Operational Plan

for the
Kingston and Cana Drinking Water Systems

Prepared by Utilities Kingston
(1425445 Ontario Limited)
for
The City of Kingston

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 City of Kingston.

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 non-conformity 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 Kingston and Cana Drinking Water Systems. 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 drinking water systems owned by the City of Kingston, 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 City of Kingston's Drinking Water Supply Systems – W-P-01 is reviewed and approved by Top Management.

Quality Management System Policy for the City of Kingston's Drinking Water Supply Systems

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 water treatment and distribution facilities owned by the City of Kingston, 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 our community's drinking water by meeting or exceeding the requirements of all relevant legislation and regulations, and the Drinking Water Quality Management Standard.

3. Commitment and Endorsement

The original draft of this Operational Plan was endorsed by Utilities Kingston Top Management and provided to Kingston City Council for their consideration at the Council Meeting of November 25, 2008. Updated versions of the Operational Plan are provided to Kingston City Council for their review and renewal of their endorsement. The Owner and Top Management Endorsement of the Operational Plan for the City of Kingston's Drinking Water Supply Systems – W-P-02 has been signed by the City of Kingston's representatives and Utilities Kingston Top Management.

Owner and Top Management Endorsement of The Operational Plan for Kingston's Drinking Water Supply Systems

The City of Kingston and Utilities Kingston support the implementation, maintenance, and continual improvement of a Quality Management System for the drinking water systems owned by the City of Kingston and operated by Utilities Kingston as documented in the Kingston and Cana Drinking Water Systems 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 Plans, the Drinking Water Quality Management Standard, and the Safe Drinking Water Act.

4. Quality Management System Representative

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 Representative(s) should the QMS Representative 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 Acknowledgement of Responsibilities – W-P-03.

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 Kingston Drinking Water System

6.1.1 General

The Kingston Drinking Water System, depicted by Figure 1 – Kingston Drinking Water System Map, is owned by the City of Kingston and operated by Utilities Kingston and provides safe drinking water to people living and working within the urban area of the City of Kingston. The area serviced by the system stretches along Lake Ontario and the St. Lawrence River from Coronation Boulevard in the west, easterly for approximately twenty kilometers to Milton Subdivision in the east, and generally south of Highway 401.

Drinking water is distributed to the serviced area by the Class 4 Kingston Drinking Water Distribution System. The distribution system is comprised of over 590km of water mains, 3 ground level reservoir/pumping stations, 5 water towers (4 elevated storage tanks and 1 standpipe), 3 booster stations, over 5,495 main line valves, and over 3,560 fire hydrants and their associated isolation valves.

Drinking water is supplied to the distribution system by two Class 3 water treatment plants. The Point Pleasant Water Treatment Plant is located at 80 Sunny Acres Road and supplies potable water primarily to Distribution Area 1. The King Street Water Treatment Plant is located at 302 King Street West and supplies potable water primarily to Distribution Areas 2 and 3. The raw water source for both treatment facilities is Lake Ontario.

To enable efficient system monitoring and maintenance, three ‘Distribution Areas’ have been identified. Distribution Area 1 (West) is the area west of the Little Cataraqui Creek. Distribution Area 2 (Central) is the area east of the Little Cataraqui Creek and west of the Cataraqui River. Distribution Area 3 (East) is the area east of the Cataraqui River.

Distribution Areas 1 and 2 are connected through a 300mm main on Bath Road west of Armstrong Road and a 300mm main on Princess Street at the CN Rail line. The valves controlling these connections are operated as required for efficient system operation. Water may flow in either direction, between Areas 1 or 2 through these connections.

Distribution Areas 2 and 3 are connected through two water mains (400mm and 471mm) which cross under the Cataraqui River. Water flows through these connections from Area 2 to Area 3.

6.1.2 Source Water Overview

The raw water source for both the Point Pleasant and King Street Water Treatment Plants is Lake Ontario at the mouth of the St. Lawrence River. Raw water for the Point Pleasant Water Treatment Plant is drawn from a location approximately 500 metres south of the plant at a depth of approximately eighteen metres. Raw water for the King Street Water treatment Plant is drawn from a location approximately one kilometre south of this plant and four metres off the lake bottom at a depth of approximately eighteen metres.

The raw water drawn from these locations is typically low in dissolved solids, organic carbon, and alkalinity. The water is slightly basic with an average pH of approximately 8.0 and marginally hard with an average hardness of approximately 120mg/l as $CaCO_3$. With the exception of occasional turbidity spikes, raw water turbidity levels are typically less than 0.5 NTU.

Seasonal raw water temperature fluctuations are significant. Raw water temperatures at the Point Pleasant Water Treatment Plant have ranged from as low as 0.3^{o}C during the winter months to as high as 28^{o}C during the summer. Raw water temperatures at the King Street Water Treatment Plant have ranged from as low as 0.7^{o}C during the winter months to as high as 22^{o}C during the summer.

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

6.1.2.1 Events

Seasonal changes in raw water temperatures cause vertical turnover of the lake water during spring and fall. Turnover typically takes place over a relatively short duration of approximately 2 to 7 days. During that period, settled solids from the lakebed are re-suspended resulting in increased raw water turbidity. Operators must be prepared to make appropriate plant adjustments to treat the elevated levels of turbidity experienced during turnover events.

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

6.1.2.2 Threats

The locations of the source water intakes at the eastern end of Lake Ontario are downstream of a drainage basin, the Great Lakes, which is inhabited by over thirty million people. Lake Ontario, and the entire drainage basin, receives direct discharges from wastewater treatment facilities, storm water outfalls, and industries, as well as indirect discharges from agricultural runoff. The lakes are also subject to seasonal commercial marine shipping and recreational traffic which are potential sources of contamination through spills or illegal discharges.

Locally, the City of Kingston has a number of storm water outfalls along the shoreline of the lake and the Cataraqui Bay Wastewater Treatment Plant discharges into the lake approximately 7.3 kilometres upstream of the King Street Water Treatment Plant.

While the risk of source water contamination through spills and discharges 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:

- Lake Ontario, due to its size, has a significant assimilative capacity for contaminant discharges
- 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.

6.1.2.3 Intake Protection Zones

The Cataraqui Source Protection Plan has identified Intake Protection Zones for the Point Pleasant and King Street Water Treatment Plants. 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. The Intake Protection Zones are shown in Figure 2 – Intake Protection Zones.

6.1.2.4. Operational Challenges

Lake Ontario provides high quality source water which is, for the most part, consistently low in bacteriological contamination and turbidity. Seasonally, during turbidity and temperature fluctuations,

operational changes are required for optimal coagulant dosages to ensure adequate turbidity removal while maintaining filter performance and minimizing aluminum residual carryover.

During summer months, algae blooms and water fleas can create operational challenges requiring deviations from normal operations. With these seasonal events, the operator may be required to increase the frequency of traveling screen cycles and increase the frequency and/or duration of filter backwashes to reduce screen and filter clogging.

6.1.3 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 and disinfection through chlorination (primary disinfection), continuous monitoring and automated control of treatment processes and distribution system facilities, monitoring and maintenance of sufficient chlorine residuals throughout the distribution system (secondary disinfection), and the utilization of system redundancies and standby equipment.

6.1.4 Critical Upstream and Downstream Processes

Utilities Kingston does not currently rely upon any critical processes upstream of the drinking water systems to ensure the provision of safe drinking water.

The Cross Connection Control Program is a critical downstream process, used to ensure the continued safety of the drinking water provided to customers. The program, which targets industrial, commercial, and institutional customers, requires the installation, maintenance, and testing of approved backflow prevention devices to achieve premise isolation from the distribution system to ensure that water does not flow from customer facilities into the distribution system.

6.1.5 Connections to Other Drinking Water Systems

The Kingston Drinking Water System is connected to the Fairfield Water Distribution System, owned and operated by Loyalist Township, at the western limits of the system on Bath Road just west of Coronation Boulevard. The valve at this connection is closed and no water flows between the connected systems. Figure 1 – Kingston Drinking Water System Map

Figure 1 – Kingston Drinking Water System

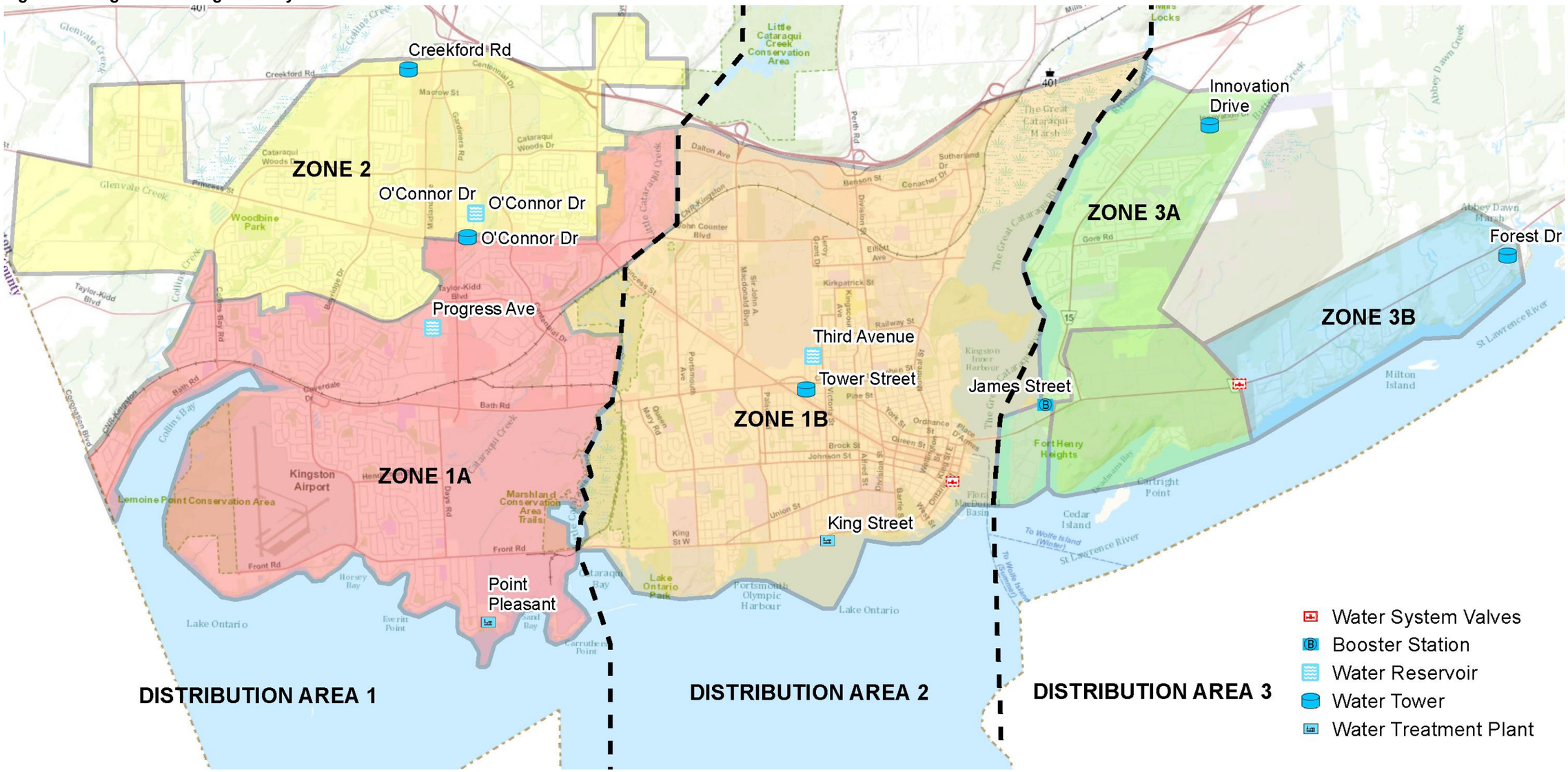
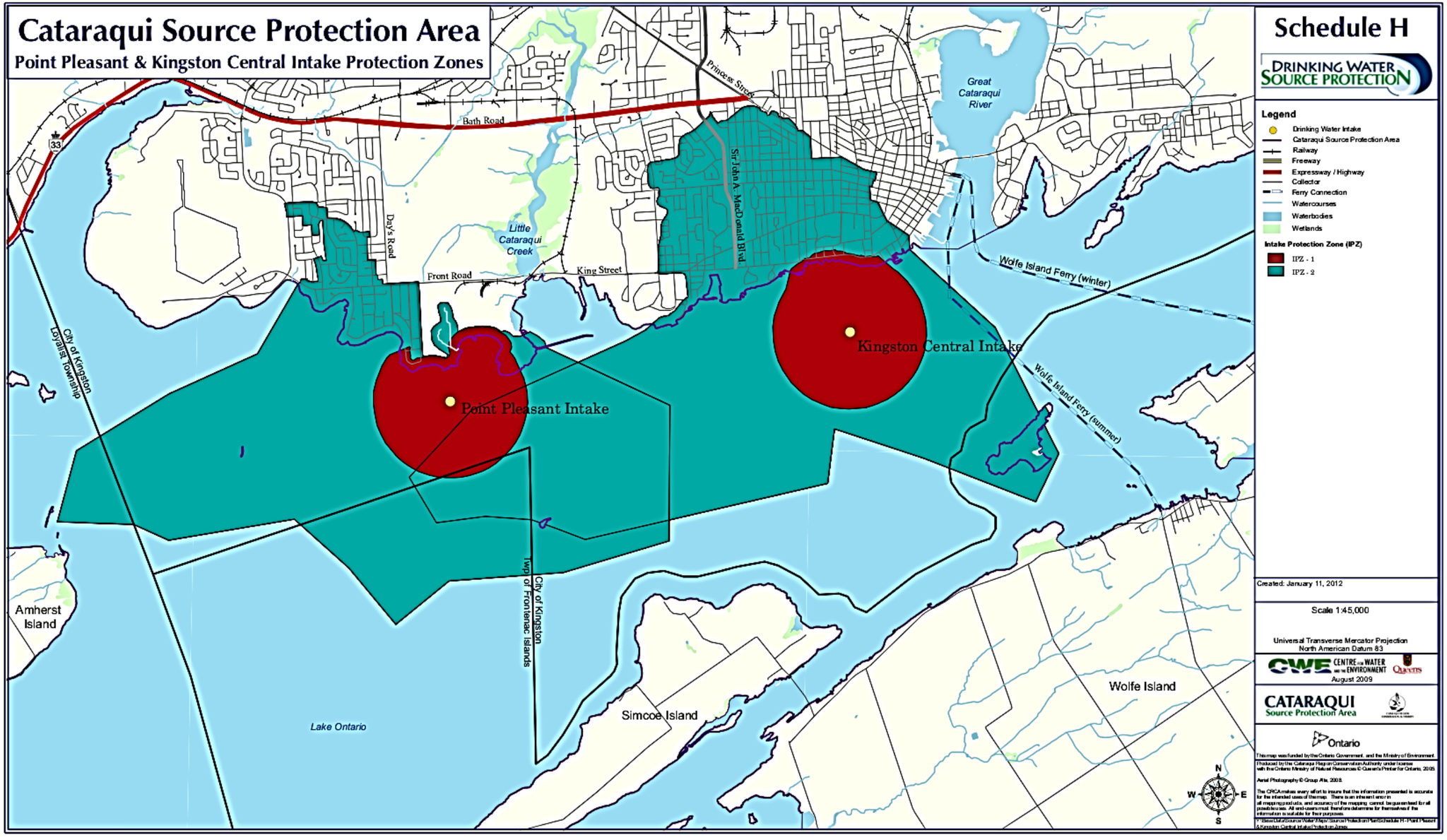


Figure 2 – Kingston Drinking Water System Intake Protection Zones



Water Treatment Facilities

6.1.5.1 Point Pleasant Water Treatment Plant

The Point Pleasant Water Treatment Plant, located at 80 Sunny Acres Road, supplies water to Distribution Area 1. This is an automated eight filter, chemically assisted, direct filtration water treatment plant with an approved capacity of 80,000m^3/day. Average flow to the distribution system is approximately 20,000m^3/day.

Raw Water Source

The raw water source is Lake Ontario at the mouth of the St. Lawrence River. The intake is located about 520m south of the treatment plant at a depth of approximately 18m. Water flows by gravity from the lake through a 1220mm intake pipe to the low lift suction well located in the Low Lift Pumping Station.

Pre-Chlorination / Zebra Mussel Control

Two chlorine solution lines are provided to facilitate chlorine solution injection to the raw water intake at the intake crib. This protects the intake from becoming encrusted with zebra mussels, which would restrict the flow of water through the intake.

Screening

The common intake well is equipped with both a manual screen and an automatically controlled mechanical bar screen. The manual screen is installed upstream of the mechanical screen and is used when the mechanical bar screen is out of service. The raw water discharge of the mechanical bar screen feeds the two low lift pump wells through manual gates installed at the inlet of each well.

Low Lift Pumping

Four low lift pumps draw water from the suction wells and lift that water from lake level through a common discharge header and then through two separated headers (750mm and 900mm) to the process building. The four pumps are comprised of three electric variable frequency drive pumps and one dual drive electric/diesel pump. The discharge headers carry the raw water to the raw water conduit in the process building.

Coagulation / Flocculation

A liquid coagulant, Polyaluminum Chloride (PACl), is dosed to the raw water in the common low lift discharge header in the low lift building. As a coagulant, 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.

After receiving the coagulant, water from the common low lift discharge header, flows through the separated headers to the raw water conduit and into five rapid mixing tanks. Each mixing tank is equipped with an electrically driven rapid mixer to ensure proper mixing of the PACl with the water. From the mixing tanks, the water then flows into one of eight dual chamber flocculation tanks where the floc begins to form and settle out. Each chamber of the flocculation tanks is equipped with an electrically driven variable speed mixer (flocculator) to assist the flocculation process.

Filtration

Flocculation tank effluent flows into the flocculated water conduit and then to eight 'rapid sand' filters with Granular Activated Carbon (GAC) which remove particulate impurities. The GAC also removes compounds that may cause tastes and odours. Water flowing on top of the filters travels down through

the filter media layers and is collected by an underdrain system at the bottom of the filter. The turbidity of the water exiting each filter is measured continuously to monitor the effectiveness of the filtration process. The flow rate of filtered water exiting each filter is continuously monitored as it flows to one of four clear wells.

Filters are backwashed regularly to remove the particulates they have collected. The filter is air scoured to break up any large particles, and clean water from the clear well is pumped backwards through the filter media to wash it.

Process Waste Management

Effluent from the filter backwash process is directed to three backwash wastewater holding tanks. The decanted wastewater is directed back to Lake Ontario, using a Calcium Thiosulphate chemical injection system as a chlorine residual quenching system. Settled waste from the filters in the backwash waste system is pumped to the sanitary sewer system.

Disinfection / Post Chlorination

Filtered water from the clear wells flows through two headers (750mm and 900mm) to the chlorine contact tank. Chlorine solution from the gas chlorinators is dosed to the water in the two headers upstream of the contact tank. The chlorinated water flows through the baffled contact tank to the two treated water reservoirs. Free chlorine residuals are continuously monitored at the water entry and exit points of the contact tank. Minimum chlorine residual levels are provided to ensure in-plant chemical disinfection CT values are equal to or greater than the required level determined by the 'Procedure for Disinfection of Water in Ontario'.

Additionally, post-chlorination is provided in the high lift suction well, to provide additional chlorination if required, based on the measured high lift suction well chlorine residual.

High Lift Pumping

Water from the treated water reservoirs flows to the high lift suction well and is then pumped to the distribution system through two distribution system discharge headers by five high lift pumps. The five pumps consist of four variable frequency drive electric pumps and one diesel driven backup pump.

The flow rate, turbidity, and free chlorine residual of treated water pumped to the distribution system are continuously monitored.

Standby Equipment

A 2500 kW diesel generator provides electricity to run the treatment plant during a power outage. In addition, diesel driven pumps are maintained to provide a reduced but continuous supply of water in the event that the backup generator fails. Standby equipment is also maintained for all critical processes.

Figure 3 – Point Pleasant Water Treatment Plant Process Flow Diagram

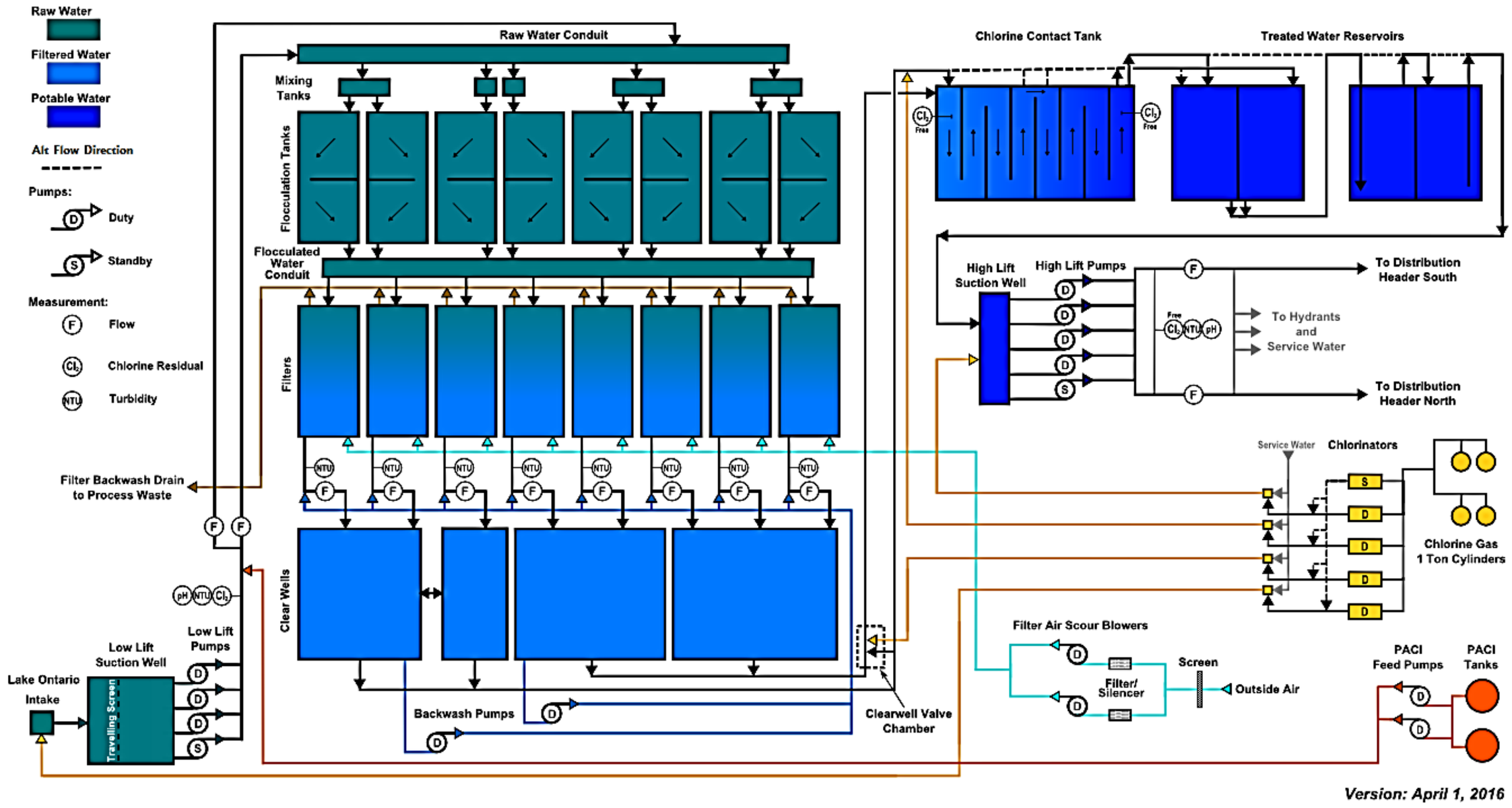
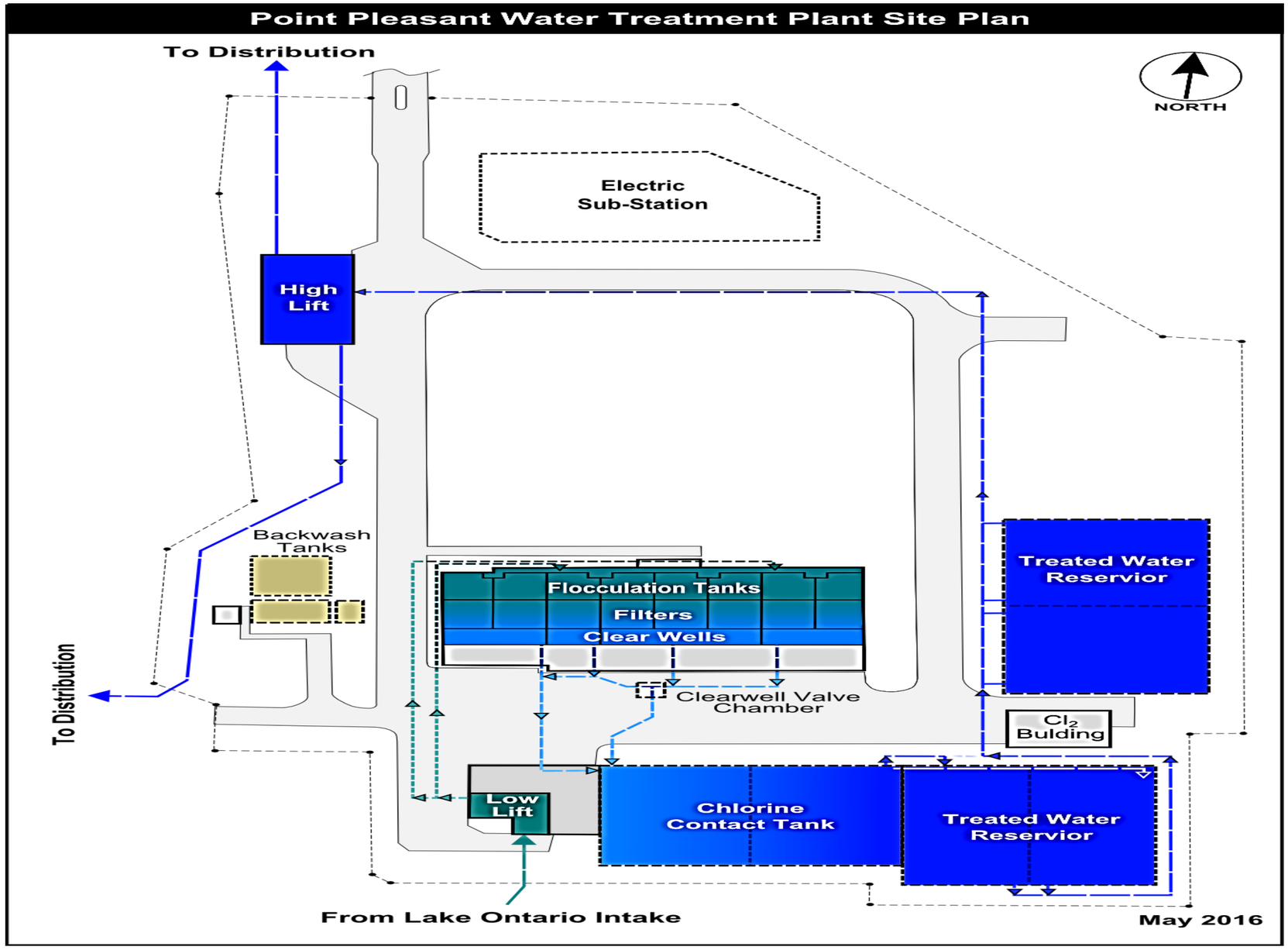


Figure 4 – Point Pleasant Water Treatment Plant Site Plan



6.1.5.2 King Street Water Treatment Plant

The King Street Water Treatment Plant, located at 302 King Street West, provides drinking water primarily to Distribution Areas 2 and 3. This is a six filter, chemically assisted, conventional water treatment plant with an approved capacity of 118,000m^3/day. Average flow to the distribution system is approximately 50,000m^3/day.

Raw Water Supply

The raw water source is Lake Ontario at the mouth of the St. Lawrence River. The intake is located 1 kilometre south of the treatment plant, 4 metres off the lake bottom, at a depth of approximately 18 metres. Water flows by gravity from the lake through 4 intake bell mouths and then through a 1200mm intake pipe and surge tank to the low lift suction well located in the in the Low Lift Pumping Station.

Disinfection / Pre-Chlorination

A Solution of 12% Sodium Hypochlorite is dosed to the raw water to begin the disinfection process. Depending on the temperature of the water, this pre-chlorination takes place either as the water enters the suction well or at the mouth of the intake pipe.

Zebra Mussel Control

Raw water temperature is monitored at the suction well. When the water temperature rises above 10 degrees Celsius (when zebra mussels become active) pre-chlorination takes place at the mouth of the intake. A small chlorine solution line runs inside the intake pipe and discharges through diffuser rings at the intake bell mouths. This protects the intake from becoming encrusted with zebra mussels, which would restrict the flow of water through the intake.

Screening

As the raw water enters the low lift suction well it passes through a traveling screen. The 1cm square mesh screen removes large objects such as weeds, fish, sticks, and other debris from the water.

Low Lift Pumping

Four low lift pumps draw water from the suction well and lift that water from lake level to the main plant through two headers (750mm and 900mm). The four pumps are comprised of two electric pumps and two dual drive electric/diesel pumps. The two low lift headers carry raw water to the mixing tanks in the main plant. The flow rate of raw water pumped through the low lift discharge headers is continuously monitored within two chambers downstream of the low lift pumps.

Coagulation/Flocculation

A liquid coagulant, Polyaluminum Chloride (PACl), is added to the water as it leaves the Low Lift Pumping Station. As a coagulant, 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 solids-separation processes.

Water from the Low Lift Pumping Station flows into three mixing/flocculation tanks. Each mixing tank has three hydraulically connected cells. Water follows a spiral flow path as it flows through the three cell mixing chambers. This hydraulic mixing is designed to assist with flocculation.

Sedimentation

After exiting the mixing tanks, the water flows into three settling tanks. The flow velocity of the water in the settling tanks is reduced allowing the heavier floc particles to settle to the bottom.

The water at the top of the tanks is collected and directed to the filters via a common settled water conduit.

Filtration

Six gravity sand filters, two with anthracite, and four with Granular Activated Carbon (GAC) remove particulate impurities. The GAC also removes compounds that may cause tastes and odours. Water flowing on top of the filters travels down through the filter layers and is collected in underdrains located at the bottom of the filter. The turbidity of the water exiting each filter is measured continuously to monitor the effectiveness of the filtration process. The flow rate of filtered water exiting each filter is continuously monitored as it flows to the two clear wells.

Filters are backwashed regularly to remove the collected particulates. Clean water from the clearwells is pumped backwards through the filter and the top layer of the filter is agitated to break up any large particles.

Process Waste Management

Effluent from the filter backwash process, and sludge from the settling process, is directed to a process waste facility. The effluent is directed to the two equalization tanks at the head of the process. A polymer is added to the water as a coagulant and the water then passes through plate settlers where sludge builds up on the plates, sloughs off, and collects at the bottom of the tanks with the sludge produced during the process. It is then pumped to the sanitary sewer system for further treatment at the Ravensview Wastewater Treatment Plant. The supernatant or clarified water from the process is chemically de-chlorinated and discharged to Lake Ontario.

Disinfection / Post Chlorination

Sodium Hypochlorite is added to the filtered water in a pre-clearwell mixing tank prior to entering the clearwells. The two baffled clearwells store approximately 5,000m^3 of water and are used to provide filtered water disinfection. Minimum chlorine residual levels are provided to ensure in-plant chemical disinfection CT values are equal to or greater than the required level determined by the Procedure for Disinfection of Water in Ontario.

High Lift Pumping

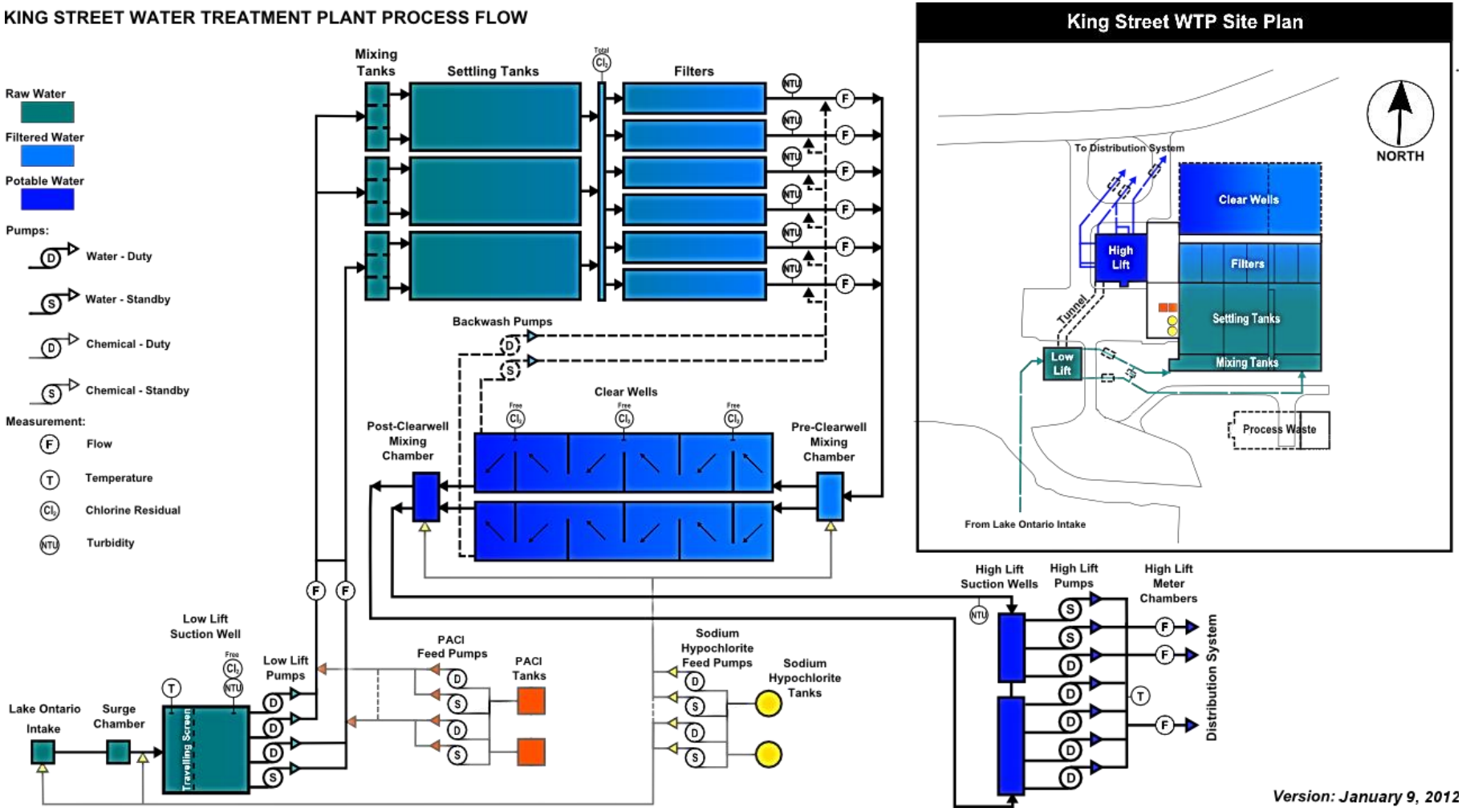
Water is pumped from the clearwells of the King Street Water Treatment Plant to the distribution system by seven pumps in the treatment plant's High Lift Pumping Station. The seven pumps consist of four electric pumps, one dual drive electric/diesel pump, and two diesel pumps.

The flow rate of treated water pumped to the distribution system is continuously monitored in three chambers downstream of the high lift pumps.

Standby Equipment

Diesel driven pumps are maintained to provide a continuous supply of water during power failures. These provide enough capacity to meet fire-fighting requirements as well as normal flows during power outages. A diesel generator provides electricity to run metering equipment and lighting in the water plant. Standby equipment is maintained for all critical processes.

Figure 5 – King Street Water Treatment Plant Process Flow Diagram



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6.1.6 Distribution System

6.1.6.1 Distribution Area 1

Distribution Area 1 is that area west of the Little Cataraqui Creek, south of Highway 401 and east of Coronation Boulevard, and north of Highway 401 along Sydenham Road northward to Mildred Street and eastward from Sydenham Road along Sunnyside Road for approximately 1.2 kilometres.

Distribution Area 1 is comprised of approximately 270km of water mains, 2 ground level reservoir/pumping stations, 2 elevated storage tanks, 2 booster stations, over 2,100 main line valves, and over 1,600 fire hydrants and their associated isolation valves.

There are 2 pressure zones within the area: Zone 1 and Zone 2.

The Point Pleasant Water Treatment Plant provides water to Pressure Zone 1. The O'Connor Drive Elevated Storage Tank and the Progress Avenue Reservoir are located within this pressure zone.

Water is supplied to Pressure Zone 2 from Pressure Zone 1 through the O'Connor Drive Reservoir and Booster Station. The Creekford Road Elevated Storage Tank is located within this zone.

Distribution Piping & Valves

Water main pipe typically ranges in size from 100mm to 1200mm and is of varied materials. Types of pipe typically found in the system are cast iron, ductile iron, asbestos cement, concrete pressure, and polyvinyl chloride (PVC). These same materials are found where service lines are 100mm or larger.

Small service piping materials, less than 100mm, that may be found in the system are copper, cross linked polyethylene (PEX) and polyethylene (PE).

Main line water valves, hydrant isolation valves, and service valves 100mm and larger typically turn clockwise to open, although there are valves found in the system that turn counter clockwise to open. Both gate valves and butterfly valves are used in the system. Gate valves found in the system range in size from 100mm to 400mm and butterfly valves range from 400mm to 1200mm.

Progress Avenue Reservoir

The Progress Avenue Reservoir, located at 730 Progress Avenue, is an in ground reservoir with a capacity of 6,600m^3. Two electric pumps and one diesel pump are available to pump water from the reservoir into the distribution system. The reservoir provides drinking water storage for pressure Zone 1. Free chlorine residuals are continuously monitored to ensure adequacy.

O'Connor Drive Elevated Storage Tank

The O'Connor Drive Elevated Storage Tank is located at 508 O'Connor Drive on the north side of Princess Street east of Gardiners Road. This tank has a total volume of 1,100m^3. The tank provides storage and system pressure stabilization for Pressure Zone 1. During normal system operation, the water level in this tank provides the primary control of pump operations at the Point Pleasant Water Treatment Plant and the Progress Avenue Reservoir. Free chlorine residuals are continuously monitored to ensure adequacy.

O'Connor Drive Reservoir

The O'Connor Drive Reservoir, located at 590 O'Connor Drive, is an above ground reservoir with a capacity of 8,044 m^3. Three electric pumps are available to pump water from Pressure Zone 1 into Pressure Zone 2, or from the reservoir tank into Pressure Zone 2. The reservoir and booster station provides drinking water pumping and storage for Pressure Zone 2.

Standby diesel generators with capacity to run two of the three booster pumps are provided at this station. Free chlorine residuals are continuously monitored to ensure adequacy.

Creekford Road Elevated Storage Tank

The Creekford Road Elevated Storage Tank is located at 2754 Creekford Road. This tank has a total volume of 6,800m^3. The tank provides storage and system pressure stabilization for Pressure Zone 2. During normal system operation, the water level in this tank provides the primary control of pump operations at the O'Connor Drive Reservoir Booster Station. Free chlorine residuals are continuously monitored to ensure adequacy.

6.1.6.2 Distribution Area 2

Distribution Area 2 is that area which is east of the Little Cataraqui Creek, west of the Cataraqui River, and south of Highway 401. A small area on the east side of the Cataraqui River upstream of the pumps at the James Street Booster Station is part of the Area 2 pressure zone. In addition, Collins Bay Institution, which is west of the Little Cataraqui Creek on Bath Road, is supplied with water from this area and from Area 1.

Distribution Area 2 is comprised of over 270km of water mains, one ground level reservoir/pumping station, one elevated storage tank, over 2,600 main line valves, and over 1,300 fire hydrants and their associated isolation valves.

There is one pressure zone within the area: Zone 1b.

The King Street Water Treatment Plant provides water to Pressure Zone 1b. The Tower Street Elevated Storage Tank and the Third Avenue Reservoir are located within this pressure zone.

Distribution Piping & Valves

Water main pipe typically ranges in size from 100mm to 750mm and is of varied materials. Types of pipe found in the system are cast iron, ductile iron, concrete pressure, polyvinyl chloride (PVC), and high density polyethylene (HDPE). These same materials may be found where service lines are 100mm or larger.

Small service piping of less than 100mm is also of varied material. Small service piping materials that may be found in the system include copper, cross-linked polyethylene (PEX), polyethylene (PE), lead, galvanized iron, and cast iron.

Main line water valves, hydrant isolation valves, and service valves 100mm and larger typically turn clockwise to open, although there are valves found in the system that turn counter clockwise to open. Both gate valves and butterfly valves are used in the system. Gate valves found in the system range in size from 100mm to 500mm and butterfly valves range from 400mm to 750mm.

Third Avenue Reservoir

The Third Avenue Reservoir, located at 119 Third Avenue, is an in ground reservoir with a capacity of 22,700m^3. Two electric pumps and one diesel pump are available to pump water from the reservoir into the distribution system. The reservoir provides drinking water storage for pressure Zone 1b. Free chlorine residuals are continuously monitored to ensure adequacy.

Tower Street Elevated Storage Tank

The Tower Street Elevated Storage Tank is located at 27 Tower Street. This tank has a total volume of 3,400m^3. The tank provides storage and system pressure stabilization for pressure Zone 1b. During normal system operation, the water level in this tank provides the primary control of pump operations at the King Street Water Treatment Plant and control of the filling and pumping operations at the Third Avenue Reservoir. Free chlorine residuals are continuously monitored to ensure adequacy.

6.1.6.3 Distribution Area 3

Distribution Area 3 is that area which is east of the Cataraqui River.

Distribution Area 3 is comprised of over 80km of water mains, one water booster station, three elevated storage facilities, over 600 main line valves, and over 300 fire hydrants and their associated isolation valves.

Under normal operating conditions there are two pressure zones within the area: Zones 3a, and 3b.

Water is supplied to Pressure Zone 3a from Pressure Zone 1b through the James Street Booster Station.

Water Zone 3A includes a Motorized Control Valve and the Innovation Drive Elevated Storage Tank.

Water is supplied to Pressure Zone 3b from Pressure Zone 3a through the Highway 2 Motorized Control Valve. The Forest Drive Standpipe is located within this pressure zone.

Distribution Piping & Valves

Water main pipe typically ranges in size from 150mm to 400mm and is of varied materials. Types of pipe found in the system are cast iron, ductile iron, concrete pressure, and polyvinyl chloride (PVC), These same materials may be found where service lines are 100mm or larger.

Small service piping of less than 100mm is also of varied material. Small service piping materials that may be found in the system include copper, cross-linked polyethylene (PEX), and polyethylene (PE),

Main line water valves, hydrant isolation valves, and service valves 100mm and larger typically turn clockwise to open although there are valves found in the system that turn counter clockwise to open. Gate valves that are found in the system range in size from 100mm to 400mm.

James Street Booster Station

The James Street Booster Station is located at 229 James Street in Barriefield village. This station is supplied by a 400mm cast iron water main and a 471mm HDPE water main, both running under the Cataraqui River from just south of the River Street Sewage Pumping Station on the west side of the river to James Street on the east side. Three electric pumps are available at this station to pump water into Distribution Area 3. Primary control of this station is provided by the water level in the Innovation Drive Elevated Storage Tank

Re-chlorination is completed at this facility, through the addition of sodium hypochlorite, to ensure adequate free chlorine residuals in this part of the distribution system.

A standby diesel generator with the capacity to run the chemical feed pumps, instrumentation, and two of the three booster pumps is provided at this station.

Distribution System Motorized Control Valves

A motorized control valves are used in Distribution Area 3 to control the flow of water to and from Pressure Zones 3A and 3B. Depending on the position of this valve, the area may be operating as one, or two, pressure zones. The motorized control valve on the north side of Highway 2 just east of CFB Kingston.

Innovation Drive Elevated Storage Tank

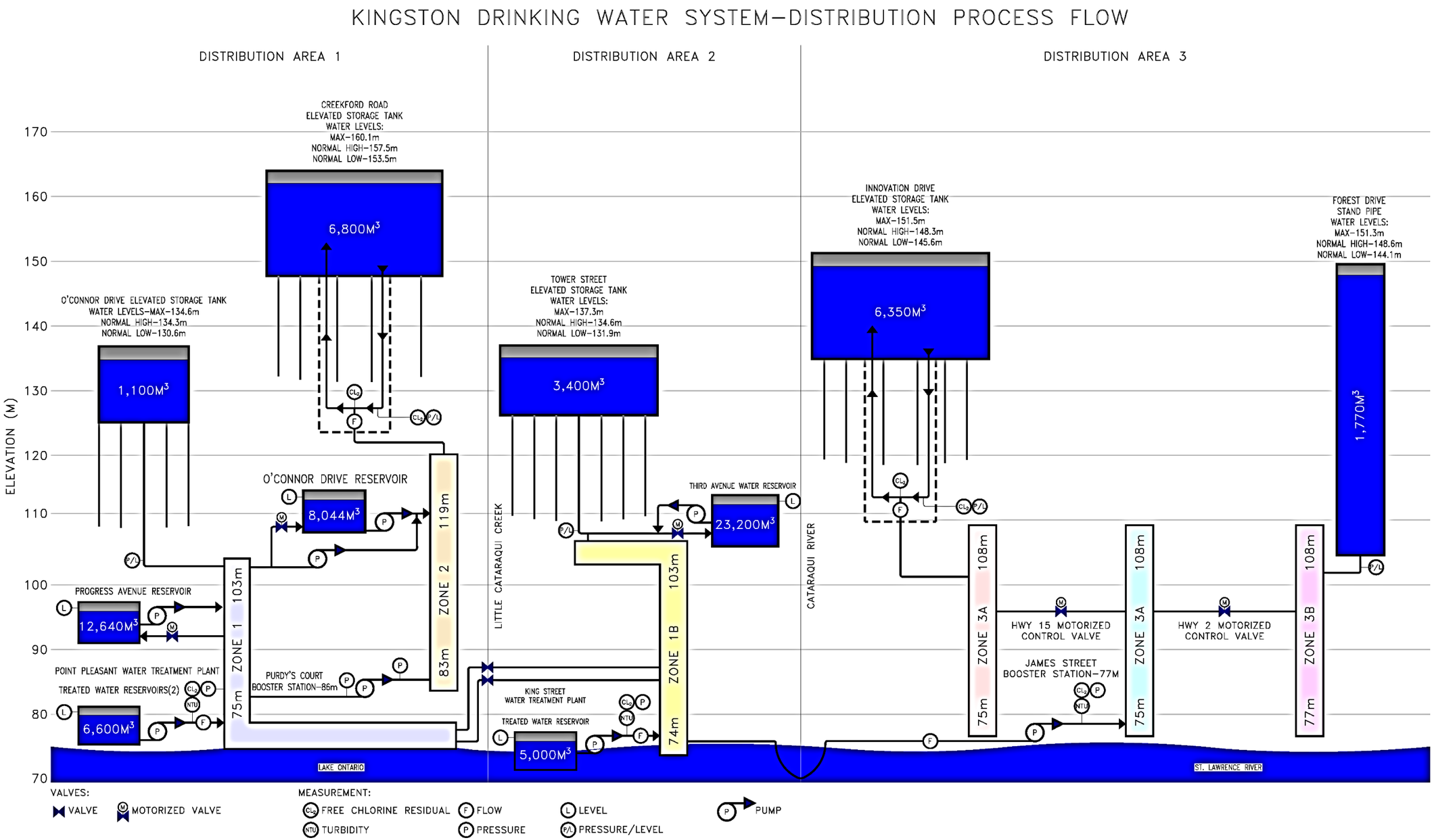
The Innovation Drive Elevated Storage Tank is located at 1000 Innovation Drive. This tank has a total volume of 6,464m^3. During normal system operation, the tank provides storage and system pressure stabilization for Pressure Zone 3A which is downstream from the Highway 15 motorized control valve. The water level in the tank is controlled by the James St Booster Station. Free chlorine residuals are continuously monitored to ensure adequacy.

Forest Drive Standpipe

(Formerly Milton Standpipe)

The Forest Drive Standpipe is located at 26 Forest Drive in Milton subdivision. This standpipe has a total volume of 1,770m^3. The usable volume which does not include the bottom 15.6m of water depth, as below this level the minimum system pressure of 150kPa is not maintained, is 1,280m^3. During normal system operation the standpipe provides storage and system pressure stabilization for Pressure Zone 3B which is downstream of the Highway 2 motorized control valve. The water level in the standpipe is controlled by the automatic operation of the Highway 2 motorized control valve.

Figure 6 – Kingston Distribution System Process Flow Diagram



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6.2 Cana Drinking Water System

6.2.1 General

The Cana Drinking Water System, owned by the City of Kingston and operated by Utilities Kingston, provides safe drinking water to the Cana subdivision which is located west of Highway 15, east of Kingston Mills Locks, and just north of Kingston Mills Road. The area serviced by the system includes Marian Crescent, Cana Boulevard, and Rochdale Crescent.

6.2.2 Source Water Overview

The Cana Well System obtains its raw water from a 150mm diameter by 18.6m deep drilled groundwater well located 45 meters south of Rochdale Crescent located within the Cana subdivision.

The chemistry of the water makes it suitable as a source for drinking water with all parameters below the Ontario Drinking Water Quality Standards. Because of the depth and structure of the aquifer the water temperature is relatively consistent around 10^{o}Celsius during the summer and winter months, the hydraulic conductivity is high, turbidity is low and pH is considered normal (typically 7.50) for groundwater systems.

6.2.2.1 Events

Data collected since well commissioning indicates that the water source is stable and consistent in terms of both quality and quantity and therefore we do not anticipate seasonal or operational events to occur.

6.2.2.2 Threats

While the risk of source water contamination through spills 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

6.2.2.3 Well Head Protection Area

The Cataraqui Source Protection Plan has identified Wellhead Protection Zones for the Cana Water treatment Plant. A wellhead protection area (WHPA) shows where groundwater is coming from to supply a municipal well and how fast it is travelling horizontally through the aquifer toward the well. A WHPA consists of different sized and spherical shaped zones around the municipal well: WHPA-A is a 100m radius around the wellhead; WHPA-B is the area within which the time of travel to the well is less than or equal to two years, but excluding WHPA-A; WHPA-C is the area within which the time of travel to the well is less than or equal to five years, but greater than two years; WHPA-D is the area within which the time of travel to the well is less than or equal to twenty-five years, but greater than five years; WHPA-E accounts for situations where the groundwater is under the direct influence of surface water. The Wellhead Protection Zones is shown in Figure 9 – Cana Wellhead Protection Zone.

6.2.2.4 Operational Challenges

The groundwater well at the Cana Well System provides quality source water which is consistently low in bacteriological contamination and turbidity. Iron and manganese are present, but not in sufficient quantity to warrant chemically assisted filtration.

6.2.3 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 disinfection through chlorination (primary disinfection), continuous monitoring and automated control of treatment processes, monitoring and maintenance of sufficient chlorine residuals throughout the distribution system (secondary disinfection), and the utilization of system redundancies and standby equipment.

6.2.4 Critical Upstream and Downstream Processes

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

6.2.5 Connections to Other Drinking Water Systems

The Cana Drinking Water System is not connected to any other drinking water systems.

6.2.6 Water Treatment Facility

6.2.6.1 Cana Water Treatment Plant

Drinking water is supplied to the distribution system by the Cana Water Treatment Plant which is a Class 1 water treatment facility with a rated capacity of 118m^3/day.

Raw Water Source and Low Lift Pumping

The raw water source is ground water pumped from a 150mm diameter by 18.6m deep well. A submersible pump, capable of pumping 75L/min, discharges raw water, via a 75mm well pump header, through the pump house and into the chlorine contact tank. Well pump run cycles are controlled by the contact tank storage level transmitter. The raw water discharge line is equipped with a magnetic flow meter, conductivity/temperature sensor and a turbidimeter for capacity and quality measurement. A pressure transmitter located at the base of the well provides for monitoring of groundwater aquifer level for determination of draw down and recharge rates.

Primary Disinfection

Sodium hypochlorite is dosed to the raw water flowing through the well pump discharge line upstream of a 45,000L in ground reservoir (contact tank). The sodium hypochlorite solution used is diluted down to a 2-3% Cl_2 solution with de-ionized water. Two peristaltic pumps are used for hypochlorite delivery. Chlorinated water flows through the baffled contact tank with high lift pump operation. The level transmitter located within the tank provides for the determination of actual storage volumes and control of the raw water well pump.

Contact tank inlet and outlet free Cl_2 residuals and pH levels are continuously monitored. Control of the chlorination system is accomplished through the monitoring of chlorine contact tank inlet Cl_2 residuals and raw water flow measurement through a PID (Process/ Integral/ Derivative) control loop. This is to ensure in-plant chemical disinfection CT values are equal to or greater than the required level determined by the ‘Procedure for Disinfection of Water in Ontario’.

High Lift Pumping and Distribution System Pressure Maintenance

Two submersible pumps, capable of pumping 92L/min each, discharge treated water from the outlet of the chlorine contact tank to the distribution system. The discharge of the two high lift pumps is routed back inside the pump house where it is filtered through two cartridge filters (one lead, one standby) that are 5 microns in pore size. Two 450L pressure tanks are located directly downstream of the cartridge filters and maintain system pressure while the high lift pumps are off. High lift pump operation is controlled in a duty/standby rotation through a pressure transmitter that regulates high lift discharge pressure between 40 and 60psi. The treated water discharge line is equipped with a magnetic flow meter, turbidimeter and two free chlorine/pH analyzers (one designated as contact tank outlet Cl_2 and one as treated water Cl_2).

Secondary Disinfection (Trim Chlorination)

Sodium hypochlorite is used as a secondary disinfectant. Two peristaltic pumps draw hypochlorite solution from an adjacent tank and deliver it to the treated water discharge line. This system only operates if the contact tank outlet Cl_2 residual is below an operator adjustable set point. Control of the trim chlorination system is accomplished through the monitoring of chlorine contact tank outlet Cl_2 residuals and treated water flow measurement through a PID (Process/ Integral/ Derivative) control loop to ensure adequate distribution system free chlorine residuals.

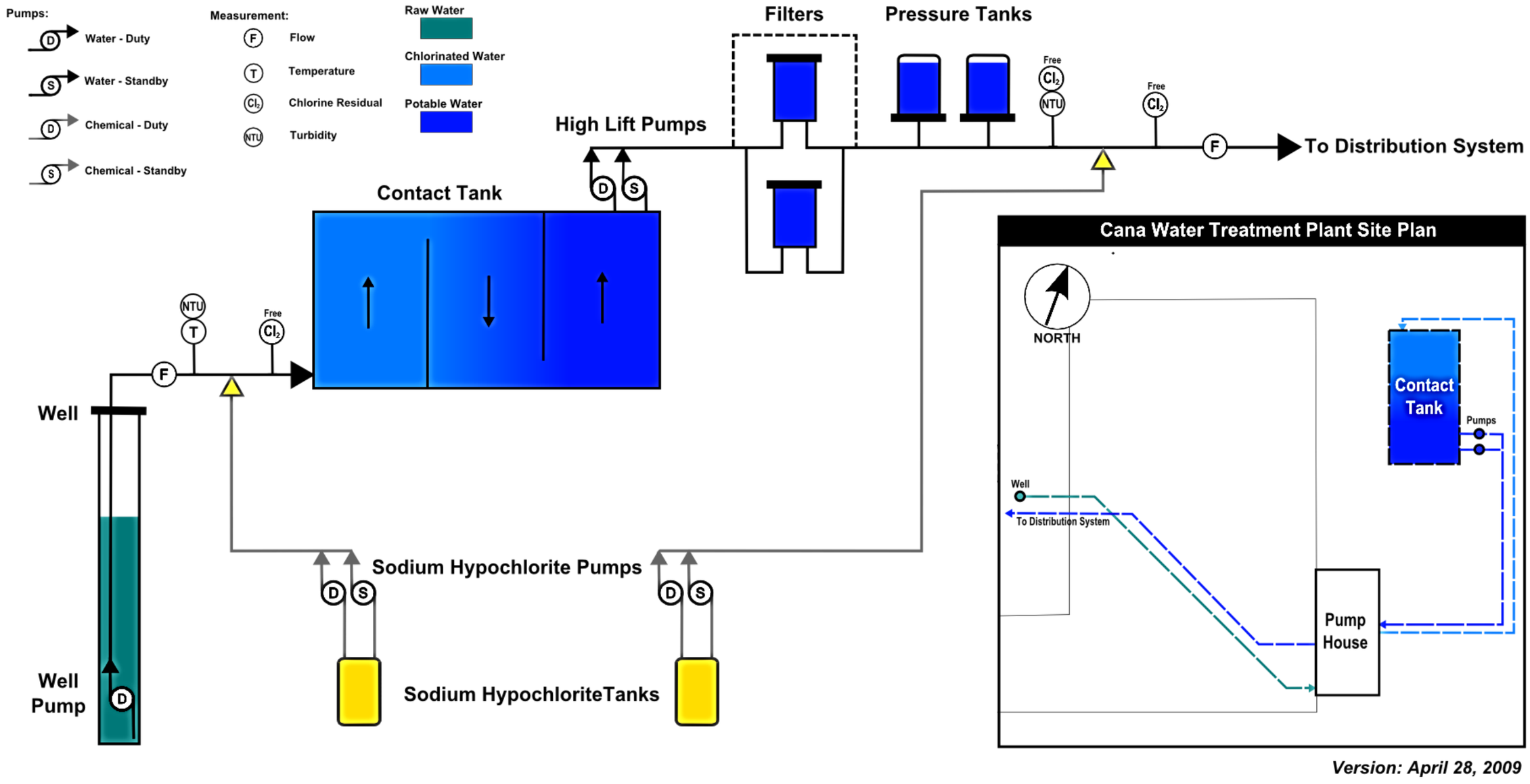
Control System

Supervisory Control and Data Acquisition (SCADA) is the method of control implemented at the Cana Well System. All analyzing, monitoring and control module equipment information is routed through the SCADA system for operator monitoring and control. Control of equipment can be accomplished locally at the SCADA panel in the pump house or remotely at the King Street Water Treatment Plant. Alarm capability and set point adjustment along with trend monitoring are also available through SCADA system controls.

Standby Equipment

Normally, power is supplied to the Cana WTP through the Hydro One distribution system. A 570kW natural gas generator maintained at the CANA WWTP provides a backup electrical supply in case of power outages. This generator is capable of fully powering all necessary pumps, and all the instrumentation and control equipment required to automatically operate the system. The backup generator is routinely tested under load to ensure reliability and continuity of effective operations during a power outage.

Figure7–CanaWaterTreatmentPlantProcessFlowDiagram



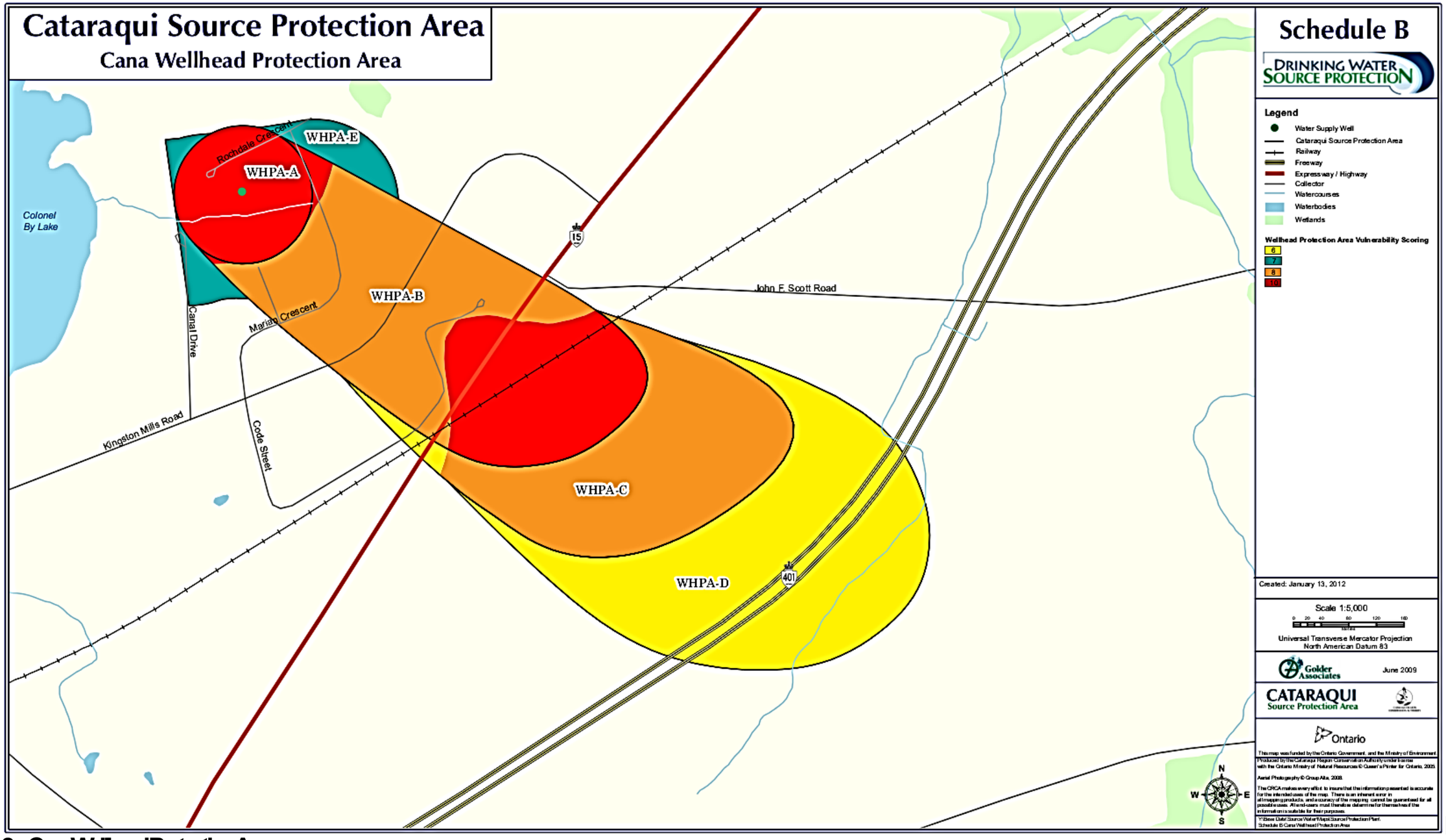


Figure 8–Cana Wellhead Protection Area

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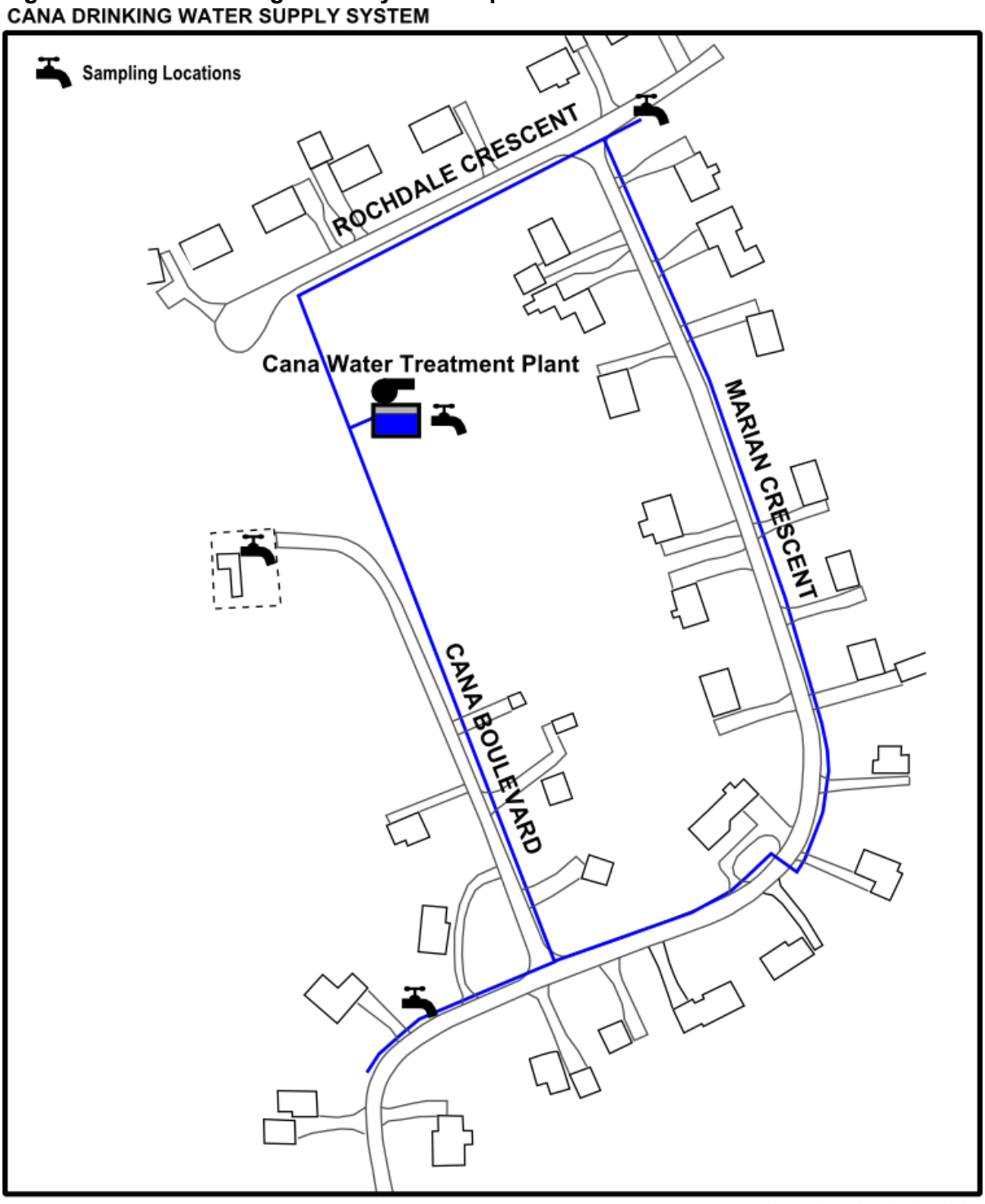
6.2.6.2 Distribution System

Drinking water is distributed to the Cana Drinking Water System through a distribution system comprised of approximately 780m of 150mm diameter polyvinyl chloride (PVC) water mains. Distribution system pressure maintenance and stabilization is accomplished through the combined operation of high lift pumps and use of two 450L pressure tanks at the Cana Water Treatment Plant.

Figure 9 – Cana 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 Kingston and Cana Drinking Water Systems is completed on a three-year cycle. The risk assessment team include experienced drinking water operators and supervisory personnel.

The risk assessment findings for the identified events are documented in W-L-11 Kingston Risk Assessment Outcomes and W-L-11c Cana Risk Assessment Outcomes. Events/hazards are listed by event classification in descending order of assessed 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 essential to ensure the safety of the drinking water supplied to the customer, requirements outlined in the Procedure for Disinfection of Water in Ontario (minimum CCP), if primary controls can be applied and if the results of the applied controls can be measured.

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 Kingston and Cana Drinking Water Systems, 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 alarms and exceedance of critical control limits.

8.1.1 Kingston Drinking Water System

8.1.1.1 Coagulation Critical Control Limit

Raw water coagulation ensures proper suspended solids removal through floc formation and agglomeration. Correct floc formation is important for adequate sedimentation/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 both the King Street and Point Pleasant Water Treatment Plants.

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 Kingston Drinking Water System Coagulation Critical Control Limit Response Procedure – W-CC-01 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 Kingston Drinking Water System Filter Effluent Turbidity Critical Control Limit Response Procedure W-CC-02.

8.1.1.2 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 Kingston Drinking Water Supply System water treatment facilities use gravity fed filters with granular activated carbon or anthracite as the installed filter media. This allows for the adsorption of extremely small particles suspended within the water prior to the primary disinfection process. Filtration performance at these facilities is monitored continuously through filter effluent turbidimeters installed on each filter effluent line. Samples are collected weekly and calibrations performed to ensure effluent turbidimeters are reading accurately. 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 Point Pleasant and King Street Water Treatment Plants have the ability to remotely initiate a filter backwash through the SCADA system for all of the treatment facilities operated by Utilities Kingston. 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 Kingston Drinking Water System Filter Effluent Critical Control Limit Response Procedure

W-CC-01 describes the response to a filter effluent turbidity alarm and possible exceedance of the critical control limit.

8.1.1.3 Primary Disinfection Critical Control Limit

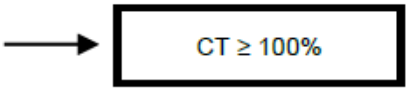
The use of chlorination for primary (post) disinfection ensures adequate inactivation of pathogens potentially present in the source water that have not been removed by filtration. The application of chlorine is accomplished through one of two different methods. Gas chlorination, the application of chlorine using chlorine gas chlorinators, is used at the Point Pleasant Water Treatment Plant and hypo-chlorination, the application of chlorine using sodium hypochlorite delivery pumps, is used at the King Street Water Treatment Plant.

The following parameters together are used in determining disinfectant CT and are trended on SCADA programs.

- Temperature is monitored continuously at contact tank exit locations 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 at contact tank exit locations with a pH probe. pH is a parameter that changes with variations in water quality on a seasonal basis and is not controlled through operational process.
- Contact Tank Volume is monitored continuously with ultra-sonic or water pressure measuring devices which give level values. Contact tank volumes vary as changes to influent and effluent flow rates alter clearwell levels, resulting in stored volume changes.
- High Lift Flow is monitored continuously at plant discharge using magnetic or venturi flow meters. The high lift flow varies continually based on the distribution system demand.
- Free Chlorine Residual is monitored continuously at contact tank outlets using Cl_2 analyzers. Free residual varies slightly at the contact tank exit location 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.

- Temperature
- pH
- Contact Tank Volume
- High Lift Flow
- Free Cl_2 Residual



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. This allows 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 Point Pleasant and King Street Water Treatment Plants have the ability to remotely monitor disinfection processes through the SCADA system for all of the treatment facilities operated by Utilities Kingston. 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.

The critical control limit must be established at a level which allows sufficient time for operators to identify and respond to events or conditions which are having an unfavorable effect on the disinfection process. This is to ensure effective disinfection is maintained and adverse water quality is avoided. With consideration of these factors, the critical control limit for primary disinfection has been established at 150% of the required CT.

The Kingston Drinking Water System Primary Disinfection Critical Control Limit Response Procedure – W-CC-03 describes the response to measured parameter alarms and possible exceedance of the critical control limit.

8.1.1.4 Secondary Disinfection Critical Control Limit

Secondary disinfection ensures an adequate disinfectant residual within all areas of the distribution system. Chlorination is the method employed in the Kingston Drinking Water Supply System for the maintenance of secondary disinfection residuals. Chlorine dosage rates and the resulting Cl_2 residuals at water treatment facilities are monitored and adjusted to ensure that adequate free Cl_2 residuals are maintained at the furthest points from the water treatment plant discharge. In addition, distribution system re-chlorination facilities are employed to ensure that adequate free Cl_2 residuals are maintained. The ongoing effectiveness of chlorine 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 free Cl_2 residual analyzers installed at various locations throughout the distribution systems 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 free Cl_2 residual values.

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

Operators at the Point Pleasant and King Street Water Treatment Plants have the ability to remotely monitor treated water free Cl_2 residuals at both treatment facilities and at distribution system analyzers 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, the critical control limit for distribution system free Cl_2 residual can be established at no less than 0.20mg/L. This level allows sufficient time for operators to undertake corrective action to ensure that adverse water quality is avoided.

The Kingston Drinking Water System Secondary Disinfection Critical Control Limit Response Procedure – W-CC-04 describes the response to measured parameter alarms and possible exceedance of the critical control limit.

8.1.2 Cana Drinking Water System

8.1.2.1 Primary Disinfection Critical Control Limit

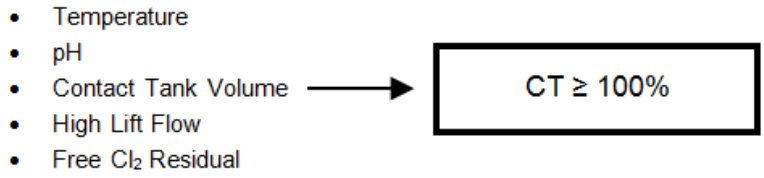
The use of chlorination for primary (post) disinfection ensures adequate inactivation of pathogens potentially present in the source water. Chlorination is achieved through the application of chlorine using sodium hypochlorite delivery pumps.

The following parameters together are used in determining disinfectant CT and are trended on SCADA programs.

The following parameters together are used in determining disinfectant CT and are trended on SCADA programs.

- Temperature is monitored continuously at contact tank exit locations 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 at contact tank exit locations with a pH probe. pH is a parameter that changes with variations in water quality on a seasonal basis and is not controlled through operational process.
- Contact Tank Volume is monitored continuously with ultra-sonic or water pressure measuring devices which give level values. Contact tank volumes vary as changes to influent and effluent flow rates alter clearwell levels, resulting in stored volume changes.
- High Lift Flow is monitored continuously at plant discharge using magnetic or venturi flow meters. The high lift flow varies continually based on distribution system demand.
- Free Chlorine Residual is monitored continuously at contact tank outlets using Cl_2 analyzers. Free residual varies slightly at the contact tank exit location 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.



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. This is to ensure that drinking water quality is not adversely affected.
Operators at the Point Pleasant and King Street Water Treatment Plants have the ability to remotely monitor disinfection processes at the Cana Water Treatment Plant through the SCADA system. Continuous operator coverage at the King Street Water Treatment Plants and the availability of standby operators ensures a very timely response to an alarm and initiation of the corrective action process. Control of equipment can also be accomplished locally at the SCADA panel in the pump house.

The critical control limit must be established at a level which allows sufficient time for operators to identify and respond to events or conditions which are having an unfavorable effect on the disinfection process. This is to ensure effective disinfection is maintained and adverse water quality is avoided. With consideration of these factors, the critical control limit for primary disinfection has been established at 150% of the required CT.

The Cana Drinking Water System Primary Disinfection Critical Control Limit Response Procedure – W-CC-05 describes the response to measured parameter alarms and possible exceedance of the critical control limit.

8.1.2.2 Secondary Disinfection Critical Control Limit

Secondary disinfection ensures an adequate disinfectant residual within all areas of the distribution system. Chlorination is the method employed in the Cana Drinking Water System for the maintenance of secondary disinfection residuals. Chlorine dosage rates and the resulting Cl_2 residuals at the Cana Water Treatment Plant are monitored and adjusted to ensure that adequate free Cl_2 residuals are maintained at the furthest points from the pump house discharge. The ongoing effectiveness of chlorine dosage rates is monitored through the collection and testing of distribution system samples described by the Sampling, Testing, and Monitoring Procedure – W-G-09.

Alarm set points for free Cl_2 residuals at the Cana Water Treatment Plant are set at levels which indicate conditions, outside of normal operational variance, with the potential to negatively affect secondary disinfection effectiveness. This allows sufficient time for operators to carry out flushing, adjust chlorine dosages, or restart disrupted processes to ensure that drinking water safety is not adversely affected.

Operators at the Point Pleasant and King Street Water Treatment Plants have the ability to remotely monitor the treated water free Cl_2 residual through the SCADA system for the Cana Water Treatment Plant. 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 free Cl_2 residual can be established at no less than 0.20mg/L. This level allows sufficient time for operators to undertake corrective action to ensure that adverse water quality is avoided.

The Cana Drinking Water System Secondary Disinfection Critical Control Limit Response Procedure – W-CC-06 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-13 – Kingston And Cana 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 uncoloured cells do not have duties and authorities which directly impact the safe and reliable supply of drinking water but may provide services which support those accountable.

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-13 – Kingston And Cana Organizational Structure, Roles, Responsibilities, And Authorities 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-13 – Kingston And Cana 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.

W-L-13 – Kingston And Cana Organizational Structure, Roles, Responsibilities, Authorities, and Competencies identifies the following levels of competency.

- **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 Kingston and Cana Drinking Water Systems. 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 Chief Operating Officer, Director of Water and Wastewater, Manager of Water and Wastewater Treatment Operations, Manager of Water and Wastewater System Operations, Water and Wastewater Treatment Operations Supervisors, and the Water and Wastewater System Operations Supervisor form the management team responsible for coordinating and directing the activities of workers employed within the Water and Wastewater Operations Groups 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.

A Treatment System Operator is designated as Shift Operator for each shift at the King Street and Point Pleasant Water Treatment Plants. At least one Treatment System Operator is on duty at all times at the King Street Water Treatment Plant. Other Treatment System Operators on duty at the water treatment plants assist the Shift Operators and perform duties throughout the Drinking Water Systems as required. Journeyperson work throughout the drinking water systems but do not make any operational changes to the system.

The System Operations Group provides assistance in the operation and maintenance of water facilities in those instances where specific knowledge, skills, or equipment is an asset.

The operation of the King Street and Point Pleasant Water Treatment Plants and distribution system storage facilities and booster stations is continuously monitored through SCADA systems. The SCADA

system allows for remote monitoring and operation of all treatment, pumping, and storage facilities from both the King Street and Point Pleasant Treatment Plants. Alarm conditions are forwarded to operators via cell phones. Under normal operating conditions, this system allows operators to perform duties away from the treatment plants.

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

11.3 Underground Infrastructure Group

All operators within the Underground Infrastructure Group are required to be 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. 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 Kingston City Council, through the Environment, Infrastructure, and Transportation Policy Committee (a committee of council), and through the Board of Directors of 1425445 Ontario Limited operating as Utilities Kingston.

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.

The Review and Provision of Infrastructure Procedure – W-G-07 describes the process used by Utilities Kingston to evaluate drinking water system infrastructure condition and capacity, and review available information to identify any needed rehabilitation, renewal, and improvement of existing infrastructure, provision of new infrastructure, prioritize those identified needs, and make recommendations to the system Owner based on the prioritized needs.

Specific to the City of Kingston's Drinking Water Systems, Utilities Kingston completes annual and ongoing reviews of drinking water system condition and capacity, including relevant outcomes of the risk assessment, when determining adequacy of the infrastructure. Under the direction of the Manager of Engineering, assigned engineering personnel complete the evaluation and review in consultation with the Water and Wastewater Operations Group. The following recommendations are submitted to Kingston City Council for budgetary consideration:

- 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.

The Infrastructure Maintenance, Rehabilitation, and Renewal Procedure W-G-08 describes the maintenance activities performed by Utilities Kingston for drinking water systems and the processes followed to monitor and review the effectiveness of those activities.

Maintenance activities may be either preventative in nature, planned maintenance, or reactive unplanned maintenance. Planned maintenance includes activities such as fire hydrant inspection and flushing, valve inspection and maintenance, scheduled calibration of measurement and recording equipment, scheduled replacement of GAC in gravity filters, 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, these records are reviewed to identify trends that could indicate the need for infrastructure rehabilitation or renewal.

Major capital works to renew or rehabilitate existing infrastructure or to construct new infrastructure is coordinated by Utilities Engineering. Recommendations from the Drinking Water Master Plan, facility condition assessments, distribution system assessments, and staff are prioritized and integrated into a long term capital plan upon which capital budget submissions are based.

Where possible, these works are scheduled and completed in coordination with other utility or transportation infrastructure work to increase efficiency and minimize service and transportation disruptions.

Operational capital works such as facility equipment renewal/improvement and distribution system appurtenance renewal such as fire hydrant replacements, are coordinated by Water and Wastewater Operations.

Water and Wastewater Operations and Utilities Engineering work closely together to plan and oversee these capital works to completion.

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. The sampling,

testing, and monitoring completed for the Kingston and Cana Drinking Water System meets and exceeds regulatory requirements. These are standalone systems and no relevant sampling upstream of the systems' raw water intakes is undertaken.

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.

Utilities Kingston has an Emergency Plan which is supplementary to the City of Kingston Emergency Plan. These plans identify Utilities Kingston's overall role during municipal emergencies and the internal mechanisms to fulfill that role. Specific to drinking water emergencies, the Utilities Kingston Emergency Plan contains a response plan for drinking water system critical infrastructure failure which outlines the response and recovery actions, considerations, and corporate/agency level responsibilities for major drinking water emergencies.

19. Internal Audits

Internal QMS 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 QMS audits are completed by Utilities Kingston.

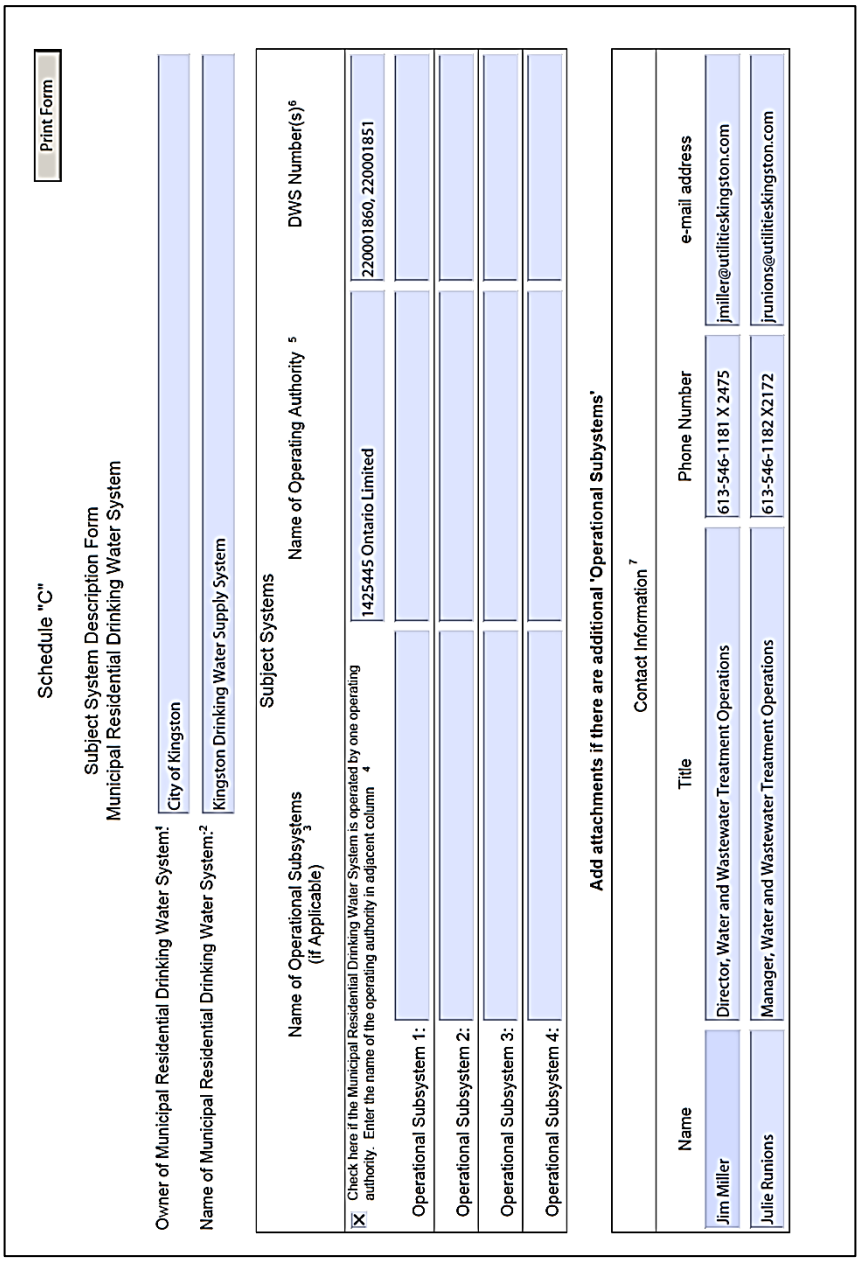
20. Management Review

At least once per 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 Environment, 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 for the Kinston Drinking Water System



Print Form

Schedule "C"

Subject System Description Form
Municipal Residential Drinking Water System

Owner of Municipal Residential Drinking Water System:[1] City of Kingston

Name of Municipal Residential Drinking Water System:[2] Kingston Drinking Water Supply 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	220001860, 220001851
Operational Subsystem 1:		
Operational Subsystem 2:		
Operational Subsystem 3:		
Operational Subsystem 4:		

Add attachments if there are additional 'Operational Subsystems'

Contact Information[7]

Name	Title	Phone Number	e-mail address
Jim Miller	Director, Water and Wastewater Treatment Operations	613-546-1181 X 2475	jmiller@utilitieskingston.com
Julie Runions	Manager, Water and Wastewater Treatment Operations	613-546-1182 X2172	jrunions@utilitieskingston.com

Appendix B – Schedule "C" Subject System Description Form for the Cana Drinking Water System

Print Form

Schedule "C"

Subject System Description Form
Municipal Residential Drinking Water System

Owner of Municipal Residential Drinking Water System[1]: City of Kingston

Name of Municipal Residential Drinking Water System:[2] Cana Drinking Water Supply System

Subject Systems

Name of Operational Subsystems (if Applicable)[3]	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	220006053
Operational Subsystem 1:		
Operational Subsystem 2:		
Operational Subsystem 3:		
Operational Subsystem 4:		

Add attachments if there are additional 'Operational Subsystems'

Contact Information[7]

Name	Title	Phone Number	e-mail address
Jim Miller	Director, Water and Wastewater Treatment Operations	613-546-1181 X 2475	jmiller@utilitieskingston.com
Julie Runions	Manager, Water and Wastewater Treatment Operations	613-546-1182 X2172	jrunions@utilitieskingston.com