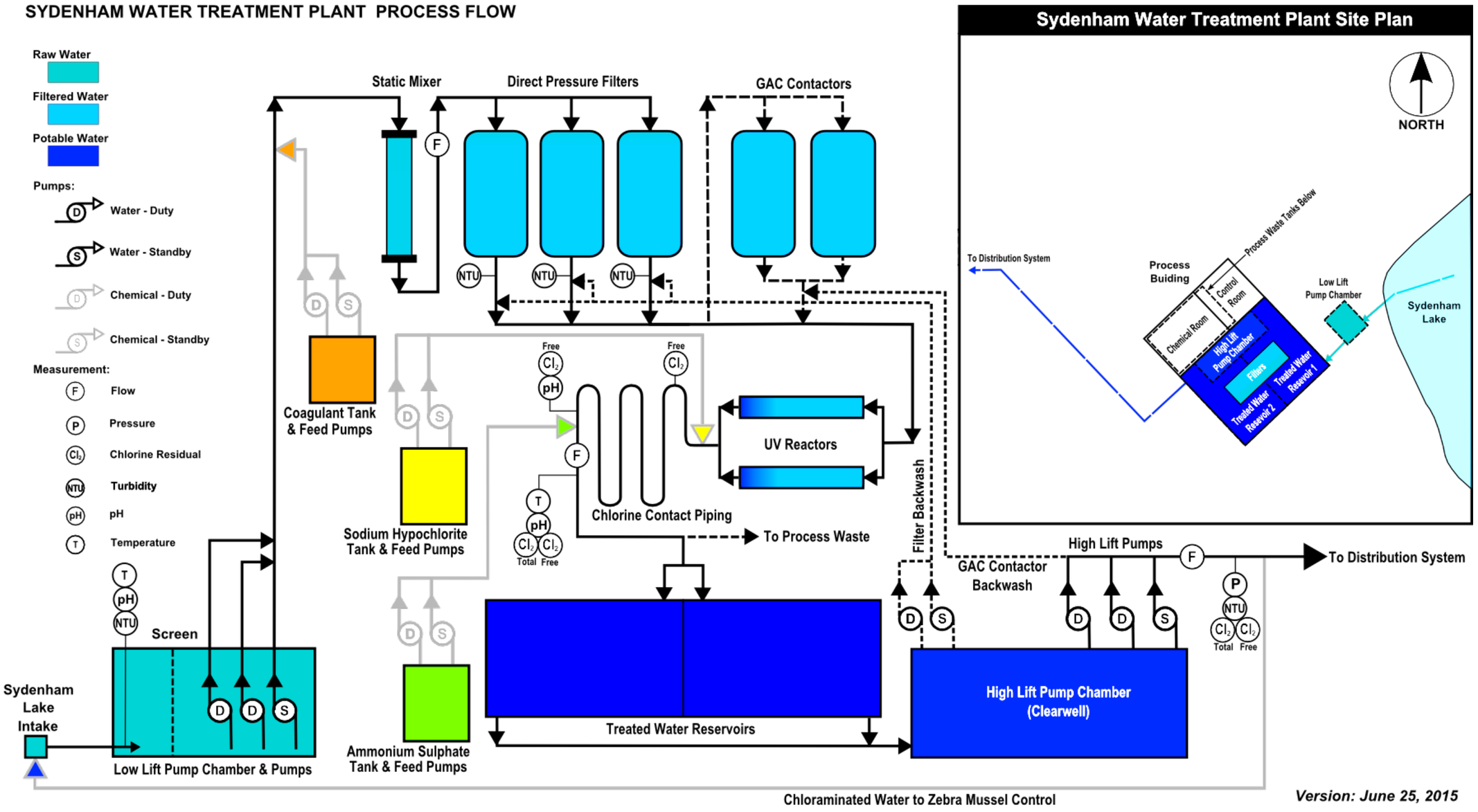
6.6.1.12 High Lift Pumping

Water from the clearwell (high lift pump chamber) is pumped into the distribution system by three high lift pumps (two duty pumps and one standby pump). The flow rate of treated water pumped to the distribution system is continuously monitored.

6.6.1.13 Standby Equipment

A 130 kW standby diesel generator provides electricity to the water plant during power interruptions. The generator and standby equipment is tested regularly to ensure proper operation when required.

Figure 2 – Sydenham Water Treatment Plant Process Flow Diagram



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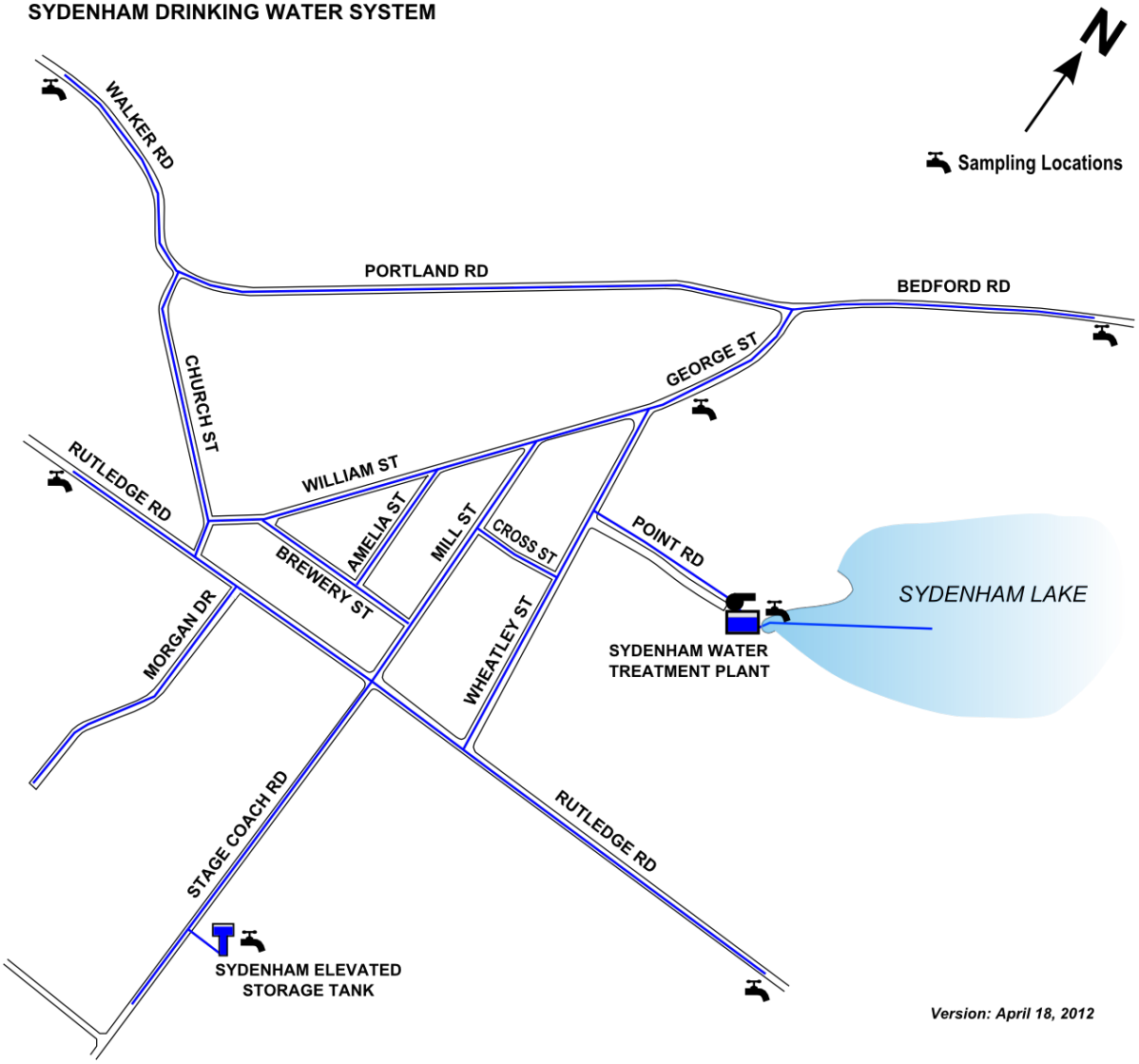
6.7 Distribution System

The Class 1 Sydenham Distribution System is comprised of approximately 6.8 km of polyvinyl chloride (PVC) water mains ranging in size from 150mm to 250mm. The distribution system also includes 1 elevated storage tank, 39 main line valves, and 50 fire hydrants and their associated isolation valves. Once all connections to the distribution system have been completed, the drinking water system will supply water to 285 customer connections.

6.7.1 The Sydenham Elevated Storage Tank

The Sydenham Elevated Storage Tank is located at 4252 Stage Coach Road. The tank has a storage capacity of 1,019m3. The tank provides storage and system pressure stabilization for the distribution system. During normal system operation, the water level in the tank provides the primary control of pump operations at the Sydenham Water Treatment Plant.

Figure 3 – Sydenham Drinking Water System Map



7. Risk Assessment

Utilities Kingston has developed the Risk Assessment Procedure – W-G-03 to ensure that potential hazardous events and the resulting drinking water health hazards are identified and that appropriate monitoring, control, and response measures are developed to mitigate the risks associated with the hazards. This is achieved through a process of identifying potential hazardous events and associated drinking water health hazards. Assessing the risks associated with those hazards by assigning values for probability, consequence and detectability. Identifying and assessing existing control and response measures, identifying Critical Control Points, establishing Critical Control Limits, and ensuring that monitoring and response processes and procedures are in place to respond to deviations from those limits. Potential risks and hazardous events identified for deliberation by the MECP must also be considered while completing a risk assessment. The results of the risk assessments are documented in the following section.

8. Risk Assessment Outcomes

The identification of hazardous events associated drinking water health hazards, and the assessment of the associated risks for the Sydenham Drinking Water System is completed on a three year cycle. The risk assessment team included experienced drinking water operators and supervisory personnel.

The risk assessment findings for the identified events are documented in W-L-11s Sydenham Risk Assessment Outcomes. Events/hazards are listed by event classification in descending order of controlled risk. The controlled risk value represents the relative risk of each event/hazard, considering the control measures in place and the response measures available, when compared to the range of values for all events/hazards assessed for the system.

Each event/hazard combination has been classified in the following categories:

- Event Classification – Events have been classified as either controlled or uncontrolled based on the availability of primary control measures to prevent or reduce the probability of the hazardous event. Each event is further classified as high, moderate, or low risk according to the risk value found during the assessment, the assigned consequence value, and the controlled risk value.
- Controlled Risk Classification – The controlled risk for each event/hazard has been classified as high, moderate, or low based on the risk level after considering the available control and response measures and the potential consequence of the event.
- Control Point Classification – Control Points and Critical Control Points (CCP) are identified based on whether the process step is required by the Procedure for the Disinfection of Drinking Water in Ontario (Minimum CCP), is essential for the delivery of safe drinking water, primary control of the event can be applied, and the results of that control are measurable.

8.1 Critical Control Limit Monitoring and Response

As a result of the risk assessment results, the following Critical Control Limits have been identified and associated response procedures developed for the Sydenham Drinking Water System with the assistance of qualified Utilities Kingston Drinking Water Operators. Each section identifies the Critical Control Limit and describes how the measured parameters are monitored and the considerations and rationale used to determine the limit. The Critical Control Limit Response Procedures referenced describe the response and reporting requirements for measured parameter.

8.1.1 Coagulation Critical Control Limit

Raw water coagulation ensures proper suspended solids removal through floc formation and agglomeration. Correct floc formation is important for adequate filtration of raw water that has the potential for microbiological contamination. Duty and standby chemical metering pumps equipped with

an automatic switchover system and flow sensing switches are used to deliver coagulant to the application point at the Sydenham Water Treatment Plant.

The Procedure for Disinfection of Drinking Water in Ontario requires that a chemical coagulant be used at all times when a treatment plant that uses conventional or direct filtration is in operation. The dosing of coagulant is directly monitored by confirmation of equipment functionality through the SCADA system, which generates an alarm should a coagulant pump fail. The Critical Control Limit for Coagulation is the generation of a coagulant pump failure alarm. Prompt investigation of this alarm condition is required to ensure the continued dosing of coagulant. The Sydenham Drinking Water System Coagulation Critical Control Limit Response Procedure – W-CC-07 describes the response to a coagulant pump failure alarm.

The effectiveness of coagulant dosing is monitored through the continuous measurement of filter effluent turbidities. Filter effluent turbidities are monitored on a continuous basis to ensure filter effluent quality meets the regulatory requirements for drinking water. Filter effluent turbidity alarms may indicate a problem associated with the coagulation process. The investigation of coagulant dosages and coagulation equipment operation is included as part of the Sydenham Drinking Water System Filter Effluent Turbidity Critical Control Limit Response Procedure W-CC-08.

8.1.2 Filter Effluent Turbidity Critical Control Limit

Filtration processes provide for the removal of suspended solids and floc particles that are created through coagulant addition. The Sydenham Water Treatment Plant uses three pressure filtration tanks containing a ceramic filtration media to remove suspended solids from the water prior to the primary disinfection process. Filtration performance is monitored continuously through filter effluent turbidimeters installed on each filter effluent line. Trending through SCADA systems allows for operator interpretation and alarm response capability.

Regulatory limits on filter effluent turbidities have two specific values of concern. Schedule 16 of Ontario Regulation 170/03 specifies that filter effluent turbidity exceeding 1.0 NTU for longer than 15 consecutive minutes is an adverse condition and must be reported as such. The Procedure for the Disinfection of Water in Ontario specifies that the filtration process must meet the performance criterion for filtered water turbidity of less than or equal to 0.3 NTU in 95% of the measurements each month in order to claim the facility specific log removal credits used in disinfection CT calculations.

The alarm set point of 0.3 NTU allows for operator response to elevated turbidity levels well before reaching the regulatory limit of 1.0 NTU and ensures only limited periods of turbidity levels above 0.3 NTU to meet the performance criterion for filtered water turbidity of less than or equal to 0.3 NTU in 95% of the measurements each month.

Operators at the King Street and Point Pleasant Water Treatment Plants, in the City of Kingston, have the ability to remotely initiate a filter backwash through the SCADA system. Continuous operator coverage at the King Street Water Treatment Plant and the availability of standby operators ensures a very timely response to an alarm and initiation of the corrective action process.

With consideration of these factors, a critical control limit of 0.3 NTU for no longer than 30 minutes, can be established. This limit allows for short term filter effluent turbidity spikes above 0.3 NTU, due to operational conditions, which do not pose a threat and enables the identification of more persistent or severe operational conditions which could adversely affect drinking water quality.

The Sydenham Drinking Water System Filter Effluent Critical Control Limit Response Procedure – W-CC-08 describes the response to a filter effluent turbidity alarm and possible exceedance of the critical control limit.

8.1.3 Primary Disinfection Critical Control Limits

The use of ultraviolet light exposure and chlorination for primary disinfection ensures adequate inactivation of pathogens potentially present in the source water that have not been removed by filtration. As a direct filtration plant, the Sydenham Water Treatment Plant is credited with 2 log removal for Giardia and Cryptosporidium, and with 1 log removal for viruses. Removal rates required for surface water plants are 2 log for Cryptosporidium, 3 log for Giardia, and 4 log for viruses. This leaves requirements for disinfection at 1 log removal for Giardia and 3 log removal for viruses.

8.1.3.1 Ultraviolet Light Disinfection

The disinfection through ultraviolet light is accomplished by exposing filtered water flowing through either of two installed UV reactors with a minimum 40 mJ/cm2 dose of UV light at a filtered water ultraviolet light transmittance (UVT) of at least 75%. The UV reactors have been validated to inactivate protozoa and bacteria (fulfilling the remaining requirement for 1 log removal of Giardia) at the dosage noted above. Therefore, only the regulated requirement for chemical disinfection for viruses remains.

The UV dose is monitored continuously. At less than a 40 mJ/cm^2 dose the process is automatically shut down and an alarm is generated. Filtered water grab samples are routinely collected to ensure a UVT of at least 75%.

8.1.3.2 Chemical Disinfection

The remaining 3 log inactivation of viruses is accomplished through the application of chlorine using sodium hypochlorite delivery pumps.

The following parameters together are used in determining the achieved disinfectant CT and are trended on SCADA programs and compared to the required CT to give a log removal achieved value.

- Temperature of the water prior to contact tank entry is monitored continuously with a temperature sensor. Temperature is a parameter that changes based on seasonal variations and cannot be controlled through operational process.
- pH is monitored continuously prior to contact tank entry locations with a pH probe. pH is a parameter that changes with variations in water quality on a seasonal basis.
- Flow Rate is monitored continuously. The rate of flow varies continually based on distribution system demand.
- Detention Time within the chlorine contact piping is calculated continuously through SCADA based on the flow rate.
- Free Chlorine Residual is monitored continuously using Cl_2 analyzers. Free residual varies slightly as dosages and chlorine demand of the water changes.

Achieved CT must be at least 100% of the required CT, which varies with water quality, to ensure that the required 3 log inactivation of viruses is achieved.

Achieved CT must be at least 100% of the required CT, which varies with water quality.

- pH
- Detention Time
- High Lift Flow
- Free Cl_2 Residual

→ CT ≥ 100% or 3 log virus inactivation

All of these parameters vary on an instantaneous basis. If one or any combination of these parameters indicates that the resulting achieved CT value may reach less than 100% of the required CT, proper corrective actions must be implemented. Alarm set points for the monitored parameters are set at levels which indicate conditions, outside of normal operational variance, with the potential to negatively affect the disinfection process and allow sufficient time for operators to adjust controllable variables or restart disrupted processes to ensure that drinking water quality is not adversely affected.

Operators at the King Street and Point Pleasant Water Treatment Plants have the ability to remotely adjust system processes through the SCADA system. Continuous operator coverage at the King Street Water Treatment Plant and the availability of standby operators ensures a very timely response to an alarm and initiation of the corrective action process.

8.1.3.3 Critical Control Limits

The critical control limits must be established at a levels which allow sufficient time for operators to identify and respond to events or conditions which are having an unfavorable effect on the disinfection processes to ensure effective disinfection is maintained and adverse water quality is avoided. With consideration of these factors, the following critical control limits for primary disinfection have been established.

- No less than 150% of the required CT (manual calculation)
- UV lamp fail alarm
- No less than 75% filtered water UVT

The Sydenham Drinking Water System Primary Disinfection Critical Control Limit Response Procedure – W-CC-09 describes the response to measured parameter alarms and possible exceedance of the critical control limit.

8.1.3.4 Secondary Disinfection Critical Control Limit

Secondary disinfection ensures an adequate disinfectant residual within all areas of the distribution system. Chloramination is the method employed in the Sydenham Drinking Water System for the maintenance of secondary disinfection residuals. Following the free chlorine primary disinfection step, ammonium sulphate is added at an approximate 4:1 ratio (free chlorine to ammonia), to react with the free chlorine residual to form chloramines for secondary disinfection. Chlorine and ammonium sulphate dosage rates and the resulting Cl_2 residuals at the Sydenham Water Treatment Plant are monitored and adjusted to ensure that adequate combined Cl_2 residuals are maintained at the furthest points from the water treatment plant discharge. The ongoing effectiveness of chlorine and ammonium sulphate dosage rates is monitored through the collection and testing of distribution system samples described by the Sampling, Testing, and Monitoring Procedure – W-G-09.

Secondary disinfection is monitored continuously through Cl_2 residual analyzers installed at the Sydenham Elevated Storage Tank and confirmed through distribution system grab samples collected on a regular basis. SCADA programs allow for the measurement, control, trending, and alarming of distribution system Cl_2 residual values.

Alarm set points for Cl_2 residuals at the water treatment plant and elevated storage tank are set at levels which indicate conditions, outside of normal operational variance, with the potential to negatively affect secondary disinfection effectiveness and allow sufficient time for operators to carry out flushing, adjust chlorine and ammonium sulphate dosages, or restart disrupted processes to ensure that drinking water safety is not adversely affected.

Operators at the King Street and Point Pleasant Water Treatment Plants have the ability to remotely monitor and/or adjust system processes through SCADA. Continuous operator coverage at the King Street Water Treatment Plant and the availability of standby operators ensures a very timely response to an alarm and initiation of the corrective action process.

With consideration of these factors, the critical control limit for distribution system combined Cl_2 residual can be established at no less than 1.00mg/L. This level allows sufficient time for operators to undertake corrective action to ensure that adverse water quality is avoided.

The Sydenham Drinking Water System Secondary Disinfection Critical Control Limit Response Procedure – W-CC-10 describes the response to measured parameter alarms and possible exceedance of the critical control limit.

9. Organizational Structure, Roles, Responsibilities, and Authorities

9.1 Organizational Structure and Roles

The City of Kingston is the sole shareholder of the Ontario Business Corporation 1425445 Ontario Limited, operating as Utilities Kingston. Utilities Kingston currently provides five different utility services to its customers; water, wastewater, electric, natural gas, and a fibre optic network.

W-L-13s – Sydenham Organizational Structure, Roles, Responsibilities, Authorities, and Competencies provides a summary view of Utilities Kingston's organizational structure. Roles which are displayed in the chart within a blue coloured cell have duties and authorities which impact the safe and reliable supply of drinking water to the customer. The responsibilities, duties and authorities of these roles are described in detail.

Roles and groups which are displayed in the chart within an uncoloured cell do not have duties and authorities which directly impact the safe and reliable supply of drinking water although they may provide services which support the activities of those accountable for the safe and reliable supply of drinking water to the customer.

9.2 Responsibilities

There are four overarching responsibilities under this Operational Plan for which persons having duties and authorities impacting the safe and reliable supply of drinking water to the customer must be held accountable. Those responsibilities are:

- The provision of a safe and secure supply of drinking water
- The identification, obtainment and provision of sufficient resources to ensure the continued safe and secure supply of drinking water
- Ensuring regulatory compliance with regard to drinking water system operations

- Supporting the development, implementation, and continual improvement of a Quality Management System for the drinking water system

9.3 Duties and Authorities

W-L-13s – Sydenham Organizational Structure, Roles, Responsibilities, Authorities, and Competencies This section describes the duties and authorities of those persons or groups accountable for the safe and reliable supply of drinking water to the customer.

10. Competencies

This section describes the competencies, certification, and training requirements for personnel performing duties directly affecting drinking water quality by monitoring, maintaining, and adjusting drinking water system processes, directing changes and adjustments to drinking water system processes, or having duties related to the design, construction, and inspection of drinking water system infrastructure. W-L-13s – Sydenham Organizational Structure, Roles, Responsibilities, Authorities, and Competencies identifies the current required competencies, certification, and training for Utilities Kingston personnel charged with these duties as well as some specific desired competencies.

The required drinking water certifications for the Director(s), and Manager(s), are not identified by the table; desired certifications are identified. Utilities Kingston does ensure that sufficient certifications are held and maintained by management personnel to ensure effective oversight of drinking water system operation that meets regulatory requirements.

- **Competency level 1** indicates that a basic technical proficiency and/or basic knowledge and understanding of a skill or subject area are required. Level 1 competency can be obtained through a combination of education, theoretical and practical instruction, and participation in specialty courses and workshops.
- **Competency level 2** indicates that a good technical proficiency and working knowledge and understanding of a skill or subject area are required. Level 2 competency can be obtained through a combination of education, theoretical and practical instruction, participation in specialty workshops and courses, and work experience.
- **Competency level 3** indicates that an advanced technical proficiency and theoretical and working knowledge and understanding of a particular skill or subject area are required. Level 3 competencies can be achieved through various combinations of education in engineering, science, or other related fields, directly related training, extensive work experience, and regular participation at specialty workshops and courses.

10.1 Meeting and Maintaining Competencies

The Operator Training Procedure – W-G-04 describes how Drinking Water Operators are provided with sufficient training to comply with legislated requirements and to meet and maintain the competency and certification requirements identified in this Operational Plan.

Utilities Kingston encourages Operators to attain competencies and certifications above the minimum requirements. Operators that have met the required competencies and certifications are given the opportunity to receive Competency Enhancement Training as described in the Operator Training Program. These training opportunities are provided to allow Operators to acquire enhanced knowledge and skills and to assist in meeting the education requirements for upgrading Drinking Water Operator Certificates beyond the required levels identified.

Proof of training records are maintained in the personnel files maintained by Human Resources and information regarding training for all operators is tracked electronically in the City Of Kingston's Human Resources Management System (People Soft HRMS). Training information tracked by this system

includes course/training descriptions, training providers, training scheduled and completed, total hours of training completed, and total hours of Director approved training completed.

11. Personnel Coverage

11.1 General

The Personnel Coverage Procedure – W-G-05 describes how Utilities Kingston ensures that sufficient personnel are available to provide a safe and reliable supply of drinking water to the customer. The procedure deals primarily with the processes and protocols used to ensure that sufficient qualified and competent Water Treatment and Water Distribution System Operators are available and that Overall Responsible Operators and Operators in Charge are designated.

Utilities Kingston employs certified operators to operate and maintain the Sydenham Drinking Water System. All personnel employed within Utilities Kingston Water Operations, in a role identified in the Competencies Table, must meet the minimum competency and certification requirements described in the table.

The Director of Engineering, Human Resources and Treatment Operations, Director, Operations, Manager of Water and Wastewater Treatment Operations, Manager of Water and Wastewater Underground Infrastructure, Water and Wastewater Treatment Supervisors and the Water and Wastewater Underground Infrastructure Supervisor form the management team responsible for coordinating and directing the activities of workers employed within the Water and Wastewater Operations Group under the terms and conditions of a collective agreement between Utilities Kingston and the International Brotherhood of Electrical Workers.

11.2 Treatment Group

Operators within the Treatment Group are certified as Water Treatment Operators.

The operation of the Sydenham Water Treatment Plant is continuously monitored through a Supervisory Control and Data Acquisition (SCADA) system. The SCADA system allows for remote monitoring and operation of the treatment and pumping processes from the King Street or Point Pleasant Water Treatment Plants located in the City of Kingston. A shift Operator is on duty at all times at the King Street Water Treatment Plant. Local process control is available through the SCADA panel at the Sydenham Water Treatment Plant. Treatment Operators and Journeypersons perform regular rounds and routine maintenance at the plant.

Alarm conditions are forwarded to operators via cell phones. Under normal operating conditions, this system allows operators to perform duties away from the treatment plant.

Operator coverage for weekday off hours, weekends, and holidays is ensured through the use of 24 hour Operator coverage at the King Street Water Treatment Plant and standby and call out rotation schedules.

The Underground Infrastructure Group provides assistance in instances where specific knowledge, skills, or equipment is an asset.

11.3 Underground Infrastructure Group

Operators within the Underground Infrastructure Group are certified as both Water Distribution and Wastewater Collection Operators. Assistance is available from the Treatment Group in those instances where specific knowledge, skills, or equipment is an asset.

The Underground Infrastructure Group’s base of operations is at the Utilities Kingston Service Centre located at 91 Lappan’s Lane in the City of Kingston. Regular working hours are from 7:30am to 4:00pm, Monday through Friday. Operator coverage for weekday off hours, weekends, and holidays is ensured through the use of standby and call out rotation schedules.

12. QMS Communications

The QMS Communications Procedure – W-G-06 describes how relevant aspects of the Drinking Water QMS are communicated to and between Utilities Kingston Top Management, System Owners, Utilities Kingston personnel, the public, and providers of essential supplies and services.

Utilities Kingston Top Management communicates with the Owner with regard to drinking water system issues and the Drinking Water QMS through reports to the Chief Administrative Officer and Council.

13. Essential Supplies and Services

Documentation of applicable licensing, certification and accreditation ensures quality in the supplies and services employed by Utilities Kingston in the maintenance of infrastructure, and in the processes required to provide drinking water to our customers. Specifically, Utilities Kingston requires suppliers of treatment chemicals and other materials coming into contact with drinking water to provide current documentation that those products have undergone testing and have met the AWWA and ANSI standards (NSF/60, NSF/61), and CALA accreditation for those providing laboratory testing services. In addition to this, Utilities Kingston may also require other licensing, accreditation, certification and verification documentation as noted in its policies and procedures.

The Essential Supplies and Services List – W-L-06 identifies those supplies and services considered essential to the continued supply of safe drinking water to the customer and the primary and alternate suppliers.

14. Review and Provision of Infrastructure

Regular evaluation and review of the condition and capacity of drinking water systems and their components is required to ensure the continued provision of safe drinking water to the customer.

At least annually and as described by the Sydenham Drinking Water System Review and Provision of Infrastructure Procedure – W-G-07S, an evaluation of drinking water system infrastructure condition and capacity through the review of available information including relevant outcomes of the risk assessment is completed to identify any needed rehabilitation, renewal and improvement of existing infrastructure and provision of new infrastructure, prioritize those identified needs, and make recommendations to the system Owner based on the prioritized needs.

Recommendations made to the Owner must include the need for any:

- New infrastructure required due to regulatory, growth, or maintenance requirements
- Improvements to existing infrastructure required due to regulatory, growth, or maintenance requirements
- Rehabilitation and renewal of existing infrastructure based on condition assessments and maintenance requirements

15. Infrastructure Maintenance, Rehabilitation, and Renewal

The ongoing maintenance, rehabilitation, and renewal of drinking water systems and their components is required to ensure the continued provision of safe drinking water to the customer.

Maintenance activities may be either preventative in nature, planned maintenance, or reactive, unplanned maintenance. Planned maintenance includes activities such flushing, valve inspection and maintenance, scheduled calibration of measurement and recording equipment, and routine inspection of equipment condition and operation during rounds at facilities. Unplanned maintenance includes activities such as broken water main and service leak repair, response to various equipment failures, and investigating customer complaints.

Maintenance activities, whether planned or unplanned, are recorded in facility and system log books, work orders, service orders, and other applicable reports and forms. At least annually, and as described by the Infrastructure Maintenance Rehabilitation Renewal Procedure – W-G-08, these records including facility condition assessments, and the long term capital plan are reviewed to identify trends that could indicate the need for infrastructure rehabilitation or renewal.

16. Sampling, Testing, and Monitoring

Measuring and recording the various parameters used in process control and in the application of treatment chemicals and the sampling and testing of drinking water from various system locations is essential to the provision of quality drinking water to the customers of Utilities Kingston. This is a standalone system and no relevant sampling upstream of the system's raw water intake is undertaken.

The sampling, testing, and monitoring completed for the Sydenham Drinking Water System meets regulatory requirements.

The Sampling, Testing, and Monitoring Procedure – W-G-09 describes the sampling, testing and monitoring activities undertaken by Utilities Kingston to ensure optimal drinking water treatment process control and the safety of the drinking water provided to our customers.

17. Measurement and Recording Equipment Calibration & Maintenance

Accuracy in measuring and recording the various parameters used in process control and in the application of treatment chemicals is essential to the provision of quality drinking water to the customers of Utilities Kingston. The Measurement and Recording Equipment Calibration and Maintenance Procedure – W-G-10 describes when and how the calibration of equipment used to make and record measurements critical to the operation of the drinking water system is completed and documented to ensure process efficiency and accuracy, and to meet and maintain regulatory requirements and internal water goals.

18. Emergency Management

The term ‘Emergency’ is typically used to describe a situation which requires immediate action to protect and preserve the health, safety and welfare of persons and limit or prevent damage and destruction of property, infrastructure and the environment. Drinking water emergencies are those situations that may result in the loss of the ability to maintain a supply of safe drinking water to the users of the drinking water system. A potential major drinking water emergency has the potential to adversely affect the supply of safe drinking water to a significant portion of the system or to critical facilities such as hospitals, nursing homes and medical clinics. A major drinking water emergency is adversely affecting or will adversely affect the supply of safe drinking water to a significant portion of the system or to critical facilities.

The Emergency Response and Recovery Procedure – W-E-01 describes the general response and recovery processes to be followed when dealing with a drinking water emergency and evaluating the effectiveness of completed response and recovery operations. The procedure also identifies the requirements for and the processes used to identify potential future drinking water emergencies, develop contingencies to respond to potential emergencies, and evaluate the effectiveness of those contingencies.

The Township of South Frontenac’s Emergency Response Plan identifies the members of the Community Control Group and outlines each member’s responsibilities. Specific to drinking water, the Public Works Manager and the Medical Officer of Health are responsible for ensuring the safety of drinking water. During a declared emergency, Utilities Kingston will keep the Community Control Group

apprised of the operational condition of the Sydenham Drinking Water System and the safety and security of the drinking water supplied by the system.

19. Internal Audits

Internal audits are conducted to evaluate conformity of the Quality Management System with the requirements of the Drinking Water Quality Management Standard. Internal audits must be completed at least once a calendar year. The Internal Audit Procedure – W-G-11 describes how internal audits are completed for each of the drinking water systems operated by Utilities Kingston.

20. Management Review

At least once a calendar year a management review committee is required to review the performance of the Drinking Water QMS and identify any deficiencies which require corrective action. The review is intended to ensure the continuing suitability, adequacy and effectiveness of the Drinking Water QMS. The Management Review Procedure – W-G-12 describes how the review is to be completed and the results communicated. Best management practices published by the Ministry of Conservation and Parks will also be reviewed and considered during the Management Review.

21. Continual Improvement of the Quality Management System

Utilities Kingston will strive to continually improve the Quality Management System through the use of preventative actions to eliminate the cause of potential non-conformities and through corrective actions undertaken to address non-conformances identified through internal audits, and management reviews, and by implementing improvements identified and suggested by staff and management including best management practices.

Appendix A – Schedule "C" Subject System Description Form

Print Form

Schedule "C"

Subject System Description Form
Municipal Residential Drinking Water System

Owner of Municipal Residential Drinking Water System:[1] Township of South Frontenac

Name of Municipal Residential Drinking Water System:[2] Sydenham Drinking Water System

Subject Systems

Name of Operational Subsystems[3] (if Applicable)	Name of Operating Authority [5]	DWS Number(s)[6]
☒ Check here if the Municipal Residential Drinking Water System is operated by one operating authority. Enter the name of the operating authority in adjacent column [4]	1425445 Ontario Limited	260069290
Operational Subsystem 1:		
Operational Subsystem 2:		
Operational Subsystem 3:		
Operational Subsystem 4:		

Add attachments if there are additional 'Operational Subsystems'

Contact Information [7]

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