



**Utilities Kingston
Report to Council
Report Number 19-132**

To: Mayor and Members of Council

From: Jim Keech, President and CEO, Utilities Kingston

Resource Staff: Jim Miller, Director, Utilities Engineering, Human Resources
and Treatment Operations
Alan Smith, QMS Coordinator

Date of Meeting: May 21, 2019

Subject: Operational Plans for the Kingston and Cana Drinking Water
Systems – Drinking Water Quality Management Systems

Executive Summary:

The City of Kingston, as the Owner of the Kingston and Cana Drinking Water Systems, is required by the Safe Drinking Water Act to ensure that these systems are operated by an Accredited Operating Authority.

As part of the accreditation process, the Drinking Water Quality Management Standard (DWQMS) requires that an Operational Plan be maintained by the Operating Authority, endorsed by the Owner, and accepted by the Ministry of Environment, Conservation and Parks. The Quality Management System (QMS) and Operational Plan have been in place since 2009 when the City of Kingston and Utilities Kingston were among the first group of drinking water system owners and operating authorities to have their operational plan accepted and accreditation granted. It has been maintained and updated to remain current with system and organization changes, processes, procedures and DWQMS requirements.

The Operational Plan was last endorsed by the City of Kingston and Utilities Kingston in 2016. Recent updates were made to the operational plan to ensure conformance with the current version - DWQMS 2.0. As result of the updated changes made Council's endorsement of the updated Operational Plan is now required.

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Recommendation:

That Council for the City of Kingston receive the Operational Plan for the Kingston and Cana Drinking Water Systems and authorize the Mayor and City Clerk to sign the required documentation showing Council's endorsement of the plan.

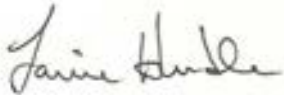
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Authorizing Signatures:



**Jim Keech, President and CEO,
Utilities Kingston**



**Lanie Hurdle, Acting Chief
Administrative Officer**

Consultation with the following Members of the Corporate Management Team:

Gary Dyke, Commissioner, Corporate Enterprise Services	Not required
Peter Huigenbos, Acting Commissioner, Community Services	Not required
Desirée Kennedy, Chief Financial Officer & City Treasurer	Not required
Sheila Kidd, Commissioner, Transportation & Public Works	Not required

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Options/Discussion:

Utilities Kingston, as the Operating Authority for the Kingston and Cana Drinking Water Systems, is responsible for the implementation and ongoing maintenance of a Quality Management System (QMS) which meets the requirements of the Drinking Water Quality Management Standard (DWQMS). The accreditation of operating authorities is based on the verification by a third-party accreditation body that an operating authority has a QMS in place that meets the requirements of the DWQMS.

Since 2009, the Operational Plan has been updated with the last changes endorsed by Council in 2016. These updates to the Operational Plan also reflect conformance with the DWQMS 2.0. and are as follows:

- Administrative updates to language,
- Updated the Quality Management System Policy, (Section 2.),
- Updated Organizational Structure, Roles Responsibilities, and Authorities (Section 9.1 Figure 10 and Section 9.3.2.),
- Updated infrastructure related risk assessment outcomes as information to be included in the review and provision of infrastructure (Section 14),
- Added reference to the long term capital plan in the Infrastructure Maintenance, Rehabilitation and Renewal activities (Section 15.),
- Added considerations of best management practices including those published by the MECP in the management review process (Section 20) and;
- Added Preventative Actions and Best Management Practices to Continual Improvement (Section 21).

Utilities Kingston Top Management personnel have endorsed the revised Operational Plan and re-confirmed their commitment to the QMS as required by the DWQMS.

Existing Policy/By-Law:

Not applicable

Notice Provisions:

Not applicable

Accessibility Considerations:

Not applicable

Financial Considerations:

Not applicable

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Other City of Kingston Staff Consulted:

Not applicable

Exhibits Attached:

Exhibit A - Operational Plan for the Kingston and Cana Drinking Water System

UTILITIES KINGSTON DRINKING WATER QUALITY MANAGEMENT SYSTEM

Document Operational Plan for the Kingston and Cana Drinking Water System	Document No. W-OP-01
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Operational Plan

for the

Kingston and Cana Drinking Water Systems



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

Approval

_____ Jim Miller, Director of Engineering, Human Resources and Treatment Operations	_____ Date
_____ Brad Joyce, Director, Operations	_____ Date

UTILITIES KINGSTON DRINKING WATER QUALITY MANAGEMENT SYSTEM

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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.

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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 other 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.

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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.

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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,

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- 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 550km of water mains, 3 ground level reservoir/pumping stations, 6 water towers (5 elevated storage tanks and 1 standpipe), 3 booster stations, over 5,000 main line valves, and over 3,200 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 CaCO₃. With the exception of occasional turbidity spikes, raw water turbidity levels are typically less than 0.5 NTU.

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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°C during the winter months to as high as 28°C during the summer. Raw water temperatures at the King Street Water Treatment Plant have ranged from as low as 0.7°C during the winter months to as high as 22°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

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

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Figure 1 - Kingston Drinking Water System

KINGSTON DRINKING WATER SYSTEM

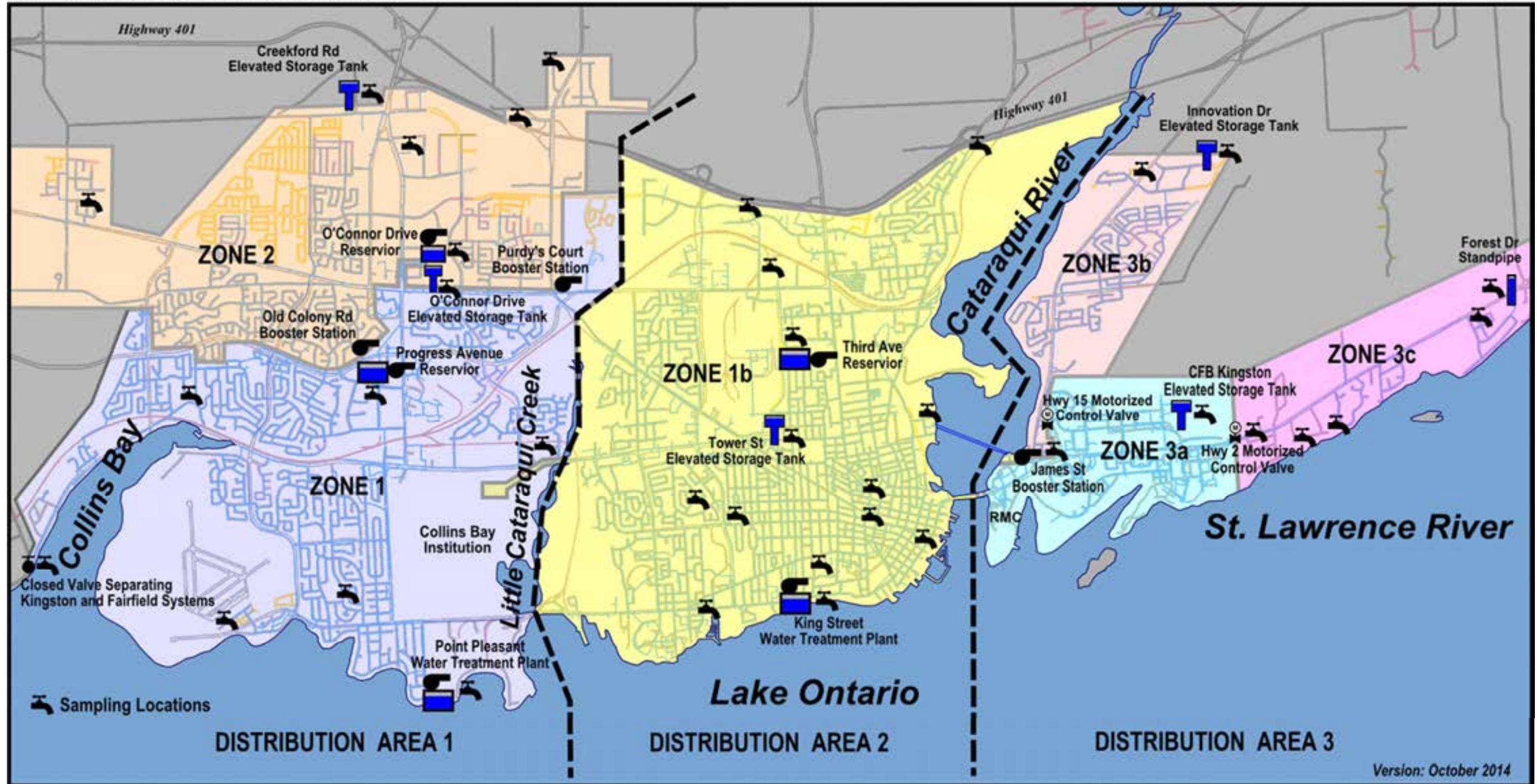
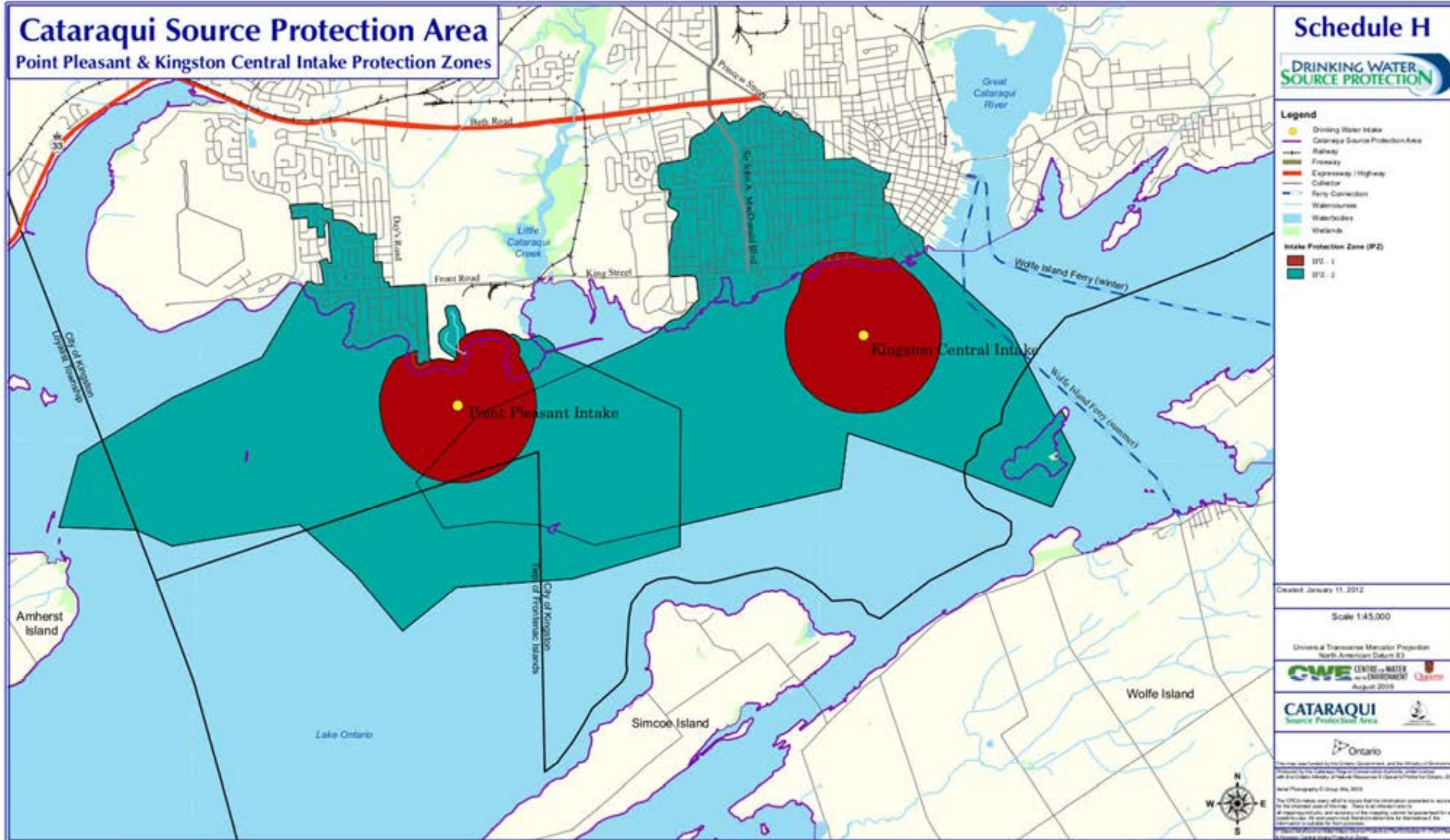


Figure 2 – Kingston Drinking Water System Intake Protection Zones



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Operational Plan For the Kingston and Cana Drinking Water Systems

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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 80,000m³/day. Average flow to the distribution system is approximately 20,000m³/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
POINT PLEASANT WATER TREATMENT PLANT PROCESS FLOW

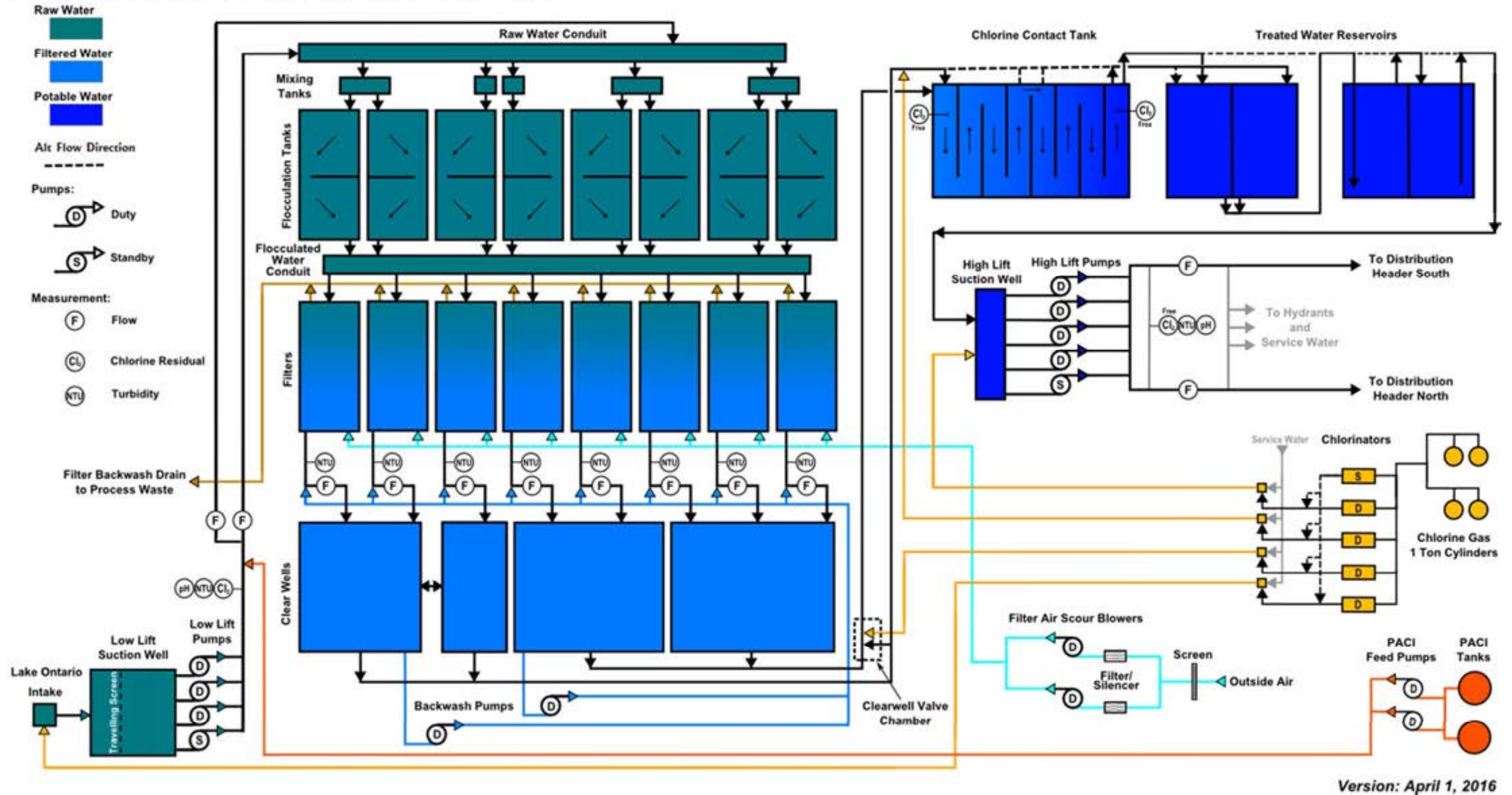
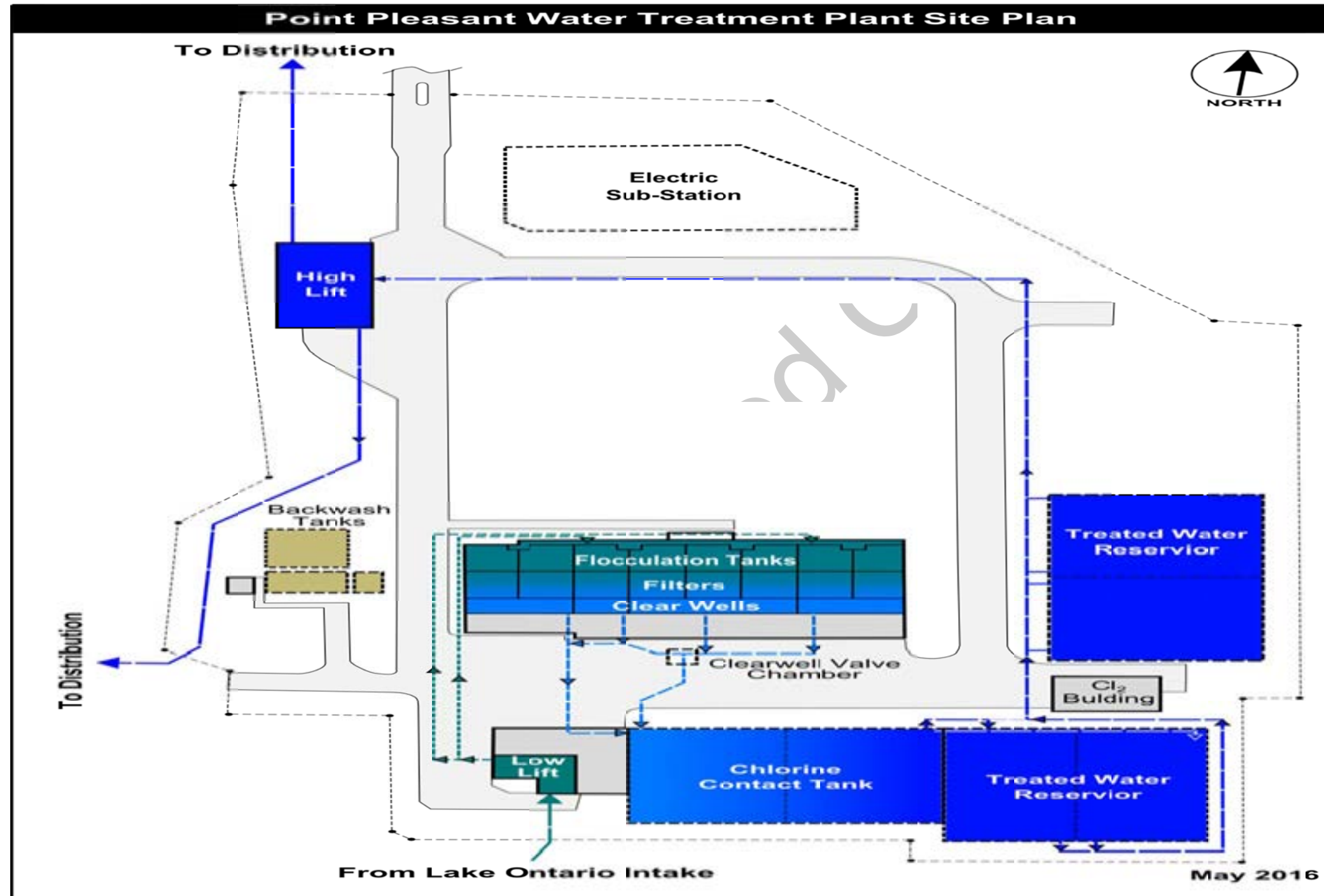


Figure 4 – Point Pleasant Water Treatment Plant Site Plan



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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 118,000m³/day. Average flow to the distribution system is approximately 50,000m³/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.

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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 5,000m³ 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.

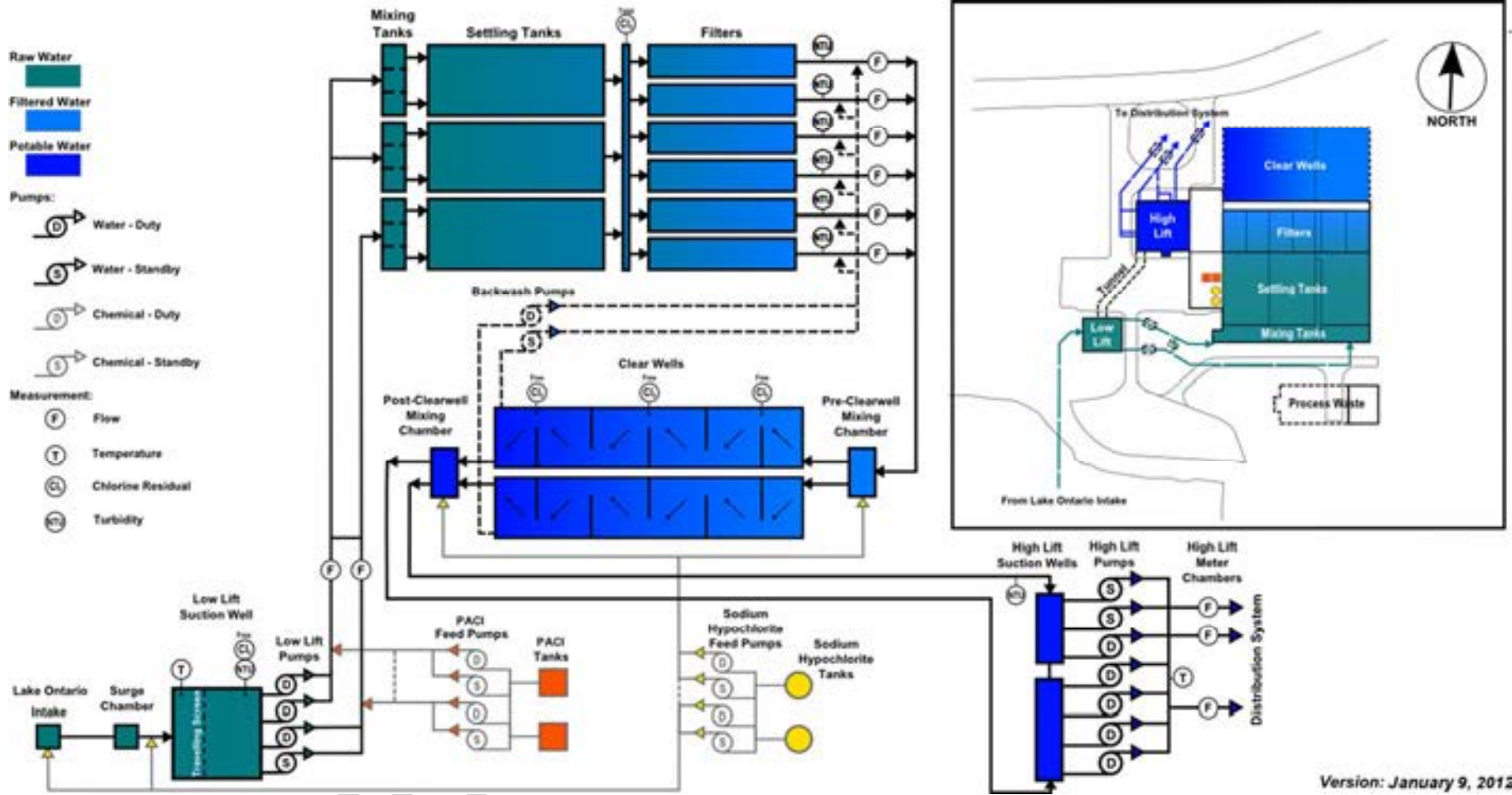
The flow rate of treated water pumped to the distribution system is continuously monitored in three chambers downstream of the high lift pumps.

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

KING STREET WATER TREATMENT PLANT PROCESS FLOW



UTILITIES KINGSTON DRINKING WATER QUALITY MANAGEMENT SYSTEM

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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 and Purdy's Court 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 6,600m³. 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.

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 1,100m³. 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.

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 m³. 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.

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Purdy’s Court Booster Station
(Formerly Sydenham Road Booster Station)

The Purdy’s Court Booster Station is located at 896 Purdy’s Court at the northeast corner of Princess Street and Sydenham Road. This station supplies water to Pressure Zone 2 from Pressure Zone 1. Three electric pumps are available at this station to pump water into Pressure Zone 2. Two pressure reducing valves are used to maintain the discharge pressure below 675kPa (98psi).

This booster station is scheduled for decommissioning after the completion of additional trunk water mains installation and commissioning and upon confirmation of satisfactory conveyance of water and maintenance of pressures within Pressure Zone 2.

Creekford Road Elevated Storage Tank

The Creekford Road Elevated Storage Tank is located at 2754 Creekford Road. This tank has a total volume of 6,800m³. 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 for water entering and exiting the tank are continuously monitored, and a re-chlorination and re-circulation system ensures water distributed from this tank contains adequate chlorine residual.

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.

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Third Avenue Reservoir

The Third Avenue Reservoir, located at 119 Third Avenue, is an in ground reservoir with a capacity of 22,700m³. 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.

Tower Street Elevated Storage Tank

The Tower Street Elevated Storage Tank is located at 27 Tower Street. This tank has a total volume of 3,400m³. 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.

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 three pressure zones within the area: Zones 3a, 3b, and 3c.

Water is supplied to Pressure Zone 3a from Pressure Zone 1b through the James Street Booster Station. The CFB Kingston Elevated Storage Tank is located within this pressure zone.

Water is supplied to Pressure Zone 3b from Pressure Zone 3a through the Highway 15 Motorized Control Valve. The Innovation Drive Elevated Storage Tank is located within this pressure zone.

Water is supplied to Pressure Zone 3c 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 CFB Kingston Elevated Storage Tank. The Innovation Drive Elevated Storage Tank water level may be selected as an alternative control.

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.

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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.

CFB Kingston Elevated Storage Tank

The CFB Kingston Elevated Storage Tank is located at 31 Somme Avenue at CFB Kingston. This tank has a total volume of 2,270m³. The tank provides storage and system pressure stabilization for Pressure Zone 3a. During normal system operation, the water level in this tank provides the primary control of pump operations at the James Street Booster Station.

Distribution System Motorized Control Valves

Motorized control valves are used in Distribution Area 3 to control the flow of water to and from Pressure Zones 3b and 3c. Depending on the position of these valves, the area may be operating as one, two, or three pressure zones. The motorized control valves are located on the east side of Highway 15 north of Wellington Street and on the north side of Highway 2 just east of CFB Kingston.

Innovation Drive Elevated Storage Tank

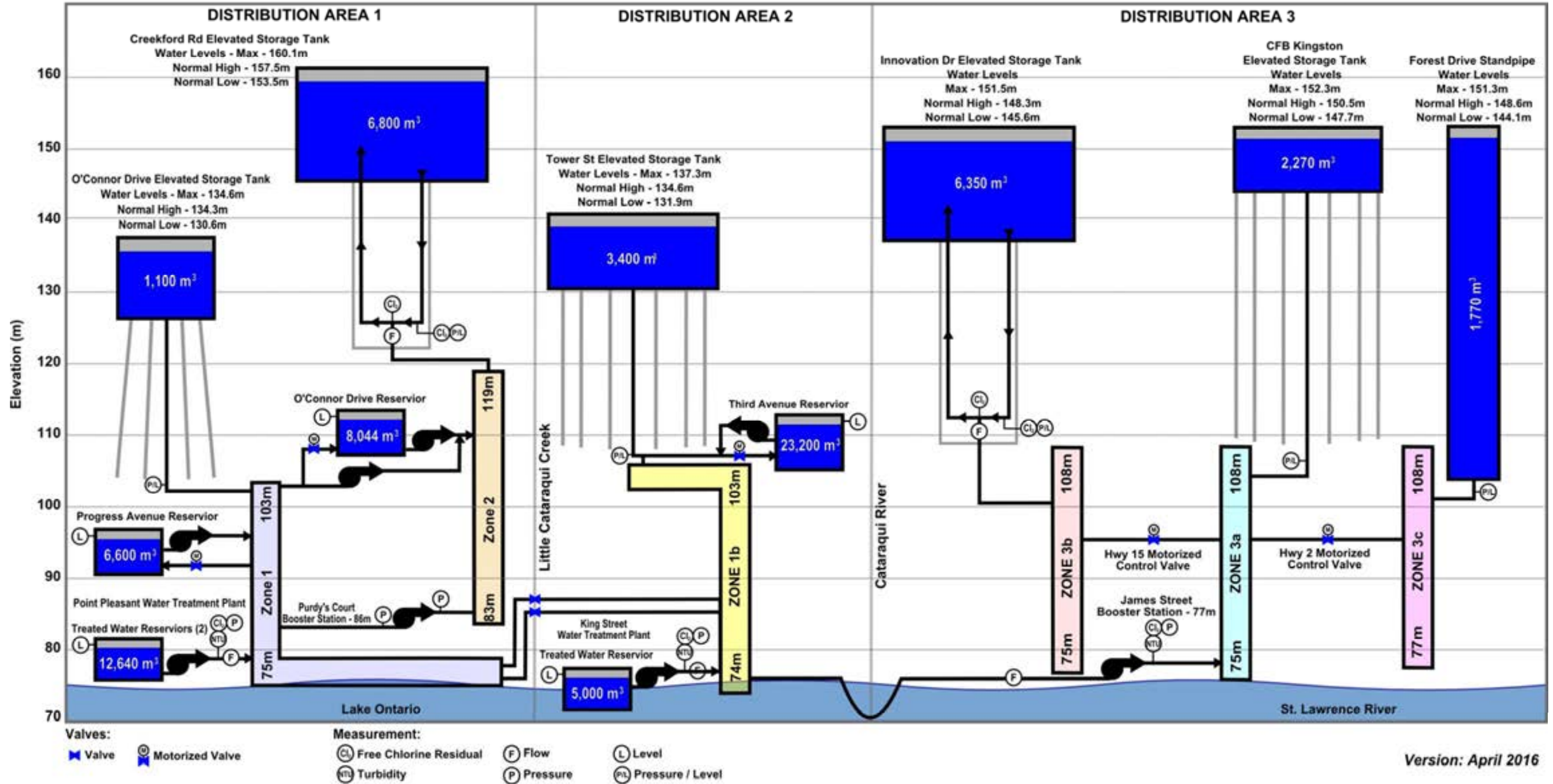
The Innovation Drive Elevated Storage Tank is located at 1000 Innovation Drive. This tank has a total volume of 6,464m³. During normal system operation, the tank provides storage and system pressure stabilization for Pressure Zone 3b which is downstream of the Highway 15 motorized control valve. The water level in the tank is controlled by the automatic operation of the Highway 15 motorized control valve.

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 1,770m³. 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 1,280m³. During normal system operation the standpipe provides storage and system pressure stabilization for Pressure Zone 3c 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
KINGSTON DRINKING WATER SYSTEM - DISTRIBUTION PROCESS FLOW



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°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 Catarauqui 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.

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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 118m³/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% Cl₂ 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 Cl₂ residuals and pH levels are continuously monitored. Control of the chlorination system is accomplished through the monitoring of chlorine contact tank inlet Cl₂ 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'.

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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 Cl₂ and one as treated water Cl₂).

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 Cl₂ residual is below an operator adjustable set point. Control of the trim chlorination system is accomplished through the monitoring of chlorine contact tank outlet Cl₂ 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.

Figure 7 – Cana Water Treatment Plant Process Flow Diagram

CANA WATER TREATMENT PLANT PROCESS FLOW

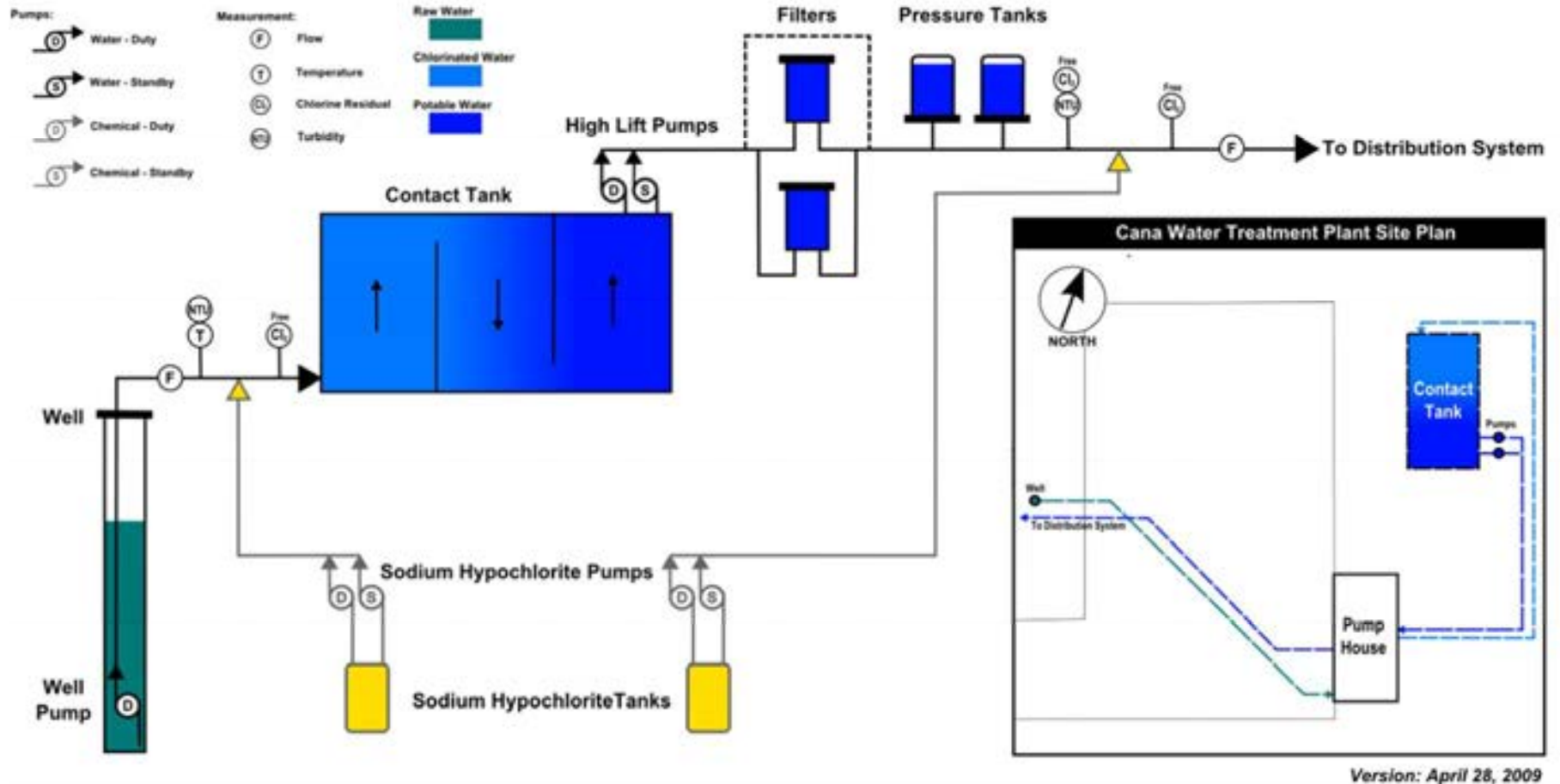
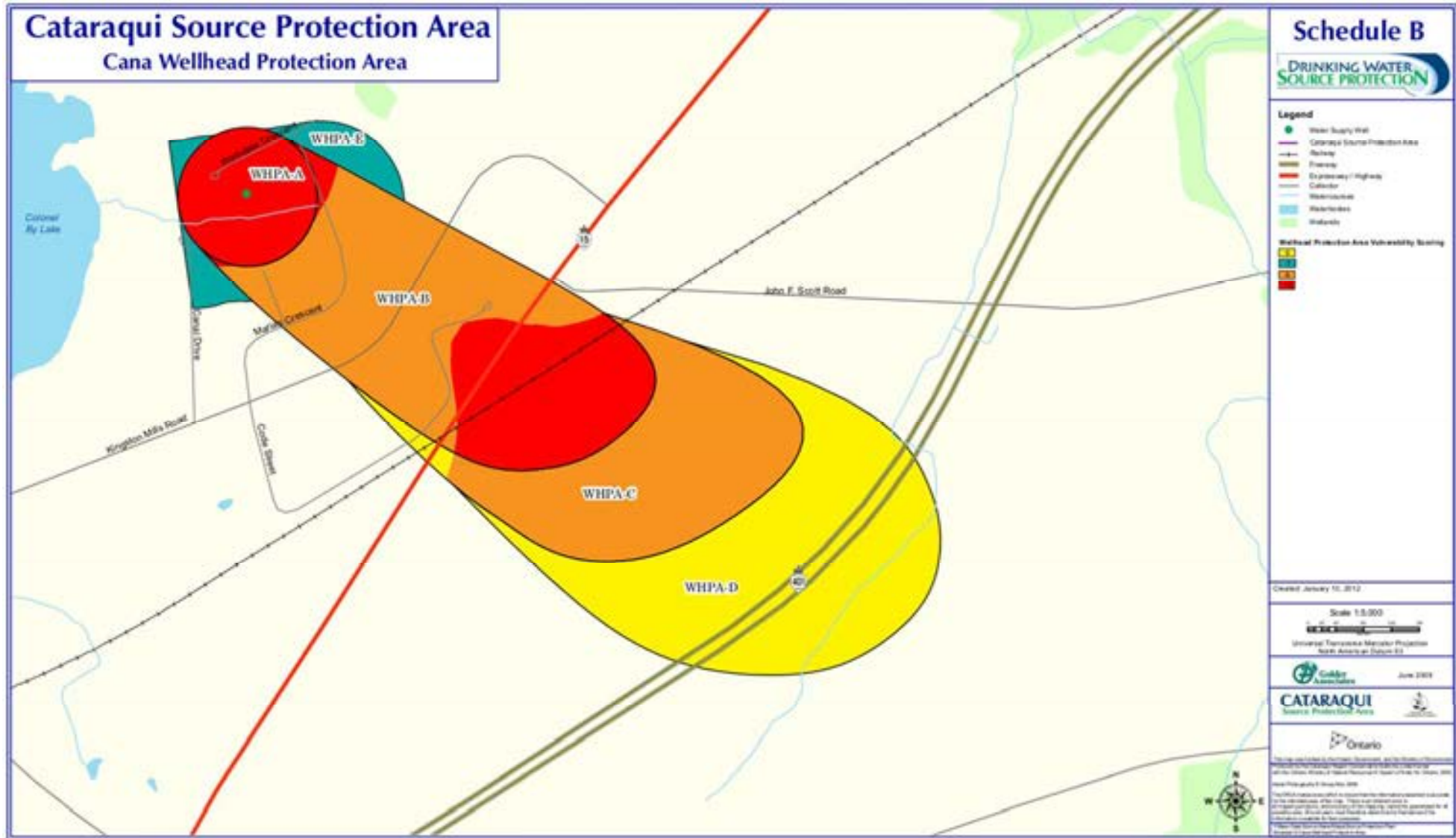


Figure 8 – Cana Wellhead Protection Area

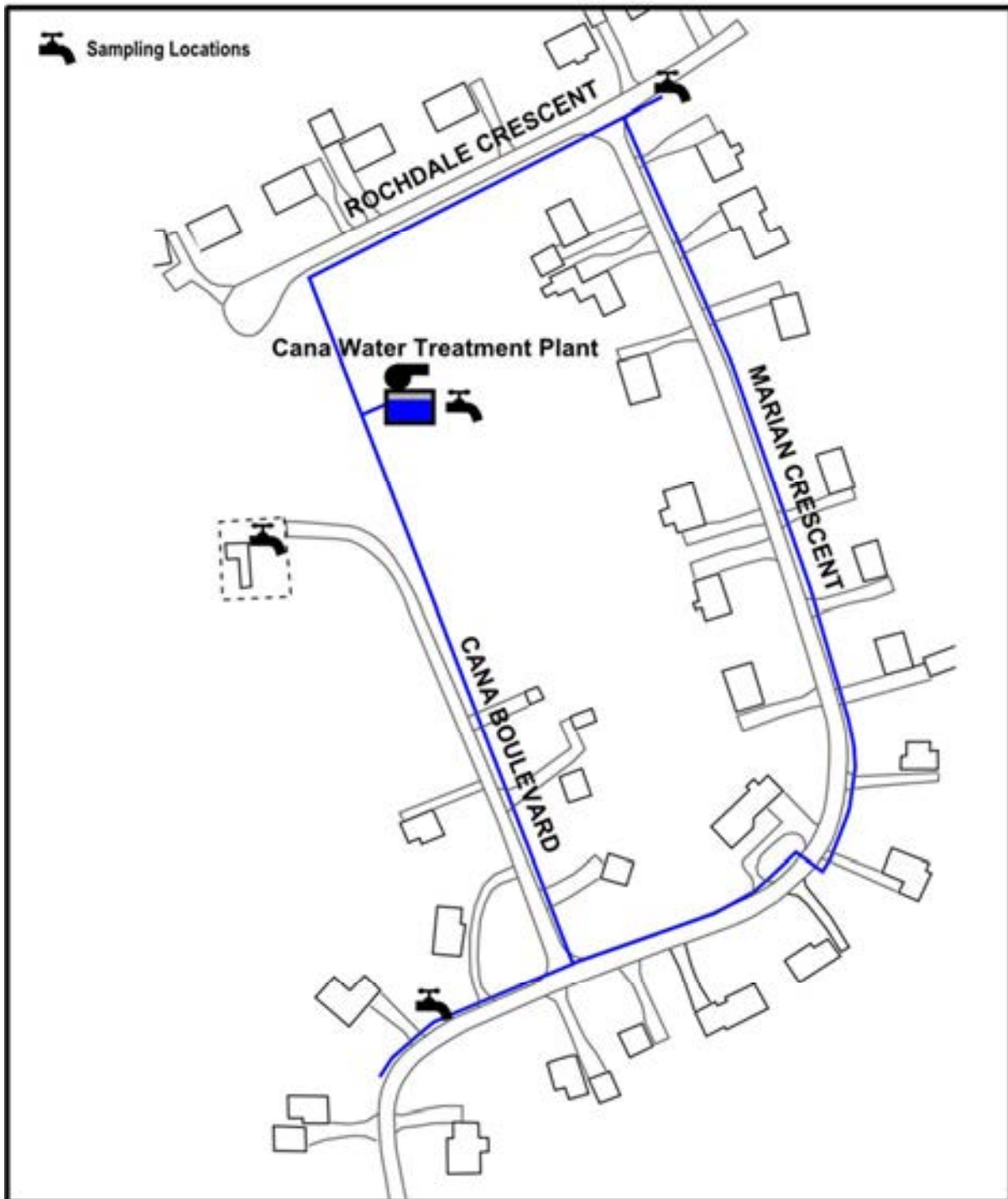


6.2.6.2 Distribution System

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.

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Figure 9 – Cana Drinking Water System Map
CANA DRINKING WATER SUPPLY SYSTEM



Version: April 28, 2009

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 Table 1 - Kingston Drinking Water System Risk Assessments and Table 2 – Cana Drinking Water System Risk Assessments. 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.

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Table 1 - Kingston Drinking Water System Risk Assessments

RISK ASSESSMENT SUMMARY TABLE																
HIGH RISK THRESHOLD VALUE: 7.25 LISTED BY EVENT CLASSIFICATION AND CONTROLLED RISK CLASSIFICATION IN DESCENDING ORDER OF ASSESSED CONTROLLED RISK																
Facility	Process Step	Hazardous Event	Hazard	Primary Control	Secondary Control	Response	Response Procedures	Probability	Consequence	Detectability	Risk Value	Control Value	Controlled Risk	CLASSIFICATION		
														Event Classification	Controlled Risk	Control Point Classification
Point Pleasant WTP	Raw Water Source	Algae Bloom	Potential for toxin producing cyanobacteria - Biological/chemical contamination of drinking water	Not available	Screens, filters, chemically assisted filtration and disinfection of water, sampling and monitoring	Increased specific sampling, process adjustments	W-E-04 Contaminated Raw Water Procedure	3	4	4	11	-2	9	HIGH RISK UNCONTROLLED HAZARDOUS EVENT	HIGH CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
King St WTP	Raw Water Source	Radiological Spill	Radiological contamination of raw water	Not available	Not available	Shut down intake, water use restrictions and public notification	W-E-04 Contaminated Raw Water Procedure, W-E-05 Spill Response Procedure, W-E-01 Emergency Response and Recovery Procedure	1	5	4	10	-1	9	HIGH RISK UNCONTROLLED HAZARDOUS EVENT	HIGH CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
Point Pleasant WTP	Raw Water Source	Radiological Spill	Radiological contamination of raw water	Not available	Not available	Shut down intake, public notification	W-E-04 Contaminated Raw Water Procedure, W-E-05 Spill Response Procedure, W-E-01 Emergency Response and Recovery Procedure	1	5	4	10	-1	9	HIGH RISK UNCONTROLLED HAZARDOUS EVENT	HIGH CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
Point Pleasant WTP	High Lift Suction Well	Spill	Chemical contamination of drinking water	Not available	Equipment inspection and maintenance	Containment, cleanup, possible isolation, reporting	W-E-05 Spill Response Procedure, W-E-01 Emergency Response and Recovery Procedure	1	5	4	10	-2	8	HIGH RISK UNCONTROLLED HAZARDOUS EVENT	HIGH CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
King St WTP	Raw Water Source	Algae Bloom	Potential for toxin producing cyanobacteria - Biological/chemical contamination of drinking water	Not available	Screens, filters, chemically assisted filtration and disinfection of water, sampling and monitoring	Increased specific sampling, process adjustments	W-E-04 Contaminated Raw Water Procedure	3	4	3	10	-2	8	HIGH RISK UNCONTROLLED HAZARDOUS EVENT	HIGH CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
Distribution System	Mains	Main Break – Transmission	Increased demand, reduced or lost flow of drinking water to area serviced by transmission main, reduction or loss of distribution system pressure - Contamination of drinking water	Not available	Positive system pressure. Secondary disinfection	Isolate and repair per SOP, possible public notification and water use restrictions	WD-02-03 Mains Break Repair, W-E-01 Emergency Response and Recovery Procedure	2	4	4	10	-2	8	HIGH RISK UNCONTROLLED HAZARDOUS EVENT	HIGH CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
Point Pleasant WTP	Automated Process Control and Monitoring	Alarms Failure	Reduced or lost process control - possible ineffective water treatment or low system pressure - Contamination of drinking water	Not available	24hr monitoring (Days - on site / Nights - from KSWTP)	Visually monitor processes through SCADA, repair	WT-05-01 Alarms Operation and Maintenance	2	4	4	10	-2	8	HIGH RISK UNCONTROLLED HAZARDOUS EVENT	HIGH CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
Distribution System	Mains	Main Break – Trunk	Increased demand, reduction or loss of distribution system pressure - Contamination of drinking water	Not available	Positive system pressure. Secondary disinfection	Isolate and repair per SOP, possible public notification and water use restrictions	WD-02-03 Mains Break Repair, W-E-01 Emergency Response and Recovery Procedure	3	3	4	10	-2	8	HIGH RISK UNCONTROLLED HAZARDOUS EVENT	HIGH CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT

UTILITIES KINGSTON DRINKING WATER QUALITY MANAGEMENT SYSTEM

Document: Operational Plan For the Kingston and Cana Drinking Water Systems	Document No: W-OP-01
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RISK ASSESSMENT SUMMARY TABLE																
HIGH RISK THRESHOLD VALUE: 7.25 LISTED BY EVENT CLASSIFICATION AND CONTROLLED RISK CLASSIFICATION IN DESCENDING ORDER OF ASSESSED CONTROLLED RISK																
Facility	Process Step	Hazardous Event	Hazard	Primary Control	Secondary Control	Response	Response Procedures	Probability	Consequence	Detectability	Risk Value	Control Value	Controlled Risk	CLASSIFICATION		
														Event Classification	Controlled Risk	Control Point Classification
King St WTP	Raw Water Source	Chemical Spill	Chemical contamination of raw water	Not available	Not available	Shut down raw water intake, increased raw water sampling, water use restrictions and public notification	W-E-04 Contaminated Raw Water Procedure, W-E-05 Spill Response Procedure, W-E-01 Emergency Response and Recovery Procedure	1	4	4	9	-1	8	HIGH RISK UNCONTROLLED HAZARDOUS EVENT	HIGH CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
King St WTP	Clearwell	Clearwell to Hig Lift Conduit Failure	Reduced or lost water flow	Not available	Not available	Possible partial bypass, water use restrictions, public notifications	WT-01-01 General Treatment Plant Operation and Operator Duties, W-E-01 Emergency Response and Recovery Procedure	1	4	4	9	-1	8	HIGH RISK UNCONTROLLED HAZARDOUS EVENT	HIGH CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
Point Pleasant WTP	Raw Water Source	Chemical Spill	Chemical contamination of raw water	Not available	Not available	Shut down intake, increased raw water monitoring, public notification, possible process adjustments	W-E-04 Contaminated Raw Water Procedure, W-E-05 Spill Response Procedure, W-E-01 Emergency Response and Recovery Procedure	1	4	4	9	-1	8	HIGH RISK UNCONTROLLED HAZARDOUS EVENT	HIGH CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
King St WTP	Automated Process Control and Monitoring	Alarms Failure	Reduced or lost process control - possible ineffective water treatment or low system pressure - Contamination of drinking water	Not available	24hr coverage at plant	Visually monitor processes through SCADA, repair	WT-05-01 Alarms Operation and Maintenance	1	4	4	9	-2	7	HIGH RISK UNCONTROLLED HAZARDOUS EVENT	MODERATE CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
Distribution System	General	Low Demand	Reduced free chlorine residuals at extremities of system - Biological contamination of drinking water	Not available	Programmed flushing and auto flushers	Increased flushing	WD-01-01 General Flushing, W-CC-04 Kingston Secondary Disinfection Critical Control Limit Response	3	3	3	9	-2	7	HIGH RISK UNCONTROLLED HAZARDOUS EVENT	MODERATE CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
King St WTP	High Lift Suction Well	Spill	Chemical contamination of drinking water	Not available	Equipment inspection and maintenance	Containment, cleanup, possible isolation, reporting	W-E-05 Spill Response Procedure, W-E-01 Emergency Response and Recovery Procedure	1	5	2	8	-2	6	HIGH RISK UNCONTROLLED HAZARDOUS EVENT	MODERATE CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
King St WTP	Automated Process Control and Monitoring	SCADA - PLC Failure	Reduced or loss of process control – possible ineffective water treatment - Contamination of drinking water	Not available	Localized automated control, manual control (24hr coverage)	Increased monitoring and sampling, operate on local or manual control, repair	WT-05-03 SCADA System Operation and Maintenance, Abnormal Operation and Failure Operation Sections of SOPS for Affected Processes	3	4	1	8	-2	6	HIGH RISK UNCONTROLLED HAZARDOUS EVENT	MODERATE CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
King St WTP	General	Electrical Power Outage	Loss of treated water supply, reduced or lost system pressure - Contamination of drinking water	Not available	Redundant electrical feed, backup diesel pumps, backup generator, uninterruptable power supply	Auto switch over to backup power and diesel pumps	WT-03-09 King Street WTP Backup Generator, Failure and abnormal operation sections of applicable SOPs	3	4	1	8	-2	6	HIGH RISK UNCONTROLLED HAZARDOUS EVENT	MODERATE CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT

UTILITIES KINGSTON DRINKING WATER QUALITY MANAGEMENT SYSTEM

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Facility	Process Step	Hazardous Event	Hazard	Primary Control	Secondary Control	Response	Response Procedures	Probability	Consequence	Detectability	Risk Value	Control Value	Controlled Risk	CLASSIFICATION		
														Event Classification	Controlled Risk	Control Point Classification
Distribution System	Mains	Main Break – Header from King St Water Treatment Plant	Reduced or lost flow of drinking water to distribution system, reduction or loss of distribution system pressure - Contamination of drinking water	Not available	Redundant header mains. Positive system pressure. Secondary disinfection. System Interconnects.	Isolate and repair per SOP, possible public notification and water use restrictions	WD-02-03 Mains Break Repair, W-E-01 Emergency Response and Recovery Procedure	2	4	2	8	-2	6	HIGH RISK UNCONTROLLED HAZARDOUS EVENT	MODERATE CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
Point Pleasant WTP	Automated Process Control and Monitoring	SCADA - PLC Failure	Reduced or loss of process control – possible ineffective water treatment - Contamination of drinking water	Not available	Localized automated control, manual control (24hr coverage)	Increased monitoring and sampling, operate on local or manual control, repair	WT-05-03 SCADA System Operation and Maintenance, Abnormal Operation and Failure Operation Sections of SOPS for Affected Processes	3	4	1	8	-2	6	HIGH RISK UNCONTROLLED HAZARDOUS EVENT	MODERATE CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
Point Pleasant WTP	Treatment Chemical Storage	Coagulant Storage Tank Failure	Ineffective chemically assisted filtration - Biological contamination of drinking water	Not available	Two Coagulant Tanks	Isolate and repair, Isolate and use other tank	WT-02-03 Point Pleasant WTP Coagulant System	1	4	3	8	-2	6	HIGH RISK UNCONTROLLED HAZARDOUS EVENT	MODERATE CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
King St WTP	Clearwell	Baffle Failure	Ineffective disinfection (CT) - Biological contamination of drinking water	Not available	Inspection	Repair baffle	W-CC-03 Kingston Primary Disinfection Critical Control Limit Response	1	3	4	8	-2	6	HIGH RISK UNCONTROLLED HAZARDOUS EVENT	MODERATE CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
King St WTP	Automated Process Control and Monitoring	Distribution System Communications Failure	Reduced or lost process control – low system pressure - Contamination of drinking water	Not available	Com Fail Alarm	Manual operation, Increased process monitoring through SCADA, investigate and repair	WT-03-07 King Street WTP High Lift & Reservoir Pumps, WS-02-01 Water Storage Facilities Operation and Maintenance, WS-03-01 Booster Stations James Street Station	4	3	1	8	-2	6	HIGH RISK UNCONTROLLED HAZARDOUS EVENT	MODERATE CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
Distribution System	Booster Stations	James St Station - Communications-SCADA Failure	Loss of remote automated control of station – Loss of water supply to area - Biological contamination of drinking water	Not available	Alarm	Manual operation	WS-03-01 Booster Stations James Street Station, W-CC-04 Kingston Secondary Disinfection Critical Control Limit Response	4	3	1	8	-2	6	HIGH RISK UNCONTROLLED HAZARDOUS EVENT	MODERATE CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
Point Pleasant WTP	Raw Water Source	Algae Bloom	Screen and filter clogging - Reduced/lost raw water flow	Not Available	Low level alarm	Increased screen washing/cleaning, increased filter backwash frequency	WT-02-01 Point Pleasant WTP Intake and Screens, WT-02-05 Point Pleasant WTP Filters and Backwash System	3	3	2	8	-2	6	HIGH RISK UNCONTROLLED HAZARDOUS EVENT	MODERATE CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
Point Pleasant WTP	Contact Tank and Treated Water Reservoir	Contact Tank Baffle Failure	Ineffective disinfection (CT) - Biological contamination of drinking water	Not available	Inspection	Repair baffle	W-CC-03 Kingston Primary Disinfection Critical Control Limit Response	1	3	4	8	-2	6	HIGH RISK UNCONTROLLED HAZARDOUS EVENT	MODERATE CONTROLLED RISK	UNCONTROLLED HAZARDOUS EVENT OCCURS AT A MINIMUM CRITICAL CONTROL POINT
Distribution System	General	Vandalism - Tampering	Damage to facilities and equipment - Contamination of drinking water	Fences, gates, and locks at facilities	Alarms, regular inspection	Investigate and rectify any found problem per applicable SOP	WT-01-03 General Alarms Monitoring and Response	1	5	4	10	-3	7	HIGH RISK CONTROLLABLE HAZARDOUS EVENT	MODERATE CONTROLLED RISK	CONTROL POINT

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HIGH RISK THRESHOLD VALUE: 7.25 LISTED BY EVENT CLASSIFICATION AND CONTROLLED RISK CLASSIFICATION IN DESCENDING ORDER OF ASSESSED CONTROLLED RISK																
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														Event Classification	Controlled Risk	Control Point Classification
Distribution System	Valves	Valve Failure Closed – Header from Point Pleasant WTP	Lost flow of drinking water to distribution system, reduction or loss of distribution system pressure - Contamination of drinking water	Inspection and maintenance, valve operation program	Use of valve operation plan	Isolate and repair, water use restrictions and public notification, open connections to zone 1B	WD-03-02 Valves Troubleshooting and Repair, W-E-01 Emergency Response and Recovery Procedure	2	4	4	10	-3	7	HIGH RISK CONTROLLABLE HAZARDOUS EVENT	MODERATE CONTROLLED RISK	CONTROL POINT
Point Pleasant WTP	Disinfection System	Loss of Post Chlorination - Water Supply Line Breakage - Blockage	Ineffective primary disinfection - Biological contamination of drinking water	Inspection and maintenance	SCADA/alarms	isolate and repair	WT-02-06 Point Pleasant WTP Disinfection Strategy and Chlorination System, W-CC-03 Kingston Primary Disinfection Critical Control Limit Response, W-E-01 Emergency Response and Recovery Procedure	1	5	3	9	-3	6	HIGH RISK CONTROLLABLE HAZARDOUS EVENT	MODERATE CONTROLLED RISK	MINIMUM CRITICAL CONTROL POINT
Point Pleasant WTP	Disinfection System	Loss of Post Chlorination - Water Supply Line Breakage - Blockage	Insufficient free chlorine residual to maintain secondary disinfection - Biological contamination of drinking water	Inspection and maintenance	SCADA/alarms	isolate and repair	WT-02-06 Point Pleasant WTP Disinfection Strategy and Chlorination System, W-CC-04 Kingston Secondary Disinfection Critical Control Limit Response, W-E-01 Emergency Response and Recovery Procedure	1	5	3	9	-3	6	HIGH RISK CONTROLLABLE HAZARDOUS EVENT	MODERATE CONTROLLED RISK	MINIMUM CRITICAL CONTROL POINT
King St WTP	Coagulant System	Loss of Coagulant Dosing - Chemical Line Breakage or Blockage	Ineffective chemically assisted filtration - Biological contamination of drinking water	Inspection and flushing of lines	Flow alarms, process alarms and monitoring, manual redundancy	Use redundant line, repair broken/blocked line	WT-03-03 King Street WTP Coagulant System, W-CC-01 Kingston Coagulation Critical Control Limit Response, W-E-01 Emergency Response and Recovery Procedure	2	4	3	9	-3	6	HIGH RISK CONTROLLABLE HAZARDOUS EVENT	MODERATE CONTROLLED RISK	MINIMUM CRITICAL CONTROL POINT
King St WTP	General	Unavailability of Staff	Increased response time to hazardous event	Call out protocol for shift coverage, standby operators	Use of qualified staff from other groups, supervisory personnel, contractors	Follow call out protocols, use of supervisory personnel, staff from other groups or contractor where required	W-G-05 Personnel Coverage Procedure	1	4	4	9	-3	6	HIGH RISK CONTROLLABLE HAZARDOUS EVENT	MODERATE CONTROLLED RISK	CONTROL POINT
Distribution System	Valves	Valve Failure Closed – Transmission Main	Reduced or lost flow of drinking water to area serviced by transmission main, adverse effect on distribution system hydraulics, reduction or loss of distribution system pressure - Contamination of drinking water, increased likelihood of water main breakage	Inspection and maintenance	Redundant supply and system storage available in some but not all instances, use of valve operation plan	Isolate and repair, water use restrictions and public notification	WD-03-02 Valves Troubleshooting and Repair, W-E-01 Emergency Response and Recovery Procedure	1	4	4	9	-3	6	HIGH RISK CONTROLLABLE HAZARDOUS EVENT	MODERATE CONTROLLED RISK	CONTROL POINT
Distribution System	Reservoirs	Structural Failure	Possible infiltration of untreated water - Biological contamination of drinking water	Inspections	Secondary disinfection	Isolate, drain, repair, possible public notification, operation of system per applicable SOPs	WS-02-01 Water Storage Facilities Operation and Maintenance, WS-02-02 Water Storage Facilities Isolation and Re-Commissioning	1	4	4	9	-3	6	HIGH RISK CONTROLLABLE HAZARDOUS EVENT	MODERATE CONTROLLED RISK	CONTROL POINT

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Facility	Process Step	Hazardous Event	Hazard	Primary Control	Secondary Control	Response	Response Procedures	Probability	Consequence	Detectability	Risk Value	Control Value	Controlled Risk	CLASSIFICATION		
														Event Classification	Controlled Risk	Control Point Classification
Distribution System	General	Unavailability of Staff	Increased response time to hazardous event	Standby operators, call out process	Use of qualified staff from other groups, supervisory personnel, contractors	Follow call out protocols, use of supervisory personnel, staff from other groups or contractor where required	W-G-05 Personnel Coverage Procedure	1	4	4	9	-3	6	HIGH RISK CONTROLLABLE HAZARDOUS EVENT	MODERATE CONTROLLED RISK	CONTROL POINT
Point Pleasant WTP	Coagulant System	Loss of Coagulant Dosing - Chemical Line Breakage or Blockage	Ineffective chemically assisted filtration - Biological contamination of drinking water	Inspection and flushing of lines	Flow alarms, process alarms and monitoring, manual redundancy	Use redundant line, repair broken/blocked line	WT-02-03 Point Pleasant WTP Coagulant System, W-CC-01 Kingston Coagulation Critical Control Limit Response, W-E-01 Emergency Response and Recovery Procedure	2	4	3	9	-3	6	HIGH RISK CONTROLLABLE HAZARDOUS EVENT	MODERATE CONTROLLED RISK	MINIMUM CRITICAL CONTROL POINT
Point Pleasant WTP	General	Unavailability of Staff	Increased response time to hazardous event	Call out protocol for shift coverage, standby operators	Use of qualified staff from other groups, supervisory personnel, contractors	Follow call out protocols, use of supervisory personnel, staff from other groups or contractor where required	W-G-05 Personnel Coverage Procedure	1	4	4	9	-3	6	HIGH RISK CONTROLLABLE HAZARDOUS EVENT	MODERATE CONTROLLED RISK	CONTROL POINT
Distribution System	Valves	Valve Failure Closed – Local Main-Dead End	Lost flow to and pressure in dead end main - Contamination of drinking water	Inspection and maintenance	Not available	Isolate, repair, disinfect, flush and sample	WD-03-02 Valves Troubleshooting and Repair, W-E-01 Emergency Response and Recovery Procedure	2	3	4	9	-3	6	HIGH RISK CONTROLLABLE HAZARDOUS EVENT	MODERATE CONTROLLED RISK	CONTROL POINT
Distribution System	General	Low Free Chlorine Residual	Possible loss of secondary disinfection - Bacteriological contamination of drinking water	Post chlorination at WTP, distribution re-chlorination, programmed flushing, auto flushers	Alarms, flushing and sampling	Ensure op of chlorination facilities, flushing, resample, possible notification	W-CC-04 Kingston Secondary Disinfection Critical Control Limit Response	3	3	3	9	-3	6	HIGH RISK CONTROLLABLE HAZARDOUS EVENT	MODERATE CONTROLLED RISK	MINIMUM CRITICAL CONTROL POINT
Point Pleasant WTP	Filters and Backwash System	Filter Underdrain Failure	Reduced backwash capacity and flow/Biological contamination of drinking water	Routine monitoring	SCADA/alarms, redundant filters	Isolate filter, repair	WT-02-05 Point Pleasant WTP Filters and Backwash System, W-CC-02 Kingston Filter Effluent Turbidity Critical Control Limit Response	3	4	2	9	-4	5	HIGH RISK CONTROLLABLE HAZARDOUS EVENT	MODERATE CONTROLLED RISK	MINIMUM CRITICAL CONTROL POINT
King St WTP	Disinfection System	Loss of Post-Chlorination - Chemical Feed Pump Failure	Ineffective primary disinfection - Biological contamination of drinking water	Automated redundancy, automated control and monitoring, maintenance	SCADA/alarms	Ensure operation of backup, repair failed chemical pump	WT-03-06 King Street WTP Disinfection Strategy and Chlorination System, W-CC-03 Kingston Primary Disinfection Critical Control Limit Response, W-E-01 Emergency Response and Recovery Procedure	3	5	1	9	-5	4	HIGH RISK CONTROLLABLE HAZARDOUS EVENT	MODERATE CONTROLLED RISK	MINIMUM CRITICAL CONTROL POINT

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HIGH RISK THRESHOLD VALUE: 7.25 LISTED BY EVENT CLASSIFICATION AND CONTROLLED RISK CLASSIFICATION IN DESCENDING ORDER OF ASSESSED CONTROLLED RISK																
Facility	Process Step	Hazardous Event	Hazard	Primary Control	Secondary Control	Response	Response Procedures	Probability	Consequence	Detectability	Risk Value	Controlled Risk	CLASSIFICATION			
													Event Classification	Controlled Risk	Control Point Classification	
King St WTP	Disinfection System	Loss of Post-Chlorination - Chemical Feed Pump Failure	Insufficient free chlorine residual to maintain secondary disinfection - Biological contamination of drinking water	Automated redundancy, automated control and monitoring, maintenance	SCADA/alarms	Ensure operation of backup, repair failed chemical pump	WT-03-06 King Street WTP Disinfection Strategy and Chlorination System, W-CC-03 Kingston Primary Disinfection Critical Control Limit Response, W-CC-04 Kingston Secondary Disinfection Critical Control Limit Response, W-E-01 Emergency Response and Recovery Procedure	3	5	1	9	-5	4	HIGH RISK CONTROLLABLE HAZARDOUS EVENT	MODERATE CONTROLLED RISK	MINIMUM CRITICAL CONTROL POINT
Point Pleasant WTP	Disinfection System	Loss of Post Chlorination - Chlorine Solution Line Breakage or Blockage	Ineffective primary disinfection - Biological contamination of drinking water	Inspection and maintenance	SCADA/alarms	Repair failed line	WT-02-06 Point Pleasant WTP Disinfection Strategy and Chlorination System, W-CC-03 Kingston Primary Disinfection Critical Control Limit Response, W-E-01 Emergency Response and Recovery Procedure	1	5	2	8	-3	5	HIGH RISK CONTROLLABLE HAZARDOUS EVENT	MODERATE CONTROLLED RISK	MINIMUM CRITICAL CONTROL POINT
Point Pleasant WTP	Disinfection System	Loss of Post Chlorination - Chlorine Solution Line Breakage or Blockage	Insufficient free chlorine residual to maintain secondary disinfection - Biological contamination of drinking water	Inspection and maintenance	SCADA/alarms	Alternate injection point, repair	WT-02-06 Point Pleasant WTP Disinfection Strategy and Chlorination System, W-CC-04 Kingston Secondary Disinfection Critical Control Limit Response, W-E-01 Emergency Response and Recovery Procedure	1	5	2	8	-3	5	HIGH RISK CONTROLLABLE HAZARDOUS EVENT	MODERATE CONTROLLED RISK	MINIMUM CRITICAL CONTROL POINT
King St WTP	Low Lift Suction Well	Spill In Low Lift Station - Fuel-Oil	Chemical contamination of raw water	Inspection and maintenance of equipment and fuel systems	Containment structure.	Containment of spill, shut down low lift pumps if required and by-pass pump from lake to mixing tanks	W-E-05 Spill Response Procedure, W-E-04 Contaminated Raw Water Procedure, W-E-01 Emergency Response and Recovery Procedure	1	4	3	8	-3	5	HIGH RISK CONTROLLABLE HAZARDOUS EVENT	MODERATE CONTROLLED RISK	CONTROL POINT
Distribution System	Elevated Storage	Structural Failure	Loss of system pressure maintenance and stabilization provided by hydraulic head, possible low or high distribution system pressures – Increased likelihood of water main breakage, biological contamination of drinking water	Inspection and maintenance, coatings and cathodic protection	Use of alternate elevated storage where available	Isolate, drain, repair, operation of system per applicable SOPs	WS-02-01 Water Storage Facilities Operation and Maintenance, WS-02-02 Water Storage Facilities Isolation and Re-Commissioning	1	4	3	8	-3	5	HIGH RISK CONTROLLABLE HAZARDOUS EVENT	MODERATE CONTROLLED RISK	CONTROL POINT
Distribution System	Elevated Storage	Structural Failure	Reduced distribution system storage capacity, possible insufficient flow to distribution system during periods of extreme high demand resulting in reduced distribution system pressure - Contamination of drinking water	Inspection and maintenance, coatings and cathodic protection	Use of alternate elevated storage where available, secondary disinfection	Isolate, drain, repair, operation of system per applicable SOPs	WS-02-01 Water Storage Facilities Operation and Maintenance, WS-02-02 Water Storage Facilities Isolation and Re-Commissioning	1	4	3	8	-3	5	HIGH RISK CONTROLLABLE HAZARDOUS EVENT	MODERATE CONTROLLED RISK	CONTROL POINT

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RISK ASSESSMENT SUMMARY TABLE																
HIGH RISK THRESHOLD VALUE: 7.25 LISTED BY EVENT CLASSIFICATION AND CONTROLLED RISK CLASSIFICATION IN DESCENDING ORDER OF ASSESSED CONTROLLED RISK																
Facility	Process Step	Hazardous Event	Hazard	Primary Control	Secondary Control	Response	Response Procedures	Probability	Consequence	Detectability	Risk Value	Control Value	Controlled Risk	CLASSIFICATION		
														Event Classification	Controlled Risk	Control Point Classification
Distribution System	General	High Demand	Reduced distribution system storage levels, possible insufficient flow to distribution system during extended periods of extreme high demand resulting in reduced distribution system pressure - Contamination of drinking water	Leak detection, seasonal water restrictions, metering, water conservation initiatives	Leak repairs, Water main replacement, relining	Operational changes, additional water use restrictions and public notice	WT-XX-07 XX WTP High Lift & Reservoir Pumps, WD-01-03 General Leak Survey , WD-01-03 General Leak Survey, other procedures specific to the situation	3	4	1	8	-3	5	HIGH RISK CONTROLLABLE HAZARDOUS EVENT	MODERATE CONTROLLED RISK	CONTROL POINT
Point Pleasant WTP	Low Lift Suction Well	Spill - Fuel-Oil	Chemical contamination of raw water	Inspection and maintenance of equipment and fuel systems	Containment structure.	Containment of spill, shut down low lift pumps if required and by-pass pump from lake to mixing tanks	W-E-05 Spill Response Procedure, W-E-04 Contaminated Raw Water Procedure, W-E-01 Emergency Response and Recovery Procedure	1	4	3	8	-3	5	HIGH RISK CONTROLLABLE HAZARDOUS EVENT	MODERATE CONTROLLED RISK	CONTROL POINT
Point Pleasant WTP	General	Vandalism - Tampering	Damage to equipment - Contamination of drinking water	Auto-Locks, fences	Alarms, Cameras	Response to alarm/investigate, call police	WT-01-03 General Alarms Monitoring and Response	1	4	3	8	-3	5	HIGH RISK CONTROLLABLE HAZARDOUS EVENT	MODERATE CONTROLLED RISK	CONTROL POINT
King St WTP	Clearwell	Valve Failure	Reduced or lost water flow	Valve Maintenance	Redundant Clearwells	Repair	WT-05-05 Valves Gates and Actuators Operation and Maintenance, W-E-01 Emergency Response and Recovery Procedure	1	3	4	8	-3	5	HIGH RISK CONTROLLABLE HAZARDOUS EVENT	MODERATE CONTROLLED RISK	CONTROL POINT
Distribution System	Valves	Valve Failure Closed – Header from King St WTP	Lost flow of drinking water to distribution system, reduction or loss of distribution system pressure - Contamination of drinking water	Inspection and maintenance, valve operation program	Redundant header mains and valves, use of valve operation plan	Isolate and repair, water use restrictions and public notification, open connections to zone 1	WD-03-02 Valves Troubleshooting and Repair, W-E-01 Emergency Response and Recovery Procedure	1	3	4	8	-3	5	HIGH RISK CONTROLLABLE HAZARDOUS EVENT	MODERATE CONTROLLED RISK	CONTROL POINT
Distribution System	Valves	Valve Failure Closed - Header to-from booster station	Reduced or lost flow of drinking water to pressure zone, reduction or loss of distribution system pressure - Contamination of drinking water	Inspection and maintenance	Maintenance of positive system pressure through elevated storage or other booster stations, use of valve operation plan	Isolate and repair per SOP, possible public notification and water use restrictions	WD-03-02 Valves Troubleshooting and Repair, W-E-01 Emergency Response and Recovery Procedure	1	3	4	8	-3	5	HIGH RISK CONTROLLABLE HAZARDOUS EVENT	MODERATE CONTROLLED RISK	CONTROL POINT
Point Pleasant WTP	Contact Tank and Treated Water Reservoir	Valve Failure	Reduced or lost water flow	Inspection and Maintenance	Partial by-pass	Repair	WT-05-05 Valves Gates and Actuators Operation and Maintenance, W-E-01 Emergency Response and Recovery Procedure	1	3	4	8	-3	5	HIGH RISK CONTROLLABLE HAZARDOUS EVENT	MODERATE CONTROLLED RISK	CONTROL POINT

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King St WTP	Disinfection System	Loss of Post-Chlorination - Chemical Line Breakage or Blockage	Ineffective primary disinfection - Biological contamination of drinking water	Maintenance / Flushing lines	SCADA/alarms	Alternate injection point, repair line	WT-03-06 King Street WTP Disinfection Strategy and Chlorination System, W-CC-03 Kingston Primary Disinfection Critical Control Limit Response, W-E-01 Emergency Response and Recovery Procedure	2	5	1	8	-4	4	HIGH RISK CONTROLLABLE HAZARDOUS EVENT	MODERATE CONTROLLED RISK	MINIMUM CRITICAL CONTROL POINT
King St WTP	Disinfection System	Loss of Post-Chlorination - Chemical Line Breakage or Blockage	Insufficient free chlorine residual to maintain secondary disinfection - Biological contamination of drinking water	Maintenance / Flushing lines	SCADA/alarms	Alternate injection point, repair line	WT-03-06 King Street WTP Disinfection Strategy and Chlorination System, W-CC-03 Kingston Primary Disinfection Critical Control Limit Response, W-CC-04 Kingston Secondary Disinfection Critical Control Limit Response, W-E-01 Emergency Response and Recovery Procedure	2	5	1	8	-4	4	HIGH RISK CONTROLLABLE HAZARDOUS EVENT	MODERATE CONTROLLED RISK	MINIMUM CRITICAL CONTROL POINT
Point Pleasant WTP	Disinfection System	Loss of Post Chlorination - Chlorine Gas Line Breakage	Ineffective primary disinfection - Biological contamination of drinking water	Inspection and maintenance, vacuum system/auto shut down	SCADA/alarms, Multiple Injection Points	isolate and repair	WT-02-06 Point Pleasant WTP Disinfection Strategy and Chlorination System, W-CC-03 Kingston Primary Disinfection Critical Control Limit Response, W-E-01 Emergency Response and Recovery Procedure	2	5	1	8	-4	4	HIGH RISK CONTROLLABLE HAZARDOUS EVENT	MODERATE CONTROLLED RISK	MINIMUM CRITICAL CONTROL POINT
Point Pleasant WTP	Disinfection System	Loss of Post Chlorination - Chlorine Gas Line Breakage	Insufficient free chlorine residual to maintain secondary disinfection - Biological contamination of drinking water	Inspection and maintenance, vacuum system/auto shut down	SCADA/alarms	isolate and repair	WT-02-06 Point Pleasant WTP Disinfection Strategy and Chlorination System, W-CC-04 Kingston Secondary Disinfection Critical Control Limit Response, W-E-01 Emergency Response and Recovery Procedure	2	5	1	8	-4	4	HIGH RISK CONTROLLABLE HAZARDOUS EVENT	MODERATE CONTROLLED RISK	MINIMUM CRITICAL CONTROL POINT
King St WTP	Automated Process Control and Monitoring	Localized Component Failure - Raw Water Flow Meter	Reduced or loss of process control – possible ineffective water treatment - Contamination of drinking water	Calibration and Maintenance	SCADA/Alarms, redundant headers/meters	Direct flow through alternate header/meter, isolate/repair	WT-05-02 Instrumentation Operation and Maintenance	2	4	2	8	-4	4	HIGH RISK CONTROLLABLE HAZARDOUS EVENT	MODERATE CONTROLLED RISK	MINIMUM CRITICAL CONTROL POINT
Point Pleasant WTP	Automated Process Control and Monitoring	Localized Component Failure - Post Chlorine Analysers	Reduced or loss of process control – possible ineffective water treatment - Contamination of drinking water	Maintenance and calibration	SCADA/alarms, observations during daily rounds, manual redundancy	Increased sampling and monitoring, repair/replace defective analyzer	WT-05-02 Instrumentation Operation and Maintenance, WT-02-06 Point Pleasant WTP Disinfection Strategy and Chlorination System, W-CC-03 Kingston Primary Disinfection Critical Control Limit Response	3	4	1	8	-4	4	HIGH RISK CONTROLLABLE HAZARDOUS EVENT	MODERATE CONTROLLED RISK	MINIMUM CRITICAL CONTROL POINT

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Facility	Process Step	Hazardous Event	Hazard	Primary Control	Secondary Control	Response	Response Procedures	Probability	Consequence	Detectability	Risk Value	Control Value	Controlled Risk	CLASSIFICATION		
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Point Pleasant WTP	Disinfection System	Loss of Post Chlorination - Chlorinator Failure	Ineffective primary disinfection - Biological contamination of drinking water	Automated redundancy, automated control and monitoring , annual rebuild	SCADA/alarms, Interconnects	Ensure operation of backup, repair failed chlorinator	WT-02-06 Point Pleasant WTP Disinfection Strategy and Chlorination System, W-CC-03 Kingston Primary Disinfection Critical Control Limit Response, W-E-01 Emergency Response and Recovery Procedure	2	5	1	8	-5	3	HIGH RISK CONTROLLABLE HAZARDOUS EVENT	MODERATE CONTROLLED RISK	MINIMUM CRITICAL CONTROL POINT
Point Pleasant WTP	Disinfection System	Loss of Post Chlorination - Chlorinator Failure	Insufficient free chlorine residual to maintain secondary disinfection - Biological contamination of drinking water	Automated redundancy, automated control and monitoring , scheduled maintenance	SCADA/alarms	Ensure operation of backup, repair failed chlorinator	WT-02-06 Point Pleasant WTP Disinfection Strategy and Chlorination System, W-CC-04 Kingston Secondary Disinfection Critical Control Limit Response, W-E-01 Emergency Response and Recovery Procedure	2	5	1	8	-5	3	HIGH RISK CONTROLLABLE HAZARDOUS EVENT	MODERATE CONTROLLED RISK	MINIMUM CRITICAL CONTROL POINT
King St WTP	Coagulant System	Loss of Coagulant Dosing - Chemical Feed Pump Failure	Ineffective chemically assisted filtration - Biological contamination of drinking water	Maintenance, redundant pumps, auto pump switch over	SCADA/alarms	Ensure operation of backup, repair failed pump	WT-03-03 King Street WTP Coagulant System, W-CC-01 Kingston Coagulation Critical Control Limit Response, W-E-01 Emergency Response and Recovery Procedure	3	4	1	8	-5	3	HIGH RISK CONTROLLABLE HAZARDOUS EVENT	MODERATE CONTROLLED RISK	MINIMUM CRITICAL CONTROL POINT
Point Pleasant WTP	Coagulant System	Loss of Coagulant Dosing - Chemical Feed Pump Failure	Ineffective chemically assisted filtration - Biological contamination of drinking water	Maintenance, redundant pumps, auto pump switch over	SCADA/alarms	Ensure operation of backup, repair failed pump	WT-02-03 Point Pleasant WTP Coagulant System, W-CC-01 Kingston Coagulation Critical Control Limit Response, W-E-01 Emergency Response and Recovery Procedure	3	4	1	8	-5	3	HIGH RISK CONTROLLABLE HAZARDOUS EVENT	MODERATE CONTROLLED RISK	MINIMUM CRITICAL CONTROL POINT
Distribution System	Mains	Main Break - Local	Increased demand, localized reduction or loss of distribution system pressure - Contamination of drinking water	Not available	Positive system pressure. Secondary disinfection	Isolate and repair per SOP, possible public notification and water use restrictions	WD-02-03 Mains Break Repair, W-E-01 Emergency Response and Recovery Procedure	5	2	4	11	-2	9	MODERATE RISK UNCONTROLLED HAZARDOUS EVENT	MODERATE CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
Distribution System	Booster Stations	Check Valve Failure	Increased pump operation to meet demand, low pressure in zone - Contamination of drinking water	Not available	Not available	Isolate and repair	WS-03-02 Booster Stations Pressure Zone Stations, WS-03-01 Booster Stations James Street Station	3	2	3	8	-1	7	MODERATE RISK UNCONTROLLED HAZARDOUS EVENT	MODERATE CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
King St WTP	Intake and Screens	Frazzle Ice	Reduced / lost raw water flow	Not available	Inspection and maintenance of screens. Low level and flow alarms.	Agitate water in well, ice removal, screen cleaning	WT-03-01 King Street WTP Intake and Screens	2	2	4	8	-2	6	MODERATE RISK UNCONTROLLED HAZARDOUS EVENT	MODERATE CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
Point Pleasant WTP	Intake and Screens	Frazzle Ice	Reduced / lost raw water flow	Not available	Inspection and maintenance of screens. Low level and flow alarms.	Agitate water in well, ice removal, screen cleaning	WT-02-01 Point Pleasant WTP Intake and Screens	2	2	4	8	-2	6	MODERATE RISK UNCONTROLLED HAZARDOUS EVENT	MODERATE CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT

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Point Pleasant WTP	Clearwell	Valve Failure	Reduced or lost water flow	Not available	Multiple clearwells	Repair	WT-05-05 Valves Gates and Actuators Operation and Maintenance, W-E-01 Emergency Response and Recovery Procedure	2	2	4	8	-2	6	MODERATE RISK UNCONTROLLED HAZARDOUS EVENT	MODERATE CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
King St WTP	High Lift Pumping	Total Loss of Highlift Pumping - Localized Electrical-Control	Loss of drinking water flow to distribution system, reduction or loss of distribution system pressure - Contamination of drinking water	Not available	SCADA/alarms, diesel backup	Manually run diesel backups	WT-03-07 King Street WTP High Lift & Reservoir Pumps, W-E-01 Emergency Response and Recovery Procedure	1	5	1	7	-2	5	MODERATE RISK UNCONTROLLED HAZARDOUS EVENT	LOW CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
Point Pleasant WTP	Low Lift Pumping	Discharge Header Breakage	Reduced / lost raw water flow	Not available	Supply of water from zone 1b, Interconnects with Central Zone	By-pass pump from low lift suction well to floc tanks, isolate and repair, water restrictions, public notification	WT-02-02 Point Pleasant WTP Low Lift Pumps, W-E-01 Emergency Response and Recovery Procedure	1	5	1	7	-2	5	MODERATE RISK UNCONTROLLED HAZARDOUS EVENT	LOW CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
Point Pleasant WTP	High Lift Pumping	Discharge Header Breakage	Reduced or lost flow of drinking water to distribution system, reduction or loss of distribution system pressure - Contamination of drinking water	Not available	North and South Headers	Shut down process, isolate and repair, water use restrictions and public notifications, Isolate and utilize other header	WT-02-07 Point Pleasant WTP High Lift & Reservoir Pumps, W-E-01 Emergency Response and Recovery Procedure	1	5	1	7	-2	5	MODERATE RISK UNCONTROLLED HAZARDOUS EVENT	LOW CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
Point Pleasant WTP	High Lift Pumping	Total Loss of Highlift Pumping - Localized Electrical-Control	Loss of drinking water flow to distribution system, reduction or loss of distribution system pressure - Contamination of drinking water	Not available	SCADA/alarms, diesel backup	Manually run diesel backups	WT-02-07 Point Pleasant WTP High Lift & Reservoir Pumps, W-E-01 Emergency Response and Recovery Procedure	1	5	1	7	-2	5	MODERATE RISK UNCONTROLLED HAZARDOUS EVENT	LOW CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
King St WTP	Treatment Chemical Storage	Coagulant Storage Tank Failure	Ineffective chemically assisted filtration - Biological contamination of drinking water	Not available	Level alarm, redundant tank	Use second tank, isolate and repair	WT-03-03 King Street WTP Coagulant System	1	4	2	7	-2	5	MODERATE RISK UNCONTROLLED HAZARDOUS EVENT	LOW CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
Distribution System	Mains	Main Break – Header to-from elevated storage	Increased demand, loss of system pressure maintenance and stabilization provided by hydraulic head, reduction or loss of distribution system pressure, loss of distribution system storage capacity - Contamination of drinking wat	Not available	Positive system pressure. Secondary disinfection	Isolate and repair per SOP, possible public notification and water use restrictions	WD-02-03 Mains Break Repair, W-E-01 Emergency Response and Recovery Procedure	2	4	1	7	-2	5	MODERATE RISK UNCONTROLLED HAZARDOUS EVENT	LOW CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT

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Facility	Process Step	Hazardous Event	Hazard	Primary Control	Secondary Control	Response	Response Procedures	Probability	Consequence	Detectability	Risk Value	Control Value	CLASSIFICATION			
													Controlled Risk	Event Classification	Control Point Classification	
Distribution System	Mains	Main Break – Header to-from James St booster station	Increased demand, reduced or lost flow of drinking water to pressure zone, reduction or loss of distribution system pressure - Contamination of drinking water	Not available	Positive system pressure. Secondary disinfection. Two headers leaving facility. Hi/Lo Pressure Alarms.	Isolate and repair per SOP. Utilize second header. Possible public notification and water use restrictions Maintenance of positive system pressure through by-pass piping, check valves, and system storage.	WD-02-03 Mains Break Repair, W-E-01 Emergency Response and Recovery Procedure	2	4	1	7	-2	5	MODERATE RISK UNCONTROLLED HAZARDOUS EVENT	LOW CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
Distribution System	Mains	Main Break – Header to-from ground level storage	Increased demand, reduction or loss of distribution system pressure, loss of distribution system storage capacity - Contamination of drinking water	Not available	Positive system pressure. Secondary disinfection	Isolate and repair per SOP, possible public notification and water use restrictions	WD-02-03 Mains Break Repair, W-E-01 Emergency Response and Recovery Procedure	1	3	3	7	-2	5	MODERATE RISK UNCONTROLLED HAZARDOUS EVENT	LOW CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
Point Pleasant WTP	General	Electrical Power Outage	Loss of treated water supply, reduced or lost system pressure - Contamination of drinking water	Not available	Backup diesel pumps, backup generator, uninterruptable power supply	Auto switch over to backup power and diesel pumps	WT-02-08 Point Pleasant WTP Backup Generator, Failure and abnormal operation sections of applicable SOPs	3	3	1	7	-2	5	MODERATE RISK UNCONTROLLED HAZARDOUS EVENT	LOW CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
King St WTP	Intake and Screens	Intake Damage - Blockage by Debris	Blockage of Intake - Reduced/lost raw water flow	Not available	Low level / flow alarms, inspection of intake, open valves to zone 1	By-pass pump from lake to surge chamber or low lift well	WT-03-01 King Street WTP Intake and Screens, W-E-01 Emergency Response and Recovery Procedure	1	4	1	6	-2	4	MODERATE RISK UNCONTROLLED HAZARDOUS EVENT	LOW CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
King St WTP	Intake and Screens	Intake Pipe Collapse - Breakage	Blockage of Intake Pipe - Reduced/lost raw water flow	Not available	Low level / flow alarms, inspection of intake, redundant intake available	By-pass pump from lake to surge chamber or low lift well, open valves to zone 1	WT-03-01 King Street WTP Intake and Screens, W-E-01 Emergency Response and Recovery Procedure	1	4	1	6	-2	4	MODERATE RISK UNCONTROLLED HAZARDOUS EVENT	LOW CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
King St WTP	High Lift Pumping	Discharge Header Breakage	Reduced or lost flow of drinking water to distribution system, reduction or loss of distribution system pressure - Contamination of drinking water	Not available	SCADA/alarms, redundant piping	Isolate broken header, bypass through remaining headers, public notification(water use restrictions), repair broken pipe	WT-03-07 King Street WTP High Lift & Reservoir Pumps, W-E-01 Emergency Response and Recovery Procedure	1	4	1	6	-2	4	MODERATE RISK UNCONTROLLED HAZARDOUS EVENT	LOW CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
King St WTP	Automated Process Control and Monitoring	Localized Component Failure - Post-Chlorination System Controller	Reduced or loss of process control – possible ineffective water treatment - Contamination of drinking water	Not available	Manual redundancy, alarms	Switch to pre-Chlorination system, repair	WT-03-06 King Street WTP Disinfection Strategy and Chlorination System, W-CC-03 Kingston Primary Disinfection Critical Control Limit Response	1	4	1	6	-2	4	MODERATE RISK UNCONTROLLED HAZARDOUS EVENT	LOW CONTROLLED RISK	UNCONTROLLED HAZARDOUS EVENT OCCURS AT A MINIMUM CRITICAL CONTROL POINT
King St WTP	Treatment Chemical Storage	Disinfectant Storage Tank Failure	Ineffective disinfection - Biological contamination of drinking water	Not available	Level alarm, redundant tank	Use second tank, isolate - repair	WT-03-06 King Street WTP Disinfection Strategy and Chlorination System	1	4	1	6	-2	4	MODERATE RISK UNCONTROLLED HAZARDOUS EVENT	LOW CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT

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													Controlled Risk	Event Classification	Controlled Risk	Control Point Classification
Distribution System	Mains	Main Break – Header to-from booster station (O'Connor and Sydenham Rd only)	Increased demand, reduced or lost flow of drinking water to pressure zone, reduction or loss of distribution system pressure - Contamination of drinking water	Not available	Positive system pressure. Secondary disinfection. Hi/Lo Pressure Alarms.	Isolate and repair per SOP, possible public notification and water use restrictions Maintenance of positive system pressure through by-pass piping, check valves, and system storage.	WD-02-03 Mains Break Repair, W-E-01 Emergency Response and Recovery Procedure	1	4	1	6	-2	4	MODERATE RISK UNCONTROLLED HAZARDOUS EVENT	LOW CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
Point Pleasant WTP	Intake and Screens	Intake Damage - Blockage by Debris	Blockage of Intake - Reduced/lost raw water flow	Not available	Low level / flow alarms, inspection of intake	By-pass pump from lake to low lift well, open valves to zone 1B	WT-02-01 Point Pleasant WTP Intake and Screens, W-E-01 Emergency Response and Recovery Procedure	1	4	1	6	-2	4	MODERATE RISK UNCONTROLLED HAZARDOUS EVENT	LOW CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
Point Pleasant WTP	Intake and Screens	Intake Pipe Collapse - Breakage	Blockage of Intake Pipe - Reduced/lost raw water flow	Not available	Low level / flow alarms, inspection of intake	By-pass pump from lake to low lift well, open valves to zone 1B	WT-02-01 Point Pleasant WTP Intake and Screens, W-E-01 Emergency Response and Recovery Procedure	1	4	1	6	-2	4	MODERATE RISK UNCONTROLLED HAZARDOUS EVENT	LOW CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
King St WTP	Raw Water Source	Algae Bloom	Screen and filter clogging - Reduced/lost raw water flow	Not available	Inspection and maintenance of screens. Low level and flow alarms.	Increased screen washing/cleaning, increased filter backwash frequency and duration	W-E-04 Contaminated Raw Water, WT-03-01 King Street WTP Intake and Screens, WT-03-05 King Street WTP Filters and Backwash System	1	3	2	6	-2	4	MODERATE RISK UNCONTROLLED HAZARDOUS EVENT	LOW CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
King St WTP	Low Lift Pumping	Discharge Header Breakage	Reduced / lost raw water flow	Not available	Redundant low lift header	Direct flow through alternate header, isolate and repair broken header.	WT-03-02 King Street WTP Low Lift Pumps, W-E-01 Emergency Response and Recovery Procedure	1	3	1	5	-2	3	MODERATE RISK UNCONTROLLED HAZARDOUS EVENT	LOW CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
King St WTP	Low Lift Pumping	Total Loss of Low Lift Pumping (Localized control - electrical)	Loss of raw water flow	Not available	Alarms. Manual redundancy available by running diesel backup locally.	Manually run diesel backups. Possible water use restrictions	WT-03-02 King Street WTP Low Lift Pumps, W-E-01 Emergency Response and Recovery Procedure	1	3	1	5	-2	3	MODERATE RISK UNCONTROLLED HAZARDOUS EVENT	LOW CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
King St WTP	Automated Process Control and Monitoring	Localized Component Failure - Coagulant System Controller	Reduced or loss of process control – possible ineffective water treatment - Contamination of drinking water	Not available	Manual redundancy, alarms	Switch to alternate system, Repair	WT-03-03 King Street WTP Coagulant System, W-CC-01 Kingston Coagulation Critical Control Limit Response	1	3	1	5	-2	3	MODERATE RISK UNCONTROLLED HAZARDOUS EVENT	LOW CONTROLLED RISK	UNCONTROLLED HAZARDOUS EVENT OCCURS AT A MINIMUM CRITICAL CONTROL POINT

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Facility	Process Step	Hazardous Event	Hazard	Primary Control	Secondary Control	Response	Response Procedures	Probability	Consequence	Detectability	Risk Value	Control Value	Controlled Risk	CLASSIFICATION		
														Event Classification	Controlled Risk	Control Point Classification
Point Pleasant WTP	Low Lift Pumping	Total Loss of Low Lift Pumping (Localized control - electrical)	Loss of raw water flow	Not available	Alarms, Interconnects to Central Zone	Manually run diesel, run pump from portable generator or by-pass pumping from low lift suction well to mixing tanks. Possible water use restrictions.	WT-02-02 Point Pleasant WTP Low Lift Pumps, W-E-01 Emergency Response and Recovery Procedure	1	3	1	5	-2	3	MODERATE RISK UNCONTROLLED HAZARDOUS EVENT	LOW CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
Distribution System	Valves	Valve Failure Open	Increased area of isolation required for maintenance or repair or inability to carry out isolation until broken valve is repaired	Inspection and maintenance	Not Available	Isolate and repair	WD-03-02 Valves Troubleshooting and Repair, W-E-01 Emergency Response and Recovery Procedure	5	2	4	11	-3	8	MODERATE RISK CONTROLLABLE HAZARDOUS EVENT	MODERATE CONTROLLED RISK	CONTROL POINT
Distribution System	Valves	Valve Failure Closed – Local Main	Creation of dead ends until repair is completed possible reduced free chlorine residuals at dead ends - Bacteriological contamination of drinking water	Inspection and maintenance	Secondary disinfection	Isolate and repair, increased flushing and monitoring of chlorine residuals for affected main	WD-03-02 Valves Troubleshooting and Repair, W-E-01 Emergency Response and Recovery Procedure	4	2	4	10	-3	7	MODERATE RISK CONTROLLABLE HAZARDOUS EVENT	MODERATE CONTROLLED RISK	CONTROL POINT
Distribution System	Valves	Valve Failure Closed – Trunk Main	Creation of dead ends until repair is completed, adverse effect on distribution system hydraulics, possible reduced free chlorine residuals at dead ends - Bacteriological contamination of drinking water, increased likelihood of water main breakage	Inspection and maintenance	Positive system pressure. Secondary disinfection	Isolate and repair, increased flushing and monitoring of chlorine residuals for affected main	WD-03-02 Valves Troubleshooting and Repair, W-E-01 Emergency Response and Recovery Procedure	2	2	4	8	-3	5	MODERATE RISK CONTROLLABLE HAZARDOUS EVENT	MODERATE CONTROLLED RISK	CONTROL POINT
King St WTP	Clearwell	Vandalism - Spills	Contamination of drinking water	Secured covers, fencing around clearwells	Alarms, Inspection	Investigate alarm, isolate and drain if contamination suspected	WT-01-03 General Alarms Monitoring and Response, W-E-01 Emergency Response and Recovery Procedure	1	5	1	7	-3	4	MODERATE RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	CONTROL POINT
King St WTP	General	Vandalism - Tampering	Damage to equipment - Contamination of drinking water	Locks, fences, video surveillance 24hr staffing	Alarms	Response to alarm/investigate, call police	WT-01-03 General Alarms Monitoring and Response	1	4	2	7	-3	4	MODERATE RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	CONTROL POINT

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RISK ASSESSMENT SUMMARY TABLE																
HIGH RISK THRESHOLD VALUE: 7.25 LISTED BY EVENT CLASSIFICATION AND CONTROLLED RISK CLASSIFICATION IN DESCENDING ORDER OF ASSESSED CONTROLLED RISK																
Facility	Process Step	Hazardous Event	Hazard	Primary Control	Secondary Control	Response	Response Procedures	Probability	Consequence	Detectability	Risk Value	Control Value	Controlled Risk	CLASSIFICATION		
														Event Classification	Controlled Risk	Control Point Classification
Distribution System	Mains	Main Break – Header from Point Pleasant Water Treatment Plant	Reduced or lost flow of drinking water to distribution system, reduction or loss of distribution system pressure - Contamination of drinking water	Not available	Positive system pressure. Secondary disinfection. Two headers from Plant.	Isolate and repair per SOP, utilize other header. Possible public notification and water use restrictions *Maintenance of positive system pressure until repair operations require complete isolation, and then through system storage and minimal alternate supply.	WD-02-03 Mains Break Repair, W-E-01 Emergency Response and Recovery Procedure	1	4	2	7	-3	4	MODERATE RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	CONTROL POINT
Point Pleasant WTP	Automated Process Control and Monitoring	Localized Component Failure - Raw Water Flow Meter	Reduced or loss of process control – possible ineffective water treatment - Contamination of drinking water	Calibration and Maintenance	SCADA/Alarms	Isolate and repair	WT-05-02 Instrumentation Operation and Maintenance	2	4	1	7	-3	4	MODERATE RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	MINIMUM CRITICAL CONTROL POINT
Point Pleasant WTP	Automated Process Control and Monitoring	Distribution System Communications Failure	Reduced or lost process control – low system pressure - Contamination of drinking water	Redundant communication lines - UK fibre optic, Bell Telephone	Com Fail Alarm	Manual operation, Increased process monitoring through SCADA, investigate and repair	WT-02-07 Point Pleasant WTP High Lift & Reservoir Pumps, WS-02-01 Water Storage Facilities Operation and Maintenance	3	3	1	7	-3	4	MODERATE RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	CONTROL POINT
King St WTP	Filters and Backwash System	Filter Turbidity Breakthrough	Ineffective chemically assisted filtration - Biological contamination of drinking water	Backwash, automated monitoring and control, maintenance	Alarms	Manual backwash, isolate filter	WT-03-05 King Street WTP Filters and Backwash System, W-CC-02 Kingston Filter Effluent Turbidity Critical Control Limit Response	2	4	1	7	-4	3	MODERATE RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	MINIMUM CRITICAL CONTROL POINT
King St WTP	Filters and Backwash System	Filter Underdrain Failure	Reduced backwash capacity and flow/Biological contamination of drinking water (breakthrough)	Routine monitoring	SCADA/alarms, redundant filters	Isolate filter, repair	WT-03-05 King Street WTP Filters and Backwash System, W-CC-02 Kingston Filter Effluent Turbidity Critical Control Limit Response	1	4	2	7	-4	3	MODERATE RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	MINIMUM CRITICAL CONTROL POINT
King St WTP	Automated Process Control and Monitoring	Localized Component Failure - Post Chlorine Analysers	Reduced or loss of process control – possible ineffective water treatment - Contamination of drinking water	Maintenance and calibration	SCADA/alarms, observations during daily rounds	Increased sampling and monitoring, repair/replace defective analyzer	WT-05-02 Instrumentation Operation and Maintenance, WT-03-06 King Street WTP Disinfection Strategy and Chlorination System, W-CC-03 Kingston Primary Disinfection Critical Control Limit Response	2	4	1	7	-4	3	MODERATE RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	MINIMUM CRITICAL CONTROL POINT

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Point Pleasant WTP	Filters and Backwash System	Filter Turbidity Breakthrough	Ineffective chemically assisted filtration - Biological contamination of drinking water	Backwash, automated monitoring and control, maintenance	Alarms	Manual backwash, isolate filter	WT-02-05 Point Pleasant WTP Filters and Backwash System, W-CC-02 Kingston Filter Effluent Turbidity Critical Control Limit Response	2	4	1	7	-4	3	MODERATE RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	MINIMUM CRITICAL CONTROL POINT
King St WTP	Automated Process Control and Monitoring	Localized Component Failure - Filter Turbidimeter	Reduced or loss of process control – possible ineffective water treatment - Contamination of drinking water	Annual inspection and service	Alarms, redundant filters	Increased sampling and monitoring or Isolate, Repair/Replace	WT-05-02 Instrumentation Operation and Maintenance, WT-03-05 King Street WTP Filters and Backwash System, W-CC-02 Kingston Filter Effluent Turbidity Critical Control Limit Response	2	3	2	7	-4	3	MODERATE RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	MINIMUM CRITICAL CONTROL POINT
King St WTP	Automated Process Control and Monitoring	Localized Component Failure - Treated Water Flow Meter	Reduced or loss of process control – possible ineffective water treatment - Contamination of drinking water	Calibration and Maintenance	SCADA/Alarms, redundant headers/meters	Direct flow through alternate header/meter, isolate/repair	Description required in WT-05-02 Instrumentation Operation and Maintenance	2	3	2	7	-4	3	MODERATE RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	MINIMUM CRITICAL CONTROL POINT
Distribution System	Valves	Valve Failure Closed - Zone 3 Motorized Control Valve	Lost flow of drinking water to pressure zone, reduction and eventual loss of distribution system pressure - Contamination of drinking water	Inspection and maintenance	Alarms and monitoring	Manual operation, repair motor/valve	WD-03-02 Valves Troubleshooting and Repair, W-E-01 Emergency Response and Recovery Procedure	3	3	1	7	-4	3	MODERATE RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	CONTROL POINT
Point Pleasant WTP	Automated Process Control and Monitoring	Localized Component Failure - Filter Turbidimeter	Reduced or loss of process control – possible ineffective water treatment - Contamination of drinking water	Annual inspection and service	Alarms, redundant filters	Increased sampling and monitoring or Isolate, Repair/Replace	WT-05-02 Instrumentation Operation and Maintenance, WT-02-05 Point Pleasant WTP Filters and Backwash System, W-CC-02 Kingston Filter Effluent Turbidity Critical Control Limit Response	2	3	2	7	-4	3	MODERATE RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	MINIMUM CRITICAL CONTROL POINT
Point Pleasant WTP	Filters and Backwash System	Backwash Pump Failure	Loss of ability to backwash filters – possible turbidity breakthrough/loss of filtration.	Pump maintenance	Redundant pump, redundant power supply, SCADA/alarm	Use of backup pump, backup generator, repair, possible use of system pressure to backwash	WT-02-05 Point Pleasant WTP Filters and Backwash System, W-CC-02 Kingston Filter Effluent Turbidity Critical Control Limit Response	3	3	1	7	-5	2	MODERATE RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	MINIMUM CRITICAL CONTROL POINT
King St WTP	Filters and Backwash System	Backwash Pump Failure	Loss of ability to backwash filters – possible turbidity breakthrough/loss of filtration.	Pump maintenance	Redundant pump, redundant power supply, SCADA/alarm	Use of backup pump, backup generator, repair, possible use of system pressure to backwash	WT-03-05 King Street WTP Filters and Backwash System, W-CC-02 Kingston Filter Effluent Turbidity Critical Control Limit Response	2	3	1	6	-5	1	MODERATE RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	MINIMUM CRITICAL CONTROL POINT

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King St WTP	Raw Water Source	Water Fleas	Screen and filter clogging - Reduced/lost raw water flow	Not available	Inspection and maintenance of screens. Low level and flow alarms.	Increased screen washing/cleaning, increased filter backwash frequency and duration	WT-03-01 King Street WTP Intake and Screens, WT-03-05 King Street WTP Filters and Backwash System	2	2	3	7	-2	5	LOW RISK UNCONTROLLED HAZARDOUS EVENT	LOW CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
Distribution System	Booster Stations	Communications - SCADA Failure	Loss of remote automated control of station, possible low system pressures	Not available	Alarms and monitoring, elevated storage, redundant monitoring system	Manual or local auto control	WS-03-02 Booster Stations Pressure Zone Stations, WS-03-01 Booster Stations James Street Station	4	2	1	7	-2	5	LOW RISK UNCONTROLLED HAZARDOUS EVENT	LOW CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
Distribution System	Booster Stations	Electrical Power Outage - Failure of all pumps	Reduced flow of drinking water to pressure zone, low distribution system pressure - Contamination of drinking water	Not available	Maintenance of positive system pressure through by-pass piping, check valves, and system storage. Back-up generator at James Street and O'Connor Drive. Secondary disinfection.	Monitor system pressures in affected pressure zone to ensure maintenance of positive system pressure until power/pumping is restored. Use of portable generator.	WS-03-02 Booster Stations Pressure Zone Stations, WS-03-01 Booster Stations James Street Station	4	2	1	7	-2	5	LOW RISK UNCONTROLLED HAZARDOUS EVENT	LOW CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
Point Pleasant WTP	Raw Water Source	Water Fleas	Screen and filter clogging - Reduced/lost raw water flow	Not Available	Visual inspection, low level alarm	Increased screen washing/cleaning, increased filter backwash frequency	WT-02-01 Point Pleasant WTP Intake and Screens, WT-02-05 Point Pleasant WTP Filters and Backwash System	2	2	3	7	-2	5	LOW RISK UNCONTROLLED HAZARDOUS EVENT	LOW CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
King St WTP	Raw Water Source	Biological Spill	Biological contamination of raw water	Not available	Chemically assisted filtration and disinfection of water, sampling and monitoring, alarms	Process adjustments, increased sampling, possible need to close intake, possible water use restrictions and public notifications	W-E-04 Contaminated Raw Water Procedure, W-E-05 Spill Response Procedure, W-E-01 Emergency Response and Recovery Procedure	1	2	3	6	-2	4	LOW RISK UNCONTROLLED HAZARDOUS EVENT	LOW CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
King St WTP	Clearwell	Pre-Clearwell Mixer Failure	Reduced mixing of chlorine with filtered water – Reduced effectiveness of disinfectant	Not available	Visual status through SCADA	Repair	WT-01-01 General Treatment Plant Operation and Operator Duties	2	2	2	6	-2	4	LOW RISK UNCONTROLLED HAZARDOUS EVENT	LOW CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT

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Distribution System	Reservoirs	Electrical Power Outage	Loss of availability of stored water - Possible insufficient flow to distribution system during periods of extreme high demand resulting in reduced distribution system pressure - Contamination of drinking water	Not available	Standby diesel pumps and standby generators	Ensure standby operation	WS-02-01 Water Storage Facilities Operation and Maintenance, WT-03-07 King Street WTP High Lift & Reservoir Pumps, WT-02-07 Point Pleasant WTP High Lift & Reservoir Pumps, Revisions being made to WS-03-02 includes response to power outage at O'Connor Dr.	3	2	1	6	-2	4	LOW RISK UNCONTROLLED HAZARDOUS EVENT	LOW CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
Point Pleasant WTP	Raw Water Source	Biological Spill	Biological contamination of raw water	Not available	Treatment Process, Sampling and Monitoring, Alarms	Process adjustments, increased sampling, possible need to shut off intake, public notifications	W-E-04 Contaminated Raw Water Procedure, W-E-05 Spill Response Procedure, W-E-01 Emergency Response and Recovery Procedure	1	2	3	6	-2	4	LOW RISK UNCONTROLLED HAZARDOUS EVENT	LOW CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
Distribution System	Booster Stations	Pressure Reducing Valve Failure	Increased pump operation to meet demand, possible low pressure in zone - Contamination of drinking water	Not available	Not available	Isolate ,repair, and/or adjust	WS-03-02 Booster Stations Pressure Zone Stations, WS-03-01 Booster Stations James Street Station	2	1	2	5	-1	4	LOW RISK UNCONTROLLED HAZARDOUS EVENT	LOW CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
Point Pleasant WTP	Low Lift Pumping	Pump Discharge Check Valve Failure	Reduced / lost raw water flow	Not Available	Automated redundancy (low lift pumps), SCADA / alarms	Repair	WT-02-02 Point Pleasant WTP Low Lift Pumps, WT-05-05 Valves Gates and Actuators Operation and Maintenance	1	2	2	5	-2	3	LOW RISK UNCONTROLLED HAZARDOUS EVENT	LOW CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
Point Pleasant WTP	Filters and Backwash System	Filter to Waste Valve Failure	Ineffective chemically assisted filtration - Biological contamination of drinking water	Not available	Manual control, SCADA/alarms, redundant filters	Manually operate valve, isolate and repair	WT-05-05 Valves Gates and Actuators Operation and Maintenance, WT-02-05 Point Pleasant WTP Filters and Backwash System, W-CC-02 Kingston Filter Effluent Turbidity Critical Control Limit Response	2	2	1	5	-2	3	LOW RISK UNCONTROLLED HAZARDOUS EVENT	LOW CONTROLLED RISK	UNCONTROLLED HAZARDOUS EVENT OCCURS AT A MINIMUM CRITICAL CONTROL POINT
Point Pleasant WTP	High Lift Pumping	Pump Check Valve Failure	Reduced or lost flow of drinking water to distribution system, reduction or loss of distribution system pressure - Contamination of drinking water	None	Automated Redundancy (multiple pumps), manual control, SCADA/alarms, Isolation valve on each pump discharge	Isolate and repair	WT-05-05 Valves Gates and Actuators Operation and Maintenance, WT-02-07 Point Pleasant WTP High Lift & Reservoir Pumps	1	2	1	4	-2	2	LOW RISK UNCONTROLLED HAZARDOUS EVENT	LOW CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT

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King St WTP	Filters and Backwash System	Filter to Waste Valve Failure	Ineffective chemically assisted filtration - Biological contamination of drinking water	Not available	Manual control, SCADA/alarms, redundant filters	Manually operate valve, isolate and repair	WT-05-05 Valves Gates and Actuators Operation and Maintenance, WT-03-05 King Street WTP Filters and Backwash System, W-CC-02 Kingston Filter Effluent Turbidity Critical Control Limit Response	2	1	1	4	-2	2	LOW RISK UNCONTROLLED HAZARDOUS EVENT	LOW CONTROLLED RISK	UNCONTROLLED HAZARDOUS EVENT OCCURS AT A MINIMUM CRITICAL CONTROL POINT
King St WTP	Automated Process Control and Monitoring	Localized Component Failure - Pre-Chlorination System Controller	Reduced or loss of process control – possible zebra mussel colonization of intake	Not available	Alarms	Manual operation, repair	WT-03-06 King Street WTP Disinfection Strategy and Chlorination System	1	1	1	3	-2	1	LOW RISK UNCONTROLLED HAZARDOUS EVENT	LOW CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
King St WTP	Low Lift Pumping	Discharge Header Valve Failure	Reduced / lost raw water flow	Valve Maintenance	Redundant headers	Direct flow through alternate header, repair	WT-03-02 King St WTP Low Lift Pumps, WT-05-05 Valves Gates and Actuators Operation and Maintenance	1	2	4	7	-3	4	LOW RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	CONTROL POINT
King St WTP	Mixing and Settling Tanks	Failure - Tank Out of Service	Reduced water flow	Inspection and maintenance	Redundant mixing and settling tanks.	Operate with remaining mixing and settling tanks until repair is completed.	WT-03-04 King Street WTP Mixing and Settling Tanks	1	2	4	7	-3	4	LOW RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	CONTROL POINT
Distribution System	Valves	Valve Failure Closed - Header to-from elevated storage	Loss of system pressure maintenance and stabilization provided by hydraulic head, possible low or high distribution system pressures – Increased likelihood of water main breakage, biological contamination of drinking water	Inspection and maintenance	Use of valve operation plan	Isolate and repair, process adjustments to maximize available stored water and pressure maintenance and to use alternate elevated storage where available	WD-03-02 Valves Troubleshooting and Repair, W-E-01 Emergency Response and Recovery Procedure	1	2	4	7	-3	4	LOW RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	CONTROL POINT
Distribution System	Valves	Valve Failure Closed - Header to-from elevated storage	Reduced distribution system storage capacity, possible insufficient flow to distribution system during periods of extreme high demand resulting in reduced distribution system pressure - Contamination of drinking water	Inspection and maintenance	Use of valve operation plan	Isolate and repair, process adjustments to maximize available stored water and pressure maintenance and to use alternate elevated storage where available	WD-03-02 Valves Troubleshooting and Repair, W-E-01 Emergency Response and Recovery Procedure	1	2	4	7	-3	4	LOW RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	CONTROL POINT

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Distribution System	Valves	Valve Failure Closed - Header to-from reservoir	Loss of distribution system storage capacity - Possible insufficient flow to distribution system during periods of extreme high demand resulting in reduced distribution system pressure - Contamination of drinking water	Inspection and maintenance	Use of valve operation plan	Isolate and repair, process adjustments to maximize available stored water and pressure maintenance	WD-03-02 Valves Troubleshooting and Repair, W-E-01 Emergency Response and Recovery Procedure	1	2	4	7	-3	4	LOW RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	CONTROL POINT
Distribution System	Booster Stations	James St Station - Chlorine Line Breakage or Blockage	Insufficient free chlorine residual to maintain secondary disinfection - Biological contamination of drinking water	Inspection and maintenance	Alarm	Repair	WS-03-01 Booster Stations James Street Station, W-CC-04 Kingston Secondary Disinfection Critical Control Limit Response	3	2	2	7	-3	4	LOW RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	MINIMUM CRITICAL CONTROL POINT
Distribution System	Reservoirs	Structural Failure	Reduced distribution system storage capacity, possible insufficient flow to distribution system during periods of extreme high demand resulting in reduced distribution system pressure - Contamination of drinking water	Inspections	Secondary disinfection	Isolate, drain, repair, possible public notification, operation of system per applicable SOPs	WS-02-01 Water Storage Facilities Operation and Maintenance, WS-02-02 Water Storage Facilities Isolation and Re-Commissioning	1	2	4	7	-3	4	LOW RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	CONTROL POINT
Distribution System	Elevated Storage	Isolation Valve Failure (Closed)	Loss of system pressure maintenance and stabilization provided by hydraulic head, possible low or high distribution system pressures - Increased likelihood of water main breakage, biological contamination of drinking water	Inspection and maintenance	Use of alternate elevated storage where available, secondary disinfection	Isolate, drain, repair, operation of system per applicable SOPs	WS-02-01 Water Storage Facilities Operation and Maintenance, WS-02-02 Water Storage Facilities Isolation and Re-Commissioning	1	2	4	7	-3	4	LOW RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	CONTROL POINT
Distribution System	Elevated Storage	Isolation Valve Failure (Closed)	Reduced distribution system storage capacity, possible insufficient flow to distribution system during periods of extreme high demand resulting in reduced distribution system pressure - Contamination of drinking water	Inspection and maintenance	Use of alternate elevated storage where available, secondary disinfection	Isolate, drain, repair, operation of system per applicable SOPs	WS-02-01 Water Storage Facilities Operation and Maintenance, WS-02-02 Water Storage Facilities Isolation and Re-Commissioning	1	2	4	7	-3	4	LOW RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	CONTROL POINT
Point Pleasant WTP	Mixing and Flocculation Tanks	Mechanical Mixer Failure	Reduced effectiveness of flocculation process - Shorter filter runs	Inspection and maintenance	Multiple mixers and tanks	Repair	WT-02-04 Point Pleasant WTP Flocculation Tanks and Equipment	2	2	3	7	-3	4	LOW RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	CONTROL POINT
King St WTP	Automated Process Control and Monitoring	Filter Effluent Flow Meter	Reduced or loss of process control - possible ineffective water treatment - Contamination of drinking water - feed pacing for primary chlorination	Calibration and Maintenance	Redundant filters, alarm	Isolate filter, repair	WT-05-02 Instrumentation Operation and Maintenance, WT-03-05 King Street WTP Filters and Backwash System	3	2	2	7	-4	3	LOW RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	CONTROL POINT
Point Pleasant WTP	Intake and Screens	Zebra Mussel Colonization	Blockage of Intake - Reduced/lost raw water flow	Zebra mussel control(pre-chlorination)	Low level / flow alarms, annual inspection of intake	Remove zebra mussels from intake	WT-02-01 Point Pleasant WTP Intake and Screens	1	2	4	7	-4	3	LOW RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	CONTROL POINT

UTILITIES KINGSTON DRINKING WATER QUALITY MANAGEMENT SYSTEM

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														Event Classification	Controlled Risk	Control Point Classification
King St WTP	High Lift Pumping	Single Pump Failure	Reduced drinking water pumping capacity	Pump maintenance	Redundant pumps, auto pump switch over, SCADA/alarms	Isolate and repair pump	WT-03-07 King Street WTP High Lift & Reservoir Pumps	4	2	1	7	-5	2	LOW RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	CONTROL POINT
Distribution System	Booster Stations	James St Station - Chlorine Feed Pump Failure	Insufficient free chlorine residual to maintain secondary disinfection - Biological contamination of drinking water	Inspection and maintenance	Alarm, Auto redundancy	Ensure operation of standby pump, repair	WS-03-01 Booster Stations James Street Station, W-CC-04 Kingston Secondary Disinfection Critical Control Limit Response	3	2	2	7	-5	2	LOW RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	MINIMUM CRITICAL CONTROL POINT
King St WTP	Pre-Chlorination - Zebra Mussel Control	Loss of Pre-Chlorination - Solution Line Breakage-Blockage	Zebra mussel build up at intake - reduced / lost water flow	Water softener, inspection and maintenance	Alarms and monitoring	Change application point, repair	WT-03-06 King Street WTP Disinfection Strategy and Chlorination System	2	2	2	6	-3	3	LOW RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	CONTROL POINT
Distribution System	Reservoirs	Fill Valve Failure	Loss of distribution system storage capacity - Possible insufficient flow to distribution system during periods of extreme high demand resulting in reduced distribution system pressure - Contamination of drinking water	Inspection and maintenance	Alarms	Manual operation and repair	WS-02-01 Water Storage Facilities Operation and Maintenance, WT-05-05 Valves Gates and Actuators Operation and Maintenance	3	2	1	6	-3	3	LOW RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	CONTROL POINT
King St WTP	Intake and Screens	Screen Failure - Damage-Failure to Remove Debris	Low lift pump damage - reduced / lost raw water flow	Inspection and maintenance of screen, regular cleaning	Redundant low lift pumps, low level and flow alarms.	By-pass screen, clean, repair	WT-03-01 King Street WTP Intake and Screens, WT-03-02 King Street WTP Low Lift Pumps	1	1	4	6	-3	3	LOW RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	CONTROL POINT
Point Pleasant WTP	Intake and Screens	Screen Failure - Damage-Failure to Remove Debris	Low lift pump damage - reduced / lost raw water flow	Inspection and maintenance of screen, regular cleaning	Redundant low lift pumps, low level and flow alarms.	Repair to screen/pump	WT-02-01 Point Pleasant WTP Intake and Screens, WT-02-02 Point Pleasant WTP Low Lift Pumps	1	1	4	6	-3	3	LOW RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	CONTROL POINT
Point Pleasant WTP	Mixing and Flocculation Tanks	Valve Failure	Reduced or lost water flow	Inspection and maintenance	Filter level alarms, multiple flocculation/filtration trains	Repair	WT-02-04 Point Pleasant WTP Flocculation Tanks and Equipment, WT-05-05 Valves Gates and Actuators Operation and Maintenance	1	1	4	6	-3	3	LOW RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	MINIMUM CRITICAL CONTROL POINT
King St WTP	Intake and Screens	Zebra Mussel Colonization	Blockage of Intake - Reduced/lost raw water flow	Pre-chlorination at intake	Low level / flow alarms, annual inspection of intake	Remove zebra mussels from intake	WT-03-01 King Street WTP Intake and Screens	1	2	3	6	-4	2	LOW RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	CONTROL POINT
King St WTP	Filters and Backwash System	Valve Failure	Reduced or lost water flow	Valve maintenance	SCADA/alarms, redundant filters	Manual control, isolate, repair	WT-05-05 Valves Gates and Actuators Operation and Maintenance, WT-03-05 King Street WTP Filters and Backwash System, W-CC-02 Kingston Filter Effluent Turbidity Critical Control Limit Response	3	2	1	6	-4	2	LOW RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	MINIMUM CRITICAL CONTROL POINT

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RISK ASSESSMENT SUMMARY TABLE																
HIGH RISK THRESHOLD VALUE: 7.25 LISTED BY EVENT CLASSIFICATION AND CONTROLLED RISK CLASSIFICATION IN DESCENDING ORDER OF ASSESSED CONTROLLED RISK																
Facility	Process Step	Hazardous Event	Hazard	Primary Control	Secondary Control	Response	Response Procedures	Probability	Consequence	Detectability	Risk Value	Control Value	Controlled Risk	CLASSIFICATION		
														Event Classification	Controlled Risk	Control Point Classification
Distribution System	Valves	Valve Failure Open - Zone 3 Motorized Control Valve	Loss of normal process control for Distribution Area 3, insufficient cycling of water in stand pipe resulting in possible loss of free chlorine residual in standpipe – Bacteriological contamination of drinking water	Inspection and maintenance	Alarms and monitoring	Manual operation, repair motor/valve, increased monitoring of free chlorine residual, increased flushing	WD-03-02 Valves Troubleshooting and Repair, W-E-01 Emergency Response and Recovery Procedure	3	2	1	6	-4	2	LOW RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	CONTROL POINT
Point Pleasant WTP	Filters and Backwash System	Valve Failure	Reduced or lost water flow	Valve maintenance	SCADA/alarms, redundant filters	Manual control, isolate, repair	WT-05-05 Valves Gates and Actuators Operation and Maintenance, WT-02-05 Point Pleasant WTP Filters and Backwash System, W-CC-02 Kingston Filter Effluent Turbidity Critical Control Limit Response	3	2	1	6	-4	2	LOW RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	MINIMUM CRITICAL CONTROL POINT
Point Pleasant WTP	Automated Process Control and Monitoring	Filter Effluent Flow Meter	Reduced or loss of process control – possible ineffective water treatment - Contamination of drinking water - feed pacing for primary chlorination	Calibration and Maintenance	Redundant filters, alarm	Isolate filter, repair	WT-05-02 Instrumentation Operation and Maintenance, WT-02-05 Point Pleasant WTP Filters and Backwash System	2	2	2	6	-4	2	LOW RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	CONTROL POINT
King St WTP	Pre-Chlorination - Zebra Mussel Control	Loss of Pre-Chlorination - Chemical Feed Pump Failure	Zebra mussel build up at intake - reduced / lost water flow	Redundant pumps, auto pump switch over, pump maintenance	Alarms and monitoring	Ensure operation of backup, repair	WT-03-06 King Street WTP Disinfection Strategy and Chlorination System	3	2	1	6	-5	1	LOW RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	CONTROL POINT
King St WTP	Low Lift Pumping	Single Pump Failure	Reduced raw water pumping capacity	Pump maintenance	Redundant pumps, auto pump switch over, SCADA/alarms	Ensure operation of remaining pumps, repair	WT-03-02 King Street WTP Low Lift Pumps	3	2	1	6	-5	1	LOW RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	CONTROL POINT
King St WTP	High Lift Pumping	Pump Discharge Valve Failure	Reduced or lost flow of drinking water to distribution system, reduction or loss of distribution system pressure - Contamination of drinking water	Inspection and maintenance	Automated Redundancy (multiple pumps), manual control, SCADA/alarms	Manually operate valve, isolate and repair	WT-05-05 Valves Gates and Actuators Operation and Maintenance, WT-03-07 King Street WTP High Lift & Reservoir Pumps	3	2	1	6	-5	1	LOW RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	CONTROL POINT
Distribution System	Booster Stations	Single Pump Failure	Reduced pumping capacity – reduced pressure during periods of high demand	Inspection and maintenance	Redundant pumps / stations	Isolate and repair	WS-03-02 Booster Stations Pressure Zone Stations, WS-03-01 Booster Stations James Street Station	3	2	1	6	-5	1	LOW RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	CONTROL POINT
Distribution System	Reservoirs	Single Pump Failure	Reduced pumping capacity - Possible insufficient flow to distribution system during periods of extreme high demand resulting in reduced distribution system pressure - Contamination of drinking water	Pump maintenance	Auto redundancy	Ensure standby operation, repair	WS-02-01 Water Storage Facilities Operation and Maintenance, WT-03-07 King Street WTP High Lift & Reservoir Pumps, WT-02-07 Point Pleasant WTP High Lift & Reservoir Pumps, Revisions being made to WS-03-02 includes response to pump failure at O'Connor Dr.	3	2	1	6	-5	1	LOW RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	CONTROL POINT

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														Event Classification	Controlled Risk	Control Point Classification
Point Pleasant WTP	Pre-Chlorination - Zebra Mussel Control	Chlorinator Failure	Zebra mussel build up at intake - reduced/lost raw water flow	Annual rebuild of chlorinator, Multiple automated redundancy chlorinators	Sampling and monitoring - chlorine residual	Isolate and repair	WT-02-06 Point Pleasant WTP Disinfection Strategy and Chlorination System	2	2	2	6	-5	1	LOW RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	CONTROL POINT
Point Pleasant WTP	Low Lift Pumping	Single Pump Failure	Reduced raw water pumping capacity	Pump maintenance	Redundant pumps, auto pump switch over, SCADA/alarms	Ensure operation of remaining pumps, repair	WT-02-02 Point Pleasant WTP Low Lift Pumps	3	2	1	6	-5	1	LOW RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	CONTROL POINT
Point Pleasant WTP	High Lift Pumping	Single Pump Failure	Reduced drinking water pumping capacity	Pump maintenance	Redundant pumps, auto pump switch over, SCADA/alarms	Isolate and repair pump	WT-02-07 Point Pleasant WTP High Lift & Reservoir Pumps	3	2	1	6	-5	1	LOW RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	CONTROL POINT
Point Pleasant WTP	Pre-Chlorination - Zebra Mussel Control	Chlorine Solution Line Breakage - Blockage	Zebra mussel build up at intake - reduced/lost raw water flow	Inspection and maintenance	Sampling and monitoring - chlorine residual	Isolate and repair	WT-02-06 Point Pleasant WTP Disinfection Strategy and Chlorination System	1	2	2	5	-3	2	LOW RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	CONTROL POINT
Point Pleasant WTP	Automated Process Control and Monitoring	Localized Component Failure - Treated Water Flow Meter	Reduced or loss of process control – possible ineffective water treatment - Contamination of drinking water	Calibration and Maintenance	SCADA/Alarms, Two High Lift Headers	Isolate and repair, Isolate and Utilize other header	WT-05-02 Instrumentation Operation and Maintenance	2	2	1	5	-3	2	LOW RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	CONTROL POINT
King St WTP	Low Lift Pumping	Pump Discharge Valve Failure	Reduced / lost raw water flow	Valve Maintenance	Automated redundancy (low lift pumps), SCADA / alarms	Manual operation of valve, repair	WT-03-02 King Street WTP Low Lift Pumps, WT-05-05 Valves Gates and Actuators Operation and Maintenance	2	2	1	5	-5	0	LOW RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	CONTROL POINT
King St WTP	Intake and Screens	Screen Failure - Blockage	Reduced / lost raw water flow	Inspection and maintenance of screen, regular cleaning	Low level and flow alarms.	By-pass screen, clean, repair	WT-03-01 King Street WTP Intake and Screens	1	2	1	4	-3	1	LOW RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	CONTROL POINT
Point Pleasant WTP	Intake and Screens	Screen Failure - Blockage	Reduced / lost raw water flow	Auto-wash cycle, Inspection and maintenance of screen	Low flow alarms.	Clean screen, increase wash cycle, repair screen	WT-02-01 Point Pleasant WTP Intake and Screens	1	2	1	4	-3	1	LOW RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	CONTROL POINT
Point Pleasant WTP	Pre-Chlorination - Zebra Mussel Control	Chlorine Gas Line Breakage - Blockage	Zebra mussel build up at intake - reduced/lost raw water flow	Inspection and maintenance, vacuum system/auto shut down	Alarm	Isolate and repair	WT-02-06 Point Pleasant WTP Disinfection Strategy and Chlorination System	1	2	1	4	-3	1	LOW RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	CONTROL POINT
Point Pleasant WTP	Pre-Chlorination - Zebra Mussel Control	Water Supply Line Breakage - Blockage	Zebra mussel build up at intake - reduced/lost raw water flow	Inspection and maintenance	SCADA/alarm (post chlorine analyzer)	Shut down process, isolate and repair	WT-02-06 Point Pleasant WTP Disinfection Strategy and Chlorination System	1	2	1	4	-3	1	LOW RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	CONTROL POINT

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HIGH RISK THRESHOLD VALUE: 7.25 LISTED BY EVENT CLASSIFICATION AND CONTROLLED RISK CLASSIFICATION IN DESCENDING ORDER OF ASSESSED CONTROLLED RISK																
Facility	Process Step	Hazardous Event	Hazard	Primary Control	Secondary Control	Response	Response Procedures	Probability	Consequence	Detectability	Risk Value	Control Value	Controlled Risk	CLASSIFICATION		
														Event Classification	Controlled Risk	Control Point Classification
Distribution System	Valves	Valve Failure Open - Zone 3 Motorized Control Valve	Insufficient cycling of water in stand pipe resulting in increased ice build-up in standpipe during cold weather – Structural failure	Inspection and maintenance	Alarms and monitoring	Manual operation, repair motor/valve, increased flushing, possible isolation and draining of tower	WD-03-02 Valves Troubleshooting and Repair, W-E-01 Emergency Response and Recovery Procedure	1	2	1	4	-4	0	LOW RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	CONTROL POINT

Table 2 – Cana Drinking Water System Risk Assessments

RISK ASSESSMENT SUMMARY TABLE																
HIGH RISK THRESHOLD VALUE: 7.23 LISTED BY EVENT CLASSIFICATION AND CONTROLLED RISK CLASSIFICATION IN DESCENDING ORDER OF ASSESSED CONTROLLED RISK																
Facility	Process Step	Hazardous Event	Hazard	Primary Control	Secondary Control	Response	Response Procedures	Probability	Consequence	Detectability	Risk Value	Control Value	Controlled Risk	CLASSIFICATION		
														Event Classification	Controlled Risk	Control Point Classification
Cana WTP	Raw Water Source	Spill	Contamination of raw water source	Not Available	Disinfection of water, sampling and monitoring, alarms	Shut down low lift pumps, public notifications, boil water, alternate supply (water haulers, water buggy)	WT-04-01 Cana WTP Well, W-E-05 Spill Response Procedure, W-E-04 Contaminated Raw Water Procedure, W-E-01 Emergency Response and Recovery Procedure,	1	4	4	9	-2	7	HIGH RISK UNCONTROLLED HAZARDOUS EVENT	MODERATE CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
Cana Distribution	Services	Broken Water Service	Increased demand, reduction or loss of distribution system pressure - Contamination of drinking water	Not available	Secondary disinfection, positive pressure, alarms	Isolate and repair	WD-05-01 Services Repair	3	4	2	9	-2	7	HIGH RISK UNCONTROLLED HAZARDOUS EVENT	MODERATE CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT

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RISK ASSESSMENT SUMMARY TABLE

HIGH RISK THRESHOLD VALUE: 7.23 LISTED BY EVENT CLASSIFICATION AND CONTROLLED RISK CLASSIFICATION IN DESCENDING ORDER OF ASSESSED CONTROLLED RISK

Facility	Process Step	Hazardous Event	Hazard	Primary Control	Secondary Control	Response	Response Procedures	Probability	Consequence	Detectability	Risk Value	Control Value	Controlled Risk	CLASSIFICATION		
														Event Classification	Controlled Risk	Control Point Classification
Cana Distribution	Mains	Broken Water Main	Increased demand, reduction or loss of distribution system pressure - Contamination of drinking water	Not available	Secondary disinfection, positive pressure, alarms	Isolate and repair	WD-02-03 Mains Break Repair	1	5	2	8	-2	6	HIGH RISK UNCONTROLLED HAZARDOUS EVENT	MODERATE CONTROLLED RISK	UNCONTROLLED HAZARDOUS EVENT OCCURS AT A MINIMUM CRITICAL CONTROL POINT
Cana WTP	Disinfection System	Contact Tank Structural Failure	Infiltration - contamination of drinking water	Inspection and maintenance	Water quality monitoring	Isolate and repair, alternate supply (water haulers, bottled water)	W-E-01 Emergency Response and Recovery Procedure	1	5	4	10	-3	7	HIGH RISK CONTROLLABLE HAZARDOUS EVENT	MODERATE CONTROLLED RISK	MINIMUM CRITICAL CONTROL POINT
Cana WTP	Automated Process Control and Monitoring	Chlorine Analyzer Failure	Reduced or loss of process control - Possible ineffective water treatment - Contamination of drinking water	Calibration and maintenance	Alarms	Repair, replace, manual control	WT-05-02 Instrumentation Operation and Maintenance, WT-04-02 Cana WTP Disinfection Strategy and Chlorination System, W-CC-05 Cana Primary Disinfection Critical Control Limit Response	3	4	2	9	-3	6	HIGH RISK CONTROLLABLE HAZARDOUS EVENT	MODERATE CONTROLLED RISK	MINIMUM CRITICAL CONTROL POINT
Cana System	General	Unavailability of Staff	Increased response time to hazardous event	Standby operator, call out process	Use of qualified staff from other groups, supervisory personnel, contractors	Follow call out protocols, use of supervisory personnel, staff from other groups or contractor where required	W-G-05 Personnel Coverage Procedure	1	4	4	9	-3	6	HIGH RISK CONTROLLABLE HAZARDOUS EVENT	MODERATE CONTROLLED RISK	CONTROL POINT
Cana System	General	Vandalism - Tampering	Damage to facilities and equipment - Contamination of drinking water	Fences, gates, locks	Alarms, regular inspection	Investigate rectify any found problem per applicable SOP	WT-01-03 General Alarms Monitoring and Response	1	5	3	9	-3	6	HIGH RISK CONTROLLABLE HAZARDOUS EVENT	MODERATE CONTROLLED RISK	CONTROL POINT
Cana WTP	High Lift Pumping	Total loss of pumping (both pumps fail)	Loss of drinking water flow to distribution system, loss of distribution system pressure - Contamination of drinking water	Inspection and maintenance	Alarms, spare pump on site	Ensure operation of back up and repair	WT-04-03 Cana WTP Pumps	2	5	1	8	-3	5	HIGH RISK CONTROLLABLE HAZARDOUS EVENT	MODERATE CONTROLLED RISK	CONTROL POINT

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RISK ASSESSMENT SUMMARY TABLE

HIGH RISK THRESHOLD VALUE: 7.23 LISTED BY EVENT CLASSIFICATION AND CONTROLLED RISK CLASSIFICATION IN DESCENDING ORDER OF ASSESSED CONTROLLED RISK

Facility	Process Step	Hazardous Event	Hazard	Primary Control	Secondary Control	Response	Response Procedures	Probability	Consequence	Detectability	Risk Value	Control Value	Controlled Risk	CLASSIFICATION		
														Event Classification	Controlled Risk	Control Point Classification
Cana Distribution	Secondary Disinfection	Loss of Free Chlorine Residual	Loss of secondary disinfection - Bacteriological contamination of drinking water	Auto controlled primary and trim chlorination at Cana Pump House	Analyser alarms, sampling	Ensure op of chlorination facilities, flushing, resample, possible notification	W-CC-06 Cana Secondary Disinfection Critical Control Limit Response	1	5	2	8	-3	5	HIGH RISK CONTROLLABLE HAZARDOUS EVENT	MODERATE CONTROLLED RISK	MINIMUM CRITICAL CONTROL POINT
Cana Distribution	Valves	Valve Failure	Creation of dead ends or loss of water until repair is completed possible reduced free chlorine residuals at dead ends - Bacteriological contamination of drinking water	Inspection and Maintenance	Secondary disinfection, increased flushing and monitoring of chlorine residuals for affected main	Repair	WD-03-02 Valves Troubleshooting and Repair	1	3	4	8	-3	5	HIGH RISK CONTROLLABLE HAZARDOUS EVENT	MODERATE CONTROLLED RISK	CONTROL POINT
Cana WTP	General	Electrical Power Outage	Loss of treated water supply, reduced or lost system pressure - Contamination of drinking water	Not available	Alarms, Auto switch over Generator	Ensure normal operation while on redundancy power source	WT-04-05 Cana Backup Generator	4	4	1	9	-5	4	HIGH RISK CONTROLLABLE HAZARDOUS EVENT	MODERATE CONTROLLED RISK	CONTROL POINT
Cana WTP	Automated Process Control and Monitoring	SCADA Failure	Reduced or loss of process control - possible ineffective water treatment - Contamination of drinking water	Not available	Not available	Manual operation, repair	WT-05-03 SCADA System Operation and Maintenance, Abnormal Operation and Failure Operation Sections of SOPS for Affected Processes	1	4	2	7	-1	6	MODERATE RISK UNCONTROLLED HAZARDOUS EVENT	LOW CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
Cana WTP	Low Lift Pumping	Pump Failure	Loss of raw water flow	Not Available	Alarms, spare pump and starter available	Change pump	WT-04-03 Cana WTP Pumps	2	4	1	7	-2	5	MODERATE RISK UNCONTROLLED HAZARDOUS EVENT	LOW CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
Cana WTP	High Lift Pumping	Discharge Header Breakage	Loss of drinking water flow to distribution system, loss of distribution system pressure - Contamination of drinking water	Not available	Alarms	Repair broken line	W-E-01 Emergency Response and Recovery Procedure	1	5	1	7	-2	5	MODERATE RISK UNCONTROLLED HAZARDOUS EVENT	LOW CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT

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RISK ASSESSMENT SUMMARY TABLE

HIGH RISK THRESHOLD VALUE: 7.23 LISTED BY EVENT CLASSIFICATION AND CONTROLLED RISK CLASSIFICATION IN DESCENDING ORDER OF ASSESSED CONTROLLED RISK

Facility	Process Step	Hazardous Event	Hazard	Primary Control	Secondary Control	Response	Response Procedures	Probability	Consequence	Detectability	Risk Value	Control Value	Controlled Risk	CLASSIFICATION		
														Event Classification	Controlled Risk	Control Point Classification
Cana WTP	Raw Water Source	Lack of Supply - Low well level	No flow to distribution system	Not Available	Well level controls	Water use restrictions, Public notifications, alternate supply (water haulers, water buggies)	WT-04-01 Cana WTP Well, W-E-01 Emergency Response and Recovery Procedure	1	4	1	6	-2	4	MODERATE RISK UNCONTROLLED HAZARDOUS EVENT	LOW CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
Cana WTP	Low Lift Pumping	Discharge Header Breakage	Loss of raw water flow	Not Available	Alarms, stored water	Repair failed pipe, water restrictions, alternate supply (haul water)	WT-04-01 Cana WTP Well, W-E-01 Emergency Response and Recovery Procedure	1	4	1	6	-2	4	MODERATE RISK UNCONTROLLED HAZARDOUS EVENT	LOW CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
Cana WTP	Automated Process Control and Monitoring	Pressure Transmitter Failure	Reduced or loss of process control – Possible low system pressure - Contamination of drinking water	Not available	Alarms	Repair, replace, manual control	WT-05-02 Instrumentation Operation and Maintenance, WT-04-03 Cana WTP Pumps, W-CC-06 Cana Secondary Disinfection Critical Control Limit Response	1	4	1	6	-2	4	MODERATE RISK UNCONTROLLED HAZARDOUS EVENT	LOW CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
Cana WTP	Disinfection System	Loss of Primary Chlorination - Chemical line breakage or blockage	Ineffective primary disinfection - Biological contamination of drinking water	Inspection and maintenance	Alarms	Repair failed line	WT-04-02 Cana WTP Disinfection Strategy and Chlorination System, W-CC-05 Cana Primary Disinfection Critical Control Limit Response	3	3	1	7	-3	4	MODERATE RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	MINIMUM CRITICAL CONTROL POINT
Cana WTP	High Lift Pumping	Pump Failure	Loss of drinking water flow to distribution system, loss of distribution system pressure - Contamination of drinking water	Inspection and maintenance	Automated redundancy, alarms	Ensure operation of back up and repair	WT-04-03 Cana WTP Pumps	2	3	2	7	-4	3	MODERATE RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	CONTROL POINT
Cana WTP	Automated Process Control and Monitoring	Flow Meter Failure	Reduced or loss of process control – possible ineffective water treatment - Contamination of drinking water	Calibration and maintenance	Alarms	Repair, replace, manual control of chlorination	WT-05-02 Instrumentation Operation and Maintenance, WT-04-02 Cana WTP Disinfection Strategy and Chlorination System	1	4	1	6	-3	3	MODERATE RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	MINIMUM CRITICAL CONTROL POINT

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HIGH RISK THRESHOLD VALUE: 7.23 LISTED BY EVENT CLASSIFICATION AND CONTROLLED RISK CLASSIFICATION IN DESCENDING ORDER OF ASSESSED CONTROLLED RISK

Facility	Process Step	Hazardous Event	Hazard	Primary Control	Secondary Control	Response	Response Procedures	Probability	Consequence	Detectability	Risk Value	Control Value	Controlled Risk	CLASSIFICATION		
														Event Classification	Controlled Risk	Control Point Classification
Cana WTP	Disinfection System	Loss of Primary Chlorination - Chlorine feed pump failure	Ineffective primary disinfection - Biological contamination of drinking water	Redundant pumps, auto switch, Maintenance	Alarms	Ensure operation of back up, repair	WT-04-02 Cana WTP Disinfection Strategy and Chlorination System, W-CC-05 Cana Primary Disinfection Critical Control Limit Response	3	3	1	7	-5	2	MODERATE RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	MINIMUM CRITICAL CONTROL POINT
Cana WTP	Automated Process Control and Monitoring	Communication System Failure	Reduced or loss of process control – possible ineffective water treatment - Contamination of drinking water	Not available	Continued auto operation during com failure	Investigate and repair	Abnormal Operation and Failure Operation Sections of SOPs for Affected Processes	4	1	1	6	-2	4	LOW RISK UNCONTROLLED HAZARDOUS EVENT	LOW CONTROLLED RISK	NOT A CONTROL POINT FOR THIS EVENT
Cana WTP	High Lift Pumping	Pressure Tank Failure	Increased high lift pump operation /Loss of distribution pressure maintenance - Contamination of drinking water	Inspection and Maintenance	Alarms, redundant tank	Isolate failed tank and replace	WT-04-03 Cana WTP Pumps requires additional information for pressure tank failure	1	2	4	7	-3	4	LOW RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	CONTROL POINT
Cana WTP	Filters	Filter Failure - Blockage-Leak	Loss of drinking water flow to distribution system, loss of distribution system pressure - Contamination of drinking water	Inspection and Maintenance	Monitoring of headloss	Change filter	WT-04-04 Cana WTP Filters	2	2	3	7	-3	4	LOW RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	CONTROL POINT
Cana WTP	Disinfection System	Loss of Trim Chlorination - Chemical line breakage or blockage	Low distribution chlorine residual - loss of secondary disinfection	Inspection and maintenance	Alarms	Ensure adequate residual through adjustment to primary chlorination, repair line	WT-04-02 Cana WTP Disinfection Strategy and Chlorination System, W-CC-06 Cana Secondary Disinfection Critical Control Limit Response	1	1	1	3	-3	0	LOW RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	MINIMUM CRITICAL CONTROL POINT
Cana WTP	Disinfection System	Loss of Trim Chlorination - Chlorine feed pump failure	Low distribution chlorine residual - loss of secondary disinfection	Redundant pumps, auto switch, maintenance	Alarms	Ensure operation of back up, repair	WT-04-02 Cana WTP Disinfection Strategy and Chlorination System, W-CC-06 Cana Secondary Disinfection Critical Control Limit Response	1	1	1	3	-5	-2	LOW RISK CONTROLLABLE HAZARDOUS EVENT	LOW CONTROLLED RISK	MINIMUM CRITICAL CONTROL POINT

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

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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.

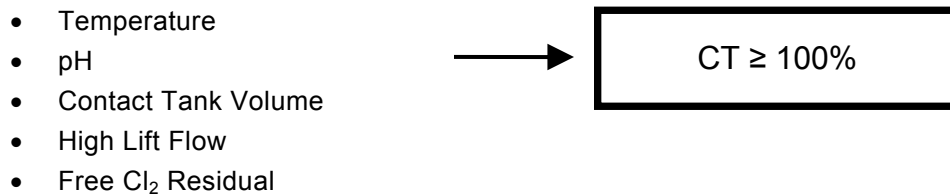
8.1.1.3 Primary Disinfection Critical Control Limit

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 hypochlorination, 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 Cl₂ 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. 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 Cl₂ residuals at water treatment facilities are monitored and adjusted to ensure that adequate free Cl₂ 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 Cl₂ 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 Cl₂ 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 Cl₂ residual values.

Alarm set points for free Cl₂ 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 Cl₂ 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 Cl₂ 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.

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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

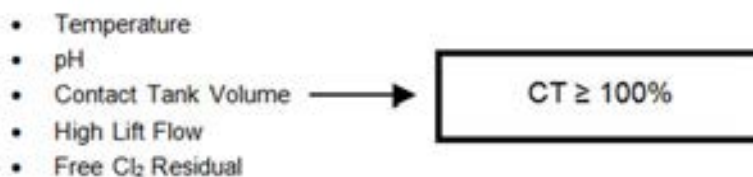
The use of chlorination for primary (post) disinfection ensures adequate inactivation of pathogens potentially present in the source water. Chlorination is achieved through the application of chlorine using sodium hypochlorite delivery pumps.

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 Cl₂ 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.

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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 Cl₂ residuals at the Cana Water Treatment Plant are monitored and adjusted to ensure that adequate free Cl₂ 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 Cl₂ 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 Cl₂ 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 Cl₂ 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

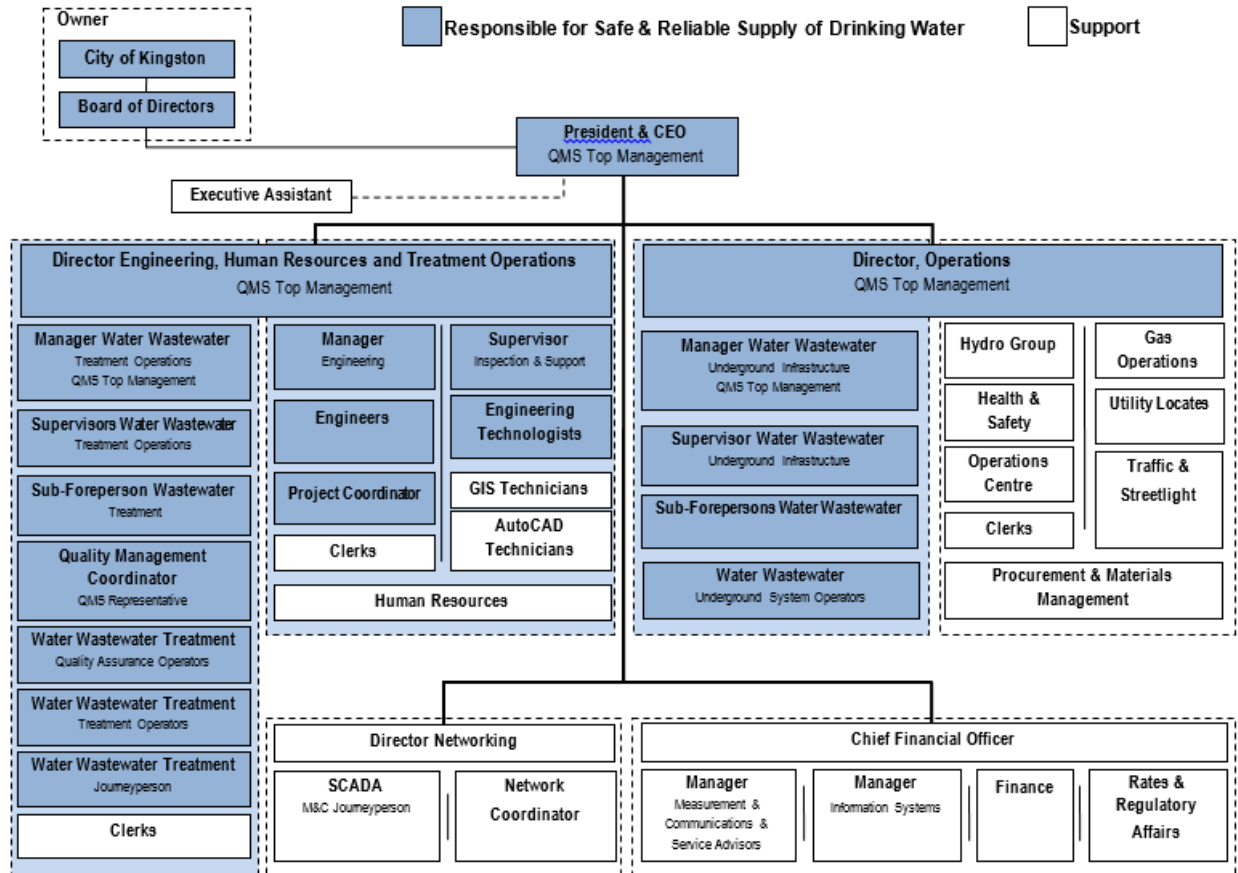
9.1 Organizational Structure and Roles

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.

Figure 10 – Utilities Kingston Organizational Chart 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.

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Figure 10 – Utilities Kingston Organizational Chart



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

This section describes the duties and authorities of those persons or groups accountable for the safe and reliable supply of drinking water to the customer.

9.3.1 Systems Owner

City Of Kingston

City of Kingston Duties and Authorities

- Ensure that the municipal drinking water system is operated by an Accredited Operating Authority
- Endorse the Drinking Water QMS Operational Plan with each new council and submit the plan to the MECP
- Submit applications for a Municipal Drinking Water License and Drinking Water Works Permit to the MECP
- Review the Drinking Water QMS Management Review documentation provided by the Operating Authority
- Approval and enforcement of the Drinking Water related Bylaws
- Approve operating and capital budgets and utility rates
- Approve proposed long term plans to ensure that resources will be available to allow the drinking water system to meet future demands

9.3.2 Utilities Kingston

Board of Directors

Board of Directors Duties and Authorities

- Ensure that qualified, competent, and responsible Top Management personnel are in place to manage the drinking water system
- Approve corporate policies, goals, strategies, directives, etc.

Top Management

Top Management Duties and Authorities

- Approve the Drinking Water QMS Policy
- Endorse the Drinking Water QMS Operational Plan
- Obtain and provide sufficient resources to maintain and continually improve the Drinking Water QMS
- Appoint and authorize a QMS Representative and an alternate
- Complete annual Management Reviews as described in the Management Review Procedure
- Communicate with the Owner, regulatory agencies, and the public with regard to drinking water system issues and the Drinking Water QMS
- Identify and communicate to the Owner any need for additional resources required to ensure the continued provision of a safe and secure supply of drinking water

President and CEO (See also Board of Directors and Top Management)

President and CEO Duties and Authorities

- Oversee corporate operations and provide direction to the management team with regard to operations within the parameters established through legislation, regulation, and corporate policies, goals, strategies, directives, etc.
- Establish corporate policies, goals, strategies, directives, etc.
- Ensure that qualified, competent, and responsible Directors are in place to manage the drinking water system
- Designate the Overall Responsible Operator (ORO)
- Provide direction to Directors with regard to planning to ensure that Utilities Kingston and the drinking water systems meet future demands
- Review annual financial statements, establish budgetary goals and identify budgetary constraints
- Provide direction to Directors with regard to the preparation of budgets within budgetary goals and constraints
- Review and approve budget submissions

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President and CEO Duties and Authorities

- Submit proposed Utilities Kingston budgets for approval

Director – Utilities Engineering, Human Resources and Treatment Operations

(See also Top Management)

Director – Utilities Engineering, Human Resources and Treatment Duties and Authorities

- Oversee activities and projects undertaken by the Utilities Engineering Group
- Ensure that qualified, competent, and responsible Managers, Supervisors, Engineers, Engineering Technologists, and other personnel are in place to carry out engineering services associated with the drinking water systems
- Provide direction to Managers with regard to the delivery of drinking water system engineering services that meet or exceed the requirements of all relevant legislation, regulations, standards, and Utilities Kingston policies and procedures
- Provide direction to Managers with regard to the provision of technical advice and assistance to the Water and Wastewater Operations Group
- Provide direction to Managers regarding the allocation of available personnel and resources to best satisfy engineering requirements for the drinking water system
- Review new and amended legislation, regulations, and standards to identify changes to Utilities Kingston processes, procedures, and standards required to maintain compliance with regard to drinking water system design and construction
- Provide direction to Managers regarding the development and implementation of improved Utilities Kingston processes, procedures, and standards
- Designate the ORO(s)
- Ensure that qualified, competent, and responsible Managers, Supervisors, Sub-Forepersons, Operators, and other personnel are in place to operate and maintain the drinking water system
- Provide direction to Managers and Supervisors with regard to operation and maintenance of the system which meets or exceeds the requirements of all relevant legislation and regulations, and Utilities Kingston policies and procedures
- Provide direction to Managers and Supervisors regarding the allocation of available personnel and resources and assignment of work to best satisfy legislative, operational, and maintenance requirements
- Review new and amended legislation and regulations and identify, develop and implement changes to processes and procedures required to maintain compliance
- Evaluate and ensure adequacy, safety, and efficiency of current system and work processes and procedures
- Provide direction to Managers and Supervisors regarding the development and implementation of improved system and work processes and procedures
- Review and approve proposed changes to system and work processes and procedures
- Review and approve QMS Operational Plans, General, Emergency and Critical Control Limit Procedures.
- Review, provide comment on, and approve capital improvement, reconstruction and refurbishment proposals
- Identify and communicate to Utilities Engineering any need for major capital improvement, reconstruction and/or refurbishment for design and completion or for technical assistance
- Approve and carry out the procurement of third party services, supplies and equipment
- Approve payment for goods and services
- Prepare operating and capital budget submissions

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Manager – Treatment Group (See also Top Management)

Manager – Treatment Group Duties and Authorities

- Manage drinking water treatment, pumping, and storage facilities operations and maintenance
- Designate the ORO(s)
- Provide direction to Supervisors, Sub-Forepersons and Operators who oversee the operation and maintenance of the systems which meets or exceeds the requirements of all relevant legislation and regulations, and Utilities Kingston policies and procedures
- Provide direction to Supervisors and Sub-Forepersons who oversee the allocation of available personnel and resources and assignment of work to best satisfy legislative, operational, and maintenance requirements
- Review new and amended legislation and regulations and identify, develop and implement changes to processes and procedures required to maintain compliance
- Evaluate and ensure adequacy, safety, and efficiency of current system and work processes and procedures
- Develop and implement improved system and work processes and procedures
- Review and provide comment on capital improvement, reconstruction and refurbishment proposals
- Review studies and long term plans and identify resources that will be required to meet future demands
- Identify and communicate to the Director any need for additional resources required to ensure the continued provision of a safe and secure supply of drinking water to the community
- Communicate with the Owner, regulatory agencies, and the public with regard to water system issues
- Approve and carry out the procurement of third party services, supplies and equipment
- Approve payment for goods and services
- Assist with the preparation of operating and capital budget submissions

Supervisors – Treatment Operations (See Also Operator – Treatment Group)

Supervisors – Treatment Operations Duties and Authorities

- Oversee the day to day operation, maintenance and quality assurances of drinking water treatment, pumping, and storage facilities as an Operator In Charge or as the Overall Responsible Operator (ORO) as assigned
- Oversee drinking water treatment, pumping, and storage facilities maintenance as an Operator In Charge or as the Overall Responsible Operator (ORO) as assigned
- Liaise with other Supervisors to ensure the coordination of operations with repair and maintenance work.
- Allocate available personnel and resources to best satisfy legislative, operational, and maintenance requirements
- Assign, coordinate, and supervise work of Treatment Operations personnel
- Provide direction, information and guidance to staff with regard to operation and maintenance of the systems which meets or exceeds the requirements of all relevant legislation and regulations, and Utilities Kingston policies and procedures
- Ensure the ongoing maintenance and improvement of the Drinking Water QMS
- Review and approve QMS Standard Operating Procedures
- Evaluate and monitor the adequacy, safety, and efficiency of current system and work processes and procedures and make recommendations for and assist with the development and implementation of improved processes and procedures
- Review new and amended legislation and regulations and identify and assist in the development and implementation of changes to processes and procedures required to maintain compliance
- Identify and Communicate to the Manager(s) and Director(s) any need for additional resources required to ensure the continued provision of a safe and secure supply of drinking water to the community
- Communicate with the Owner, regulatory agencies, and the public with regard to water system issues
- Review and provide comment on capital improvement, reconstruction and refurbishment proposals
- Review studies and long term plans and identify resources that will be required to meet future demands
- Approve and carry out the procurement of third party services, supplies and equipment
- Approve payment for goods and services

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- Assist with the preparation of operating and capital budget submissions

Sub-Foreperson – Treatment (See Also Operator – Treatment Group)

Sub-Foreperson – Treatment Operations Duties and Authorities

- Oversee drinking water treatment systems operations and maintenance as an Operator In Charge ,or as the Overall Responsible Operator (ORO) as assigned
- Provide direction to Operators with regard to operation and maintenance of the systems which meets or exceeds the requirements of all relevant legislation and regulations, and Utilities Kingston policies and procedures
- Assign, coordinate, and supervise work of Operators and/or Journey person - Water/Wastewater
- Review new and amended legislation and regulations and identify and assist in the development and implementation of changes to processes and procedures required to maintain compliance
- Assist in the development and implementation of improved system and work processes and procedures
- Review and provide comment on proposed changes to system and work processes and procedures
- Review and provide comment on capital improvement, reconstruction and refurbishment proposals
- Communicate with the Owner, regulatory agencies, and the public with regard to drinking water system issues

Quality Management Coordinator

Quality Management Coordinator Duties and Authorities

- Ensure the ongoing maintenance and improvement of the Drinking Water QMS as the QMS Representative by fulfilling the responsibilities, duties, and authorities described by the Quality Management Representative Acknowledgement of Responsibilities
- Evaluate the adequacy, safety, and efficiency of current system and work processes and procedures and make recommendations for and assist with the development and implementation of improved processes and procedures
- Develop and maintain department SharePoint site to provide staff with required tools and documents to complete QMS related activities.
- Provide information and guidance to staff with regard to Utilities Kingston policies, procedures, lists and forms which meets or exceeds the requirements of all relevant legislation and regulations, and Utilities Kingston policies and procedures
- Review new and amended legislation and regulations to identify and assist with the development and implementation of changes to processes and procedures required to maintain compliance
- Review studies and long term plans and identify resources that will be required to meet future demands
- Identify and Communicate to the Top Management any need for additional resources required to ensure the continued provision of a safe and secure supply of drinking water to the community
- Communicate with the Owner, regulatory agencies, and the public with regard to water system issues

Quality Assurance Operator – Drinking Water (See also Operator – Treatment Group)

Quality Assurance Operator (Drinking Water) Duties and Authorities

- Ensure the continued effectiveness of drinking water sampling, testing and monitoring programs and that legislated reporting requirements for drinking water quality are met
- Provide advice and direction to Operators with regard to operation and maintenance of the systems to maintain drinking water safety and quality
- Respond to and investigate drinking water quality complaints and provide information and advice to customers
- Communicate with the Owner, regulatory agencies, and the public with regard to water quality issues
- Assist in the development and implementation of improved system and work processes and procedures, particularly those related to monitoring, sampling, and reporting
- Review new and amended legislation and regulations and identify and assist in the development and implementation of changes to work and/or system processes and procedures required to maintain compliance
- Review and provide comment on proposed changes to system and work processes and procedures

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Program Coordinator – Water or Wastewater

Program Coordinator (Cross Connection Control) Duties and Authorities

- Ensure the continued effectiveness of the Cross Connection Control Program through the provision of survey and testing notices to property owners, the review of cross connection surveys and backflow preventer test reports, and the maintenance and review of related databases
- Provide advice and direction to property owners and managers and certified testers with regard to meeting the requirements of the Cross Connection Control Program and related regulations, bylaws, and standards
- Communicate with the System Owner, property owners, certified testers, regulatory agencies, and the public with regard to the Cross Connection Control Program
- Liaise with municipal building officials to ensure that required permits are obtained and inspections completed for backflow preventer installations
- Test and maintain backflow preventers installed at facilities under the operating authority
- Assist in the development and implementation of improved system and work processes and procedures, particularly those related to the Cross Connection Control Program
- Review new and amended legislation and regulations and identify and assist in the development and implementation of changes to work and/or system processes and procedures required to maintain compliance
- Review and provide comment on proposed changes to system and work processes and procedures

Operator - Treatment Group

Operator – Treatment Group Duties and Authorities

- Oversee drinking water treatment systems operations and maintenance as an Operator In Charge
- Carry out operation and maintenance duties in a manner that meets or exceeds the requirements of all relevant legislation and regulations, and Utilities Kingston policies and procedures
- Monitor and adjust treatment processes and facilities operation and distribution storage and pumping facilities operation to maximize reliability and efficiency and to ensure compliance with established critical control limits and applicable legislation, regulations, and standards
- Collect samples and perform routine laboratory analyses and complete proper delivery of samples to an accredited laboratory for testing
- Inspect and carry out routine maintenance of facilities equipment including pumps, chemical feed pumps, sample pumps, motors, drives, screens, filters, tanks, etc.
- Carry out calibration checks of online analyzers
- Record operating activities in the applicable log books and forms
- Report incidents of regulatory non-compliance to the Director, Managers, Supervisors, and Water Quality Assurance Operator, and regulatory authorities
- Report incidents of deviations from critical control limits to the Director, Managers, Supervisors, and Water Quality Assurance Operator
- Take appropriate corrective actions to address incidents of non-compliance and deviations from critical control limits
- Procure supplies, materials, and third party services as authorized by the Supervisor or Manager
- Coordinate and inspect work being completed by third parties
- Obtain and keep current the licenses and certifications required for the position held and the duties performed
- Attend required training
- Review QMS Operational Plans and Procedures, and Standard Operating Procedures to ensure familiarity with current operational conditions and processes, and operator duties and authorities
- Review QMS Operational Plans and Procedures, and Standard Operating Procedures to ensure that they remain consistent with current legislation, regulations, and operational conditions and processes as assigned
- Identify and propose improvements to operational plans, QMS procedures, standard operating procedures, and work and system processes
- Identify and communicate to the Supervisor or Manager any requirement for improvement, reconstruction, replacement or refurbishment of facilities, infrastructure, and equipment
- Review and provide comment on capital improvement, reconstruction and refurbishment proposals

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Journeyperson Water - Treatment Group

Journeyperson Water – Treatment Group Duties and Authorities

- Maintain and repair mechanical/electrical equipment in compliance with applicable regulations, codes, and procedures
- Review and provide comment on capital improvement, reconstruction and refurbishment proposals
- Review QMS Operational Plans and Procedures, and Standard Operating Procedures to ensure familiarity with current operational conditions and processes

Director – Operations (See also Top Management)

Director – Operations Duties and Authorities

- Designate the ORO(s)
- Ensure that qualified, competent, and responsible Managers, Supervisors, Sub-Forepersons, Operators, and other personnel are in place to operate and maintain the drinking water system
- Provide direction to Managers and Supervisors with regard to operation and maintenance of the system which meets or exceeds the requirements of all relevant legislation and regulations, and Utilities Kingston policies and procedures
- Provide direction to Managers and Supervisors regarding the allocation of available personnel and resources and assignment of work to best satisfy legislative, operational, and maintenance requirements
- Review new and amended legislation and regulations and identify, develop and implement changes to processes and procedures required to maintain compliance
- Evaluate and ensure adequacy, safety, and efficiency of current system and work processes and procedures
- Provide direction to Managers and Supervisors regarding the development and implementation of improved system and work processes and procedures
- Review and approve proposed changes to system and work processes and procedures
- Review and approve QMS Operational Plans, General, Emergency and Critical Control Limit Procedures
- Review, provide comment on, and approve capital improvement, reconstruction and refurbishment proposals
- Identify and communicate to Utilities Engineering any need for major capital improvement, reconstruction and/or refurbishment for design and completion or for technical assistance
- Approve and carry out the procurement of third party services, supplies and equipment
- Approve payment for goods and services
- Prepare operating and capital budget submissions

Manager – Underground Infrastructure (See also Top Management)

Manager – Underground Infrastructure Group Duties and Authorities

- Manage drinking water distribution systems operations and maintenance
- Designate the ORO(s)
- Provide direction to Supervisors, Sub-Forepersons and Operators, who oversee the operation and maintenance of the systems which meets or exceeds the requirements of all relevant legislation and regulations, and Utilities Kingston policies and procedures
- Provide direction to Supervisors and Sub-Forepersons who oversee the allocation of available personnel and resources and assignment of work to best satisfy legislative, operational, and maintenance requirements
- Review new and amended legislation and regulations and identify, develop and implement changes to processes and procedures required to maintain compliance
- Evaluate and ensure adequacy, safety, and efficiency of current system and work processes and procedures
- Develop and implement improved system and work processes and procedures
- Review and provide comment on capital improvement, reconstruction and refurbishment proposals
- Review studies and long term plans and identify resources that will be required to meet future demands

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Manager – Underground Infrastructure Group Duties and Authorities

- Identify and communicate to the Director of Engineering, Human Resources and Treatment Operations any need for additional resources required to ensure the continued provision of a safe and secure supply of drinking water to the community
- Communicate with the Owner, regulatory agencies, and the public with regard to water system issues
- Approve and carry out the procurement of third party services, supplies and equipment
- Approve payment for goods and services
- Assist with the preparation of operating and capital budget submissions

Supervisor – Underground Infrastructure (See also Operator – Underground Infrastructure)

Supervisor – Underground Infrastructure Group Duties and Authorities

- Oversee drinking water systems operations and maintenance
- Oversee drinking water distribution systems operations and maintenance as an Operator In Charge, or as the Overall Responsible Operator (ORO) as assigned
- Provide direction to Sub-Forepersons and Operators with regard to operation and maintenance of the systems which meets or exceeds the requirements of all relevant legislation and regulations, and Utilities Kingston policies and procedures
- Allocate available personnel and resources to best satisfy legislative, operational, and maintenance requirements
- Assign, coordinate, and supervise work of Underground Infrastructure personnel
- Liaise with the Supervisors of Treatment Operations to ensure the coordination of repair and maintenance work with operations.
- Review new and amended legislation and regulations and identify and assist in the development and implementation of changes to processes and procedures required to maintain compliance
- Monitor the adequacy, safety, and efficiency of current system and work processes and procedures and make recommendations for and assist in the development and implementation of improved processes and procedures
- Review and provide comment on capital improvement, reconstruction and refurbishment proposals
- Review studies and long term plans and identify resources that will be required to meet future demands
- Review and approve QMS Standard Operating Procedures
- Identify and Communicate to the Manager any need for additional resources required to ensure the continued provision of a safe and secure supply of drinking water to the community
- Communicate with the Owner, regulatory agencies, and the public with regard to water system issues
- Approve and carry out the procurement of third party services, supplies and equipment
- Assist with the preparation of operating and capital budget submissions

Sub-Foreperson - Underground Infrastructure (See also Operator – Underground)

Sub-Foreperson – Underground Infrastructure Group Duties and Authorities

- Oversee drinking water distribution systems operations and maintenance as an Operator In Charge, or as the Overall Responsible Operator (ORO) as assigned
- Provide direction to Operators with regard to operation and maintenance of the systems which meets or exceeds the requirements of all relevant legislation and regulations, and Utilities Kingston policies and procedures
- Assign, coordinate, and supervise work of Operators
- Review new and amended legislation and regulations and identify and assist in the development and implementation of changes to processes and procedures required to maintain compliance
- Assist in the development and implementation of improved system and work processes and procedures
- Review and provide comment on proposed changes to system and work processes and procedures
- Review and provide comment on capital improvement, reconstruction and refurbishment proposals
- Communicate with the Owner, regulatory agencies, and the public with regard to water system issues

Operator - Underground Infrastructure Group

Operator – Underground Infrastructure Group Duties and Authorities

- Oversee drinking water distribution systems operations and maintenance as an Operator In Charge

UTILITIES KINGSTON DRINKING WATER QUALITY MANAGEMENT SYSTEM

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Operator – Underground Infrastructure Group Duties and Authorities

- Complete operation and maintenance duties in a manner that meets or exceeds the requirements of all relevant legislation and regulations, and Utilities Kingston policies and procedures
- Inspect, maintain, and repair distribution system piping and appurtenances including fire hydrants, valves, check valves, air release valves, etc.
- Carry out isolation and re-commissioning of distribution system mains, storage facilities, and booster/pumping stations as required for inspection, maintenance, and repair
- Collect samples and complete on site testing (Cl₂, pH) and ensure proper storage and delivery of samples to an accredited laboratory for testing
- Operate system valves for testing and commissioning of new water mains completed by others including inspecting the test records for and the installation of backflow prevention devices, verifying hydrostatic and bacteriological test results, inspecting final connection(s), verifying valve states, flushing, flow testing, and sampling
- Report operating activities to the Operations Centre for entry into the Water Distribution System Log Book
- Record operating activities on the appropriate forms
- Report incidents of regulatory non-compliance to the Director, Managers, Supervisors, and Water Quality Assurance Operator, and regulatory authorities
- Report incidents of deviations from critical control limits to the Director, Managers, Supervisors, and Water Quality Assurance Operator
- Take appropriate corrective actions to address incidents of non-compliance and deviations from critical control limits
- Procure supplies, materials, and third party services as authorized by the Supervisor or Manager
- Coordinate and inspect work being completed by third parties
- Obtain and keep current the licenses and certifications required for the position held and the duties performed
- Attend required training
- Review QMS Operational Plans and Procedures, and Standard Operating Procedures to ensure familiarity with current operational conditions and processes, and operator duties and authorities.
- Identify and propose improvements to operational plans, QMS procedures, standard operating procedures, and work and system processes
- Review QMS Operational Plans and Procedures, and Standard Operating Procedures to ensure that they remain consistent with current legislation, regulations, and operational conditions and processes as assigned
- Identify and communicate to the Supervisor or Manager any requirement for improvement, reconstruction, replacement or refurbishment of facilities, infrastructure, and equipment

Manager – Engineering

Manager – Utilities Engineering Duties and Authorities

- Oversee day to day activities for projects undertaken by the Utilities Engineering Group
- Provide direction to Engineers with regard to the delivery of drinking water system engineering services that meet or exceed the requirements of all relevant legislation, regulations, standards, and Utilities Kingston policies and procedures
- Provide direction to Engineers with regard to the provision of technical advice and assistance to the Water and Wastewater Operations Group
- Allocate available personnel and resources to best satisfy engineering requirements for the water system
- Assign, coordinate, and supervise work of Engineers
- Liaise with the Supervisor of Inspection and Support to ensure project milestones are properly supported for the timely delivery of services

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- Review new and amended legislation, regulations, and standards to identify, develop, and implement changes to Utilities Kingston processes, procedures, and standards required to maintain compliance with regard to drinking water system design and construction
- Identify and Communicate to the Director of Utilities Engineering, Human Resources and Treatment Operations, any need for additional resources required to meet future demands and ensure the continued safe and secure supply of drinking water to the community
- Communicate with the Owner, regulatory agencies, and the public with regard to drinking water system issues related to planning, design, and construction
- Approve and carry out the procurement of third party services, supplies and equipment
- Approve payment for goods and services
- Assist with the preparation of operating and capital budget submissions

Engineer

Engineer Duties and Authorities

- Undertake and oversee the design, inspection and completion of drinking water system capital projects as assigned
- Liaise with the Supervisor of Inspection and Support and assigned inspection personnel to ensure project milestones are properly supported for the timely delivery of services
- Provide technical advice and assistance to the Water and Wastewater Operations Group
- Undertake and oversee the completion of studies and long term planning as assigned
- Undertake and oversee the development and implementation of Utilities Kingston design, construction and material standards as assigned
- Review new and amended legislation, regulations, and standards to ensure that projects are designed and completed in compliance with current requirements
- Identify and Communicate to the Manager of Engineering any need for additional resources required to meet future demands and ensure the continued safe and secure supply of drinking water to the community
- Communicate with the Owner, regulatory agencies, and the public with regard to drinking water system issues as required for the successful design and completion of projects
- Approve and carry out the procurement of third party services, supplies and equipment
- Assist with the preparation of operating and capital budget submissions

Supervisor – Inspection and Support

Supervisor – Inspection and Support Duties and Authorities

- Oversee day to day activities for projects undertaken by the Utilities Engineering Group
- Provide direction to Engineering Technologists with regard to the design, inspection and completion of drinking water system capital projects that meets or exceeds the requirements of all relevant legislation and regulations, and Utilities Kingston policies and procedures
- Allocate available personnel and resources to best satisfy legislative, operational, and project requirements
- Assign, coordinate, and supervise work of Engineering Technologists
- Liaise with the Manager of Engineering and Engineers to ensure project milestones are properly supported for the timely delivery of services
- Review new and amended legislation, regulations, and standards to identify, develop, and implement changes to Utilities Kingston processes, procedures, and standards required to maintain compliance with regard to drinking water system design and construction

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- Identify and Communicate to the Director of Utilities Engineering any need for additional resources required to meet future demands and ensure the continued safe and secure supply of drinking water to the community
- Approve and carry out the procurement of third party services, supplies and equipment
- Approve payment for goods and services
- Assist with the preparation of operating and capital budget submissions

Engineering Technologist

Engineering Technologist Duties and Authorities

- Undertake the design, coordination and inspection of work for drinking water system capital projects that meets or exceeds the requirements of all relevant legislation and regulations, and Utilities Kingston policies and procedures
- Coordinate and oversee drinking water distribution system operations required for the completion of a capital project as an Operator In Charge
- Collect samples and complete on site testing (Cl₂, pH) and ensure proper storage and delivery of samples to an accredited laboratory for testing
- Operate system valves for testing and commissioning of drinking water system capital projects completed by others including inspecting the test records for and the installation of backflow prevention devices, verifying hydrostatic and bacteriological test results, verifying valve states, flushing, flow testing, and sampling
- Report operating activities to the Operations Centre for entry into the Distribution System Log Book
- Record operating activities on the appropriate forms
- Report incidents of regulatory non-compliance to the applicable Directors, Managers and Supervisors and to the Water Quality Assurance Operator, and regulatory authorities
- Report incidents of deviations from critical control limits to the applicable Directors, Managers and Supervisors and to the Water Quality Assurance Operator
- Take appropriate corrective actions to address incidents of non-compliance and deviations from critical control limits
- Ensure documents are updated to reflect changes to infrastructure resulting from drinking water system capital projects
- Obtain and keep current licenses and certifications required for the position held and the duties performed
- Attend required training
- Review QMS Operational Plans and Procedures, and Standard Operating Procedures to ensure familiarity with current operational conditions and processes, and operator duties and authorities.
- Identify and propose improvements to operational plans, QMS procedures, standard operating procedures, work and system processes, etc...
- Identify and communicate to the Supervisor of Inspection and Support any need for additional resources required to ensure the continued provision of a safe and secure supply of drinking water

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. Table 3 in section 10.2 identifies the current required competencies, certification, and

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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.

Table 3 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.

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Table 3 – Competencies, Certification, and Training

Education Training, experience, and certifications may be substituted for education requirements SS – Secondary School PS – Post Secondary UN – University Licence / Designation E – Electrician M – Millwright / Industrial Mechanic CET – Certified Engineering Technologist PEng – Professional Engineer * – Within 5 years of hire ** – May be used in lieu of water treatment certification – – Not identified Competency Level 1 – Basic technical proficiency and/or knowledge and understanding 2 – Good knowledge, understanding, and technical proficiency 3 – Advanced knowledge, understanding, and technical proficiency	Required Competencies, Certification, and Training																												Desired Competencies, Certification, and Training													
	Experience, Certification, and Training									General Knowledge and Skills										Technical Knowledge and Skills									Desired Competencies, Certification, and Training													
	Education	Years Experience (related field)	Technical License / Designation	Water Treatment Certification (Class)	Water Quality Analyst	Water Distribution Certification (Class)	Driver's License (Class)	RBD 0 – 8 Ton Certification	Core and Competency Maintenance Training	Supervisory Skills	Verbal Communication Skills	Written Communication Skills	Research Skills	Long Term Planning	Budget Preparation / Analysis	Contract Management	Scheduling / Work Planning	Record Keeping	Occupational Health & Safety Act & Regulations	Safe Drinking Water Act & Regulations	Operation and Maintenance Standards & Procedures	Construction Standards & Procedures	Emergency Preparedness Procedures	Computer Literacy – Office Suite	Computer Literacy – CAD	Computer Literacy – SCADA	Treatment Unit Processes	Distribution System Processes	Troubleshooting - Process	Maintenance – Mechanical Infrastructure	Maintenance – Electrical Instrumentation / Controls	Maintenance – Other Equipment	Lab Procedures and Techniques	Sampling Procedures and Techniques	Read and Understand Detailed Design Drawings	Education	Technical License / Designation	Water Treatment Certification (Class)	Water Quality Analyst	Water Distribution Certification (Class)	Driver's License (Class)	Competency Enhancement Training
ORO - Treatment	-	-	-	III	-	-	G	-	✓	2	2	2	2	-	-	-	1	2	2	3	2	2	2	1	2	2	2	1	1	1	1	1	1	2	-	-	III	-	-	G	✓	
ORO – Distribution	-	-	-	-	-	IV	G	-	✓	2	2	2	2	-	-	-	1	2	2	3	2	2	2	1	-	1	2	1	1	1	1	1	1	2	-	-	-	-	IV	G	✓	
Director – Operations	UN	-	-	-	-	-	G	-	-	3	3	3	3	3	2	2	3	3	3	1	3	3	3	1	-	2	2	-	-	-	-	-	-	2	UN	-	-	-	-	-	-	-
Director – Utilities Engineering, Human Resources and Treatment Operations	UN	10	-	-	-	-	G	-	-	3	3	3	3	3	2	2	3	3	3	1	3	3	3	1	-	2	2	-	-	-	-	-	-	2	UN	-	-	-	-	-	-	-
Manager – W & WW Treatment Operations	PS	5	-	-	-	-	G	-	✓	3	3	3	3	3	2	2	2	3	3	3	2	3	3	1	2	3	2	1	1	1	1	1	2	PS	CET	IV	-	-	-	-	✓	
Manager – Underground Infrastructure	PS	5	-	-	-	-	G	-	✓	3	3	3	3	3	2	2	2	3	3	3	2	3	3	1	1	2	3	1	1	1	1	1	2	PS	CET	-	-	IV	-	✓		
Manager – Engineering	UN	5	-	-	-	-	G	-	-	3	3	3	3	3	2	3	2	3	3	2	3	3	3	1	2	2	2	1	1	1	1	1	3	UN	PEng	-	-	-	-	-		
Supervisor – Inspection and Support	PS	5	-	-	-	-	G	-	-	3	3	3	3	2	2	3	3	3	3	2	3	3	3	-	1	1	2	-	-	-	1	1	3	PS	CET	-	-	-	-	-		
Supervisor – Water and Wastewater Treatment Operations	PS	5	-	III	-	-	G	-	✓	3	3	3	3	2	1	2	3	3	3	3	2	3	2	1	2	3	2	3	2	2	2	3	3	3	PS	CET	IV	-	-	-	✓	
Supervisor – Underground Infrastructure	SS	5	-	-	-	IV	G	-	✓	3	3	3	3	2	1	2	3	3	3	3	3	2	1	1	1	3	3	3	1	2	1	1	3	SS	CET	-	-	IV	-	✓		
Quality Management Coordinator	PS	5	-	-	-	-	G	-	✓	2	3	3	3	2	1	1	2	3	3	2	1	3	3	1	1	1	1	1	1	1	1	1	1	1	PS	-	II	-	II	-	✓	
Engineer	UN	-	PEng	-	-	-	G	-	-	2	3	3	3	3	2	3	2	3	3	3	3	2	3	3	1	3	3	2	1	1	1	1	3	UN	PEng	-	-	-	-	-		
Sub-Foreperson – Water Treatment	PS	5	-	III	-	-	G	-	✓	2	2	2	2	1	-	1	2	2	3	3	3	2	2	2	1	2	3	2	3	2	2	2	3	3	2	PS	CET	IV	-	-	-	✓
Sub-Foreperson – Underground System Operator	SS	5	-	-	-	III	DZ	✓	✓	2	2	2	2	1	-	1	2	2	3	2	3	2	1	-	1	3	3	3	1	2	1	1	2	SS	-	-	-	IV	-	✓		
Quality Assurance Operator – Water or Wastewater	PS	5	-	III	✓**	-	G	-	✓	2	2	2	2	1	-	-	1	3	2	3	2	1	2	2	3	2	3	1	1	1	3	3	2	PS	CET	IV	-	-	-	✓		
Program Coordinator – Cross Connection	PS	-	-	-	-	-	G	-	✓	2	3	3	3	2	1	1	2	3	3	2	1	3	3	1	1	1	1	1	1	1	1	1	1	1	PS	-	-	-	-	-	✓	
Water Treatment Operator	PS	-	-	II*	-	-	G	-	✓	1	2	2	2	-	-	-	1	2	2	2	2	1	2	2	3	2	2	2	2	2	3	3	2	PS	-	IV	-	-	DZ	✓		
Journeyman – Water Wastewater Treatment	SS	5	E/M	-	-	-	G	-	✓	1	2	2	2	-	-	-	1	2	2	2	2	2	1	2	3	2	3	2	3	2	2	2	3	SS	-	IV	-	-	DZ	✓		
Underground System Operator	SS	-	-	-	-	II*	DZ	✓	✓	1	2	2	1	-	-	-	1	2	2	2	2	2	1	1	-	1	2	2	1	2	1	1	2	SS	-	-	-	IV	-	✓		
Engineering Technologist	PS	2	-	-	-	I	G	-	✓	1	2	2	1	1	-	2	2	3	3	3	2	3	3	-	2	2	1	-	-	-	1	1	3	PS	CET	-	-	-	-	✓		

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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 Director of Engineering, Human Resources and Treatment Operations, Director Operations, Manager of Water and Wastewater Treatment Operations, Manager of Water and Wastewater Underground Infrastructure, Water and Wastewater Treatment Operations Supervisors and the Water and Wastewater Underground Infrastructure Supervisor form the management team responsible for coordinating and directing the activities of workers employed within the Water and Wastewater Operations 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 Underground Infrastructure 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 pagers and 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.

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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 CAEAL 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

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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

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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 practises.

Document:

Document No:

Operational Plan For the Kingston and Cana Drinking Water Systems

W-OP-01

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:
 City of Kingston

Name of Municipal Residential Drinking Water System:
 Kingston Drinking Water Supply System

Name of Operational Subsystems (if Applicable)	Name of Operating Authority *	DWS Number(s)†
<small>* Check Item if the Municipal Residential Drinking Water System is operated by one operating authority. Enter the name of the operating authority in adjacent column †</small>		
Operational Subsystem 1:	1425445 Ontario Limited	220001860, 220001851
Operational Subsystem 2:		
Operational Subsystem 3:		
Operational Subsystem 4:		

Add attachments if there are additional 'Operational Subsystems'

Contact Information †		
Name	Title	Phone Number e-mail address
Jim Miller	Director, Water and Wastewater Treatment Operations	613-546-1181 X 2475 jim.miller@public.kingston.com
Julie Runions	Manager, Water and Wastewater Treatment Operations	613-546-1182 X2112 julie.runions@public.kingston.com

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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:

Name of Municipal Residential Drinking Water System:²

Name of Operational Subsystems (if Applicable)	Subject Systems	Name of Operating Authority ⁵	DWS Number(s) ⁶
<input checked="" type="checkbox"/> Check here if the Municipal Residential Drinking Water System is operated by one operating authority. Enter the name of this 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	jmill@utiltieskingston.com
Julie Runions	Manager, Water and Wastewater Treatment Operations	613-546-1182 X2172	jrunions@utiltieskingston.com

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