MASTER PLAN FOR WATER SUPPLY FOR THE CITY OF KINGSTON URBAN AREA AND THE CLASS ENVIRONMENTAL ASSESSMENT

(COMPLETED TO END OF PHASE 1 AND PHASE 2)

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INTRODUCTION

1 Introduction

1.1 General

Utilities Kingston is proceeding to complete a Master Plan for Water Supply for the City of Kingston Urban Area. The Master Plan has been undertaken to consider future requirements in the City of Kingston's overall drinking water treatment facilities and water distribution networks to satisfy the City of Kingston's current and projected drinking water demands including the provision of adequate fire hydrant flows and pressures.

Utilities Kingston is proceeding in a timely manner with the identification and the implementation of the preferred alternative(s) for upgrading the water treatment facilities and water distribution watermains and infrastructure, such as reservoirs, high lift water pumping stations and water booster pumping stations.

The Master Plan has been developed progressively through the use of Technical Memoranda that were forwarded to Utilities Kingston for review and comments throughout the development of the Master Plan and the Class Environmental Assessment undertaking to the end of Phase 2.

1.2 "Problem Statement"

At an early stage, it was necessary to clearly define the "Problem Statement" such that there was a clear understanding of the requirements to successfully complete the Master Plan and to allow Utilities Kingston to advertise the Commencement of Project, as required by the Class Environmental Assessment 2000, as prepared by the Municipal Engineers Association, and the Ontario Ministry of the Environment.

The "Problem Statement" has been developed as follows:

Utilities Kingston has determined the need to develop a Master Plan for the urban area of the City of Kingston's drinking water supply and distribution systems to accommodate the current (2006) drinking water demands for the urban area of the City of Kingston (Central, West and East) and to plan (in an orderly manner) for additional infrastructure (watermains, reservoirs and the associated water pumping stations and drinking water supply facilities) requirements to satisfy the considered short-term (2011), mid-term (2016) and long-term (2026) drinking water requirements for the urban area of the City of Kingston.

The existing City of Kingston water supply and distribution systems incorporates the City of Kingston (Kingston Central), the former Kingston

Township (Kingston West) and the former Pittsburgh Township (Kingston East, supplied by Kingston Central). Utilities Kingston considers Kingston Central and East, and Kingston West as two drinking water supply and distribution systems.

In order to provide an assured drinking water supply to the entire urban area of the City of Kingston from the two existing water treatment plants (the Central Water Purification Plant and the West Water Treatment Plant), it would appear that Kingston Central should be interconnected with Kingston West.

Utilities Kingston wishes to investigate potential methods to provide a unified drinking water supply and distribution system to serve the urban area of the City of Kinston (Central, West and East). These methods could include the logical interconnection of distribution systems and associated infrastructure additions/upgrades; upgrades/refurbishments to the existing facilities (water treatment plants, elevated water storage tanks, water storage standpipes, ground-level water storage reservoirs, water booster pumping stations); and new facilities (treatment plant, water storage).

It should be noted that the existing independent water supplies and distribution systems serving Kingston West and Kingston Central (including Kingston East) remained as an option to be further evaluated.

END

REVIEW OF THE EXISTING WATER TREATMENT PLANTS AND DISTRIBUTION SYSTEMS

2 Review of the Existing Water Treatment Plants and Distribution Systems

2.1 Background Information

It was necessary to develop a shared understanding of the issues and significant information relating to this undertaking, such as:

i) Existing water supplies and distribution systems

ii) Operational considerations and other significant issues

iii) Existing water treatment plants capacities (“rated” and “functional”)

iv) Existing water supply and storage requirements (“rated” and “functional”)

A consolidated summary of the information regarding the existing water treatment plants and the water distribution systems was required to develop the requirements for the Master Plan.

2.2 Overview of the existing water supplies and distribution systems

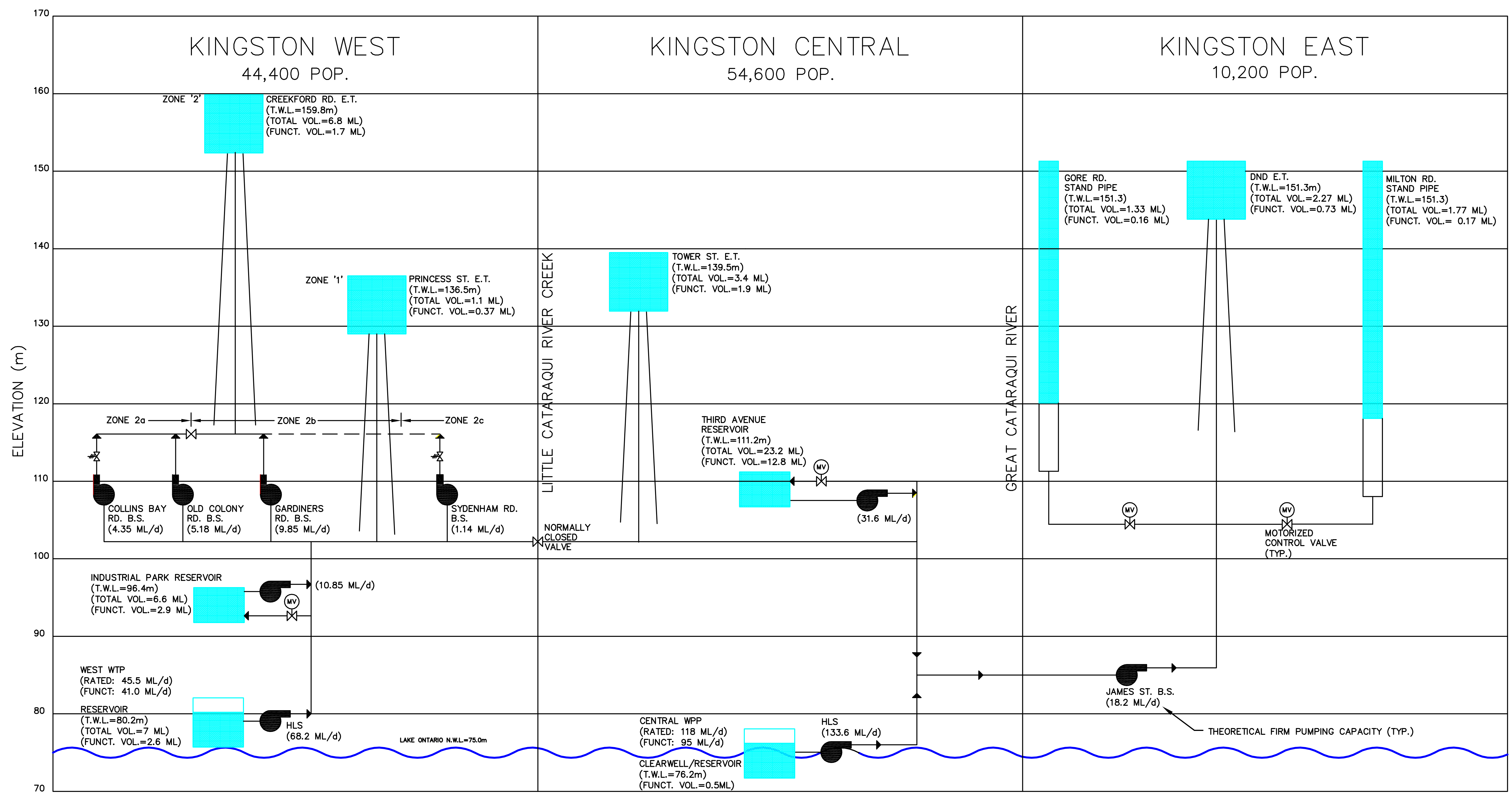
2.2.1 General

The City of Kingston urban area is presently served by two independent water treatment facilities and water distribution systems. The Kingston West Water Treatment Plant (WTP) supplies water to the Kingston West serviced area (former Kingston Township). The Central Water Purification Plant (WPP) supplies water to the serviced areas of Kingston Central and Kingston East (former Pittsburgh Township).

A schematic representation of the two water treatment plants and the three water distribution system areas has been indicated in **Figure 2.1**, on the following page. Information regarding the treatment plants, pumping stations and storage facilities are also summarized on the schematic.

Kingston Central is interconnected to Kingston East at one location (water is supplied to Kingston East through two parallel watermains crossing the Great Cataraqui River). Kingston Central and Kingston West are interconnected at one location only (a watermain on Bath Road, near Little Cataraqui Creek), but are normally isolated (the interconnection valve is normally closed and would only be used in the event of an unexpected emergency).

Major relatively recent upgrades/improvement to the water supplies and water distribution systems have been indicated in **Table 2.1**. Please note, volumes and flows have been indicated in million litres (**ML**) and (**ML/d**), respectively.



NOTES:

1. DATA SOURCES: FIGURE 3-1, CITY OF KINGSTON WATER DISTRIBUTION SYSTEM COMPUTER MODEL UPDATE, OCTOBER 2002; U-K FACILITY AND SCADA FILE INFORMATION.
2. STORAGE FACILITY 'FUNCTIONAL VOLUME' IS EFFECTIVE EQUALIZATION VOLUME BASED ON TYPICAL OPERATIONS AND SET POINTS.
3. WTP 'FUNCTIONAL CAPACITY' IS AN ESTIMATE OF SUSTAINABLE MAXIMUM CAPACITY, MAKING ALLOWANCE FOR FILTER BACKWASH OPERATIONS AND WATER REQUIRED FOR IN-PLANT USE.
4. PUMPING CAPACITIES SHOWN FOR ALL PUMPING STATIONS ARE THE THEORETICAL FIRM PUMPING CAPACITIES.

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UTILITIES KINGSTON
KINGSTON WATER SUPPLY MASTER PLAN

FIGURE 2.1:
YEAR 2006 CITY OF KINGSTON WATER DISTRIBUTION SYSTEMS SCHEMATIC

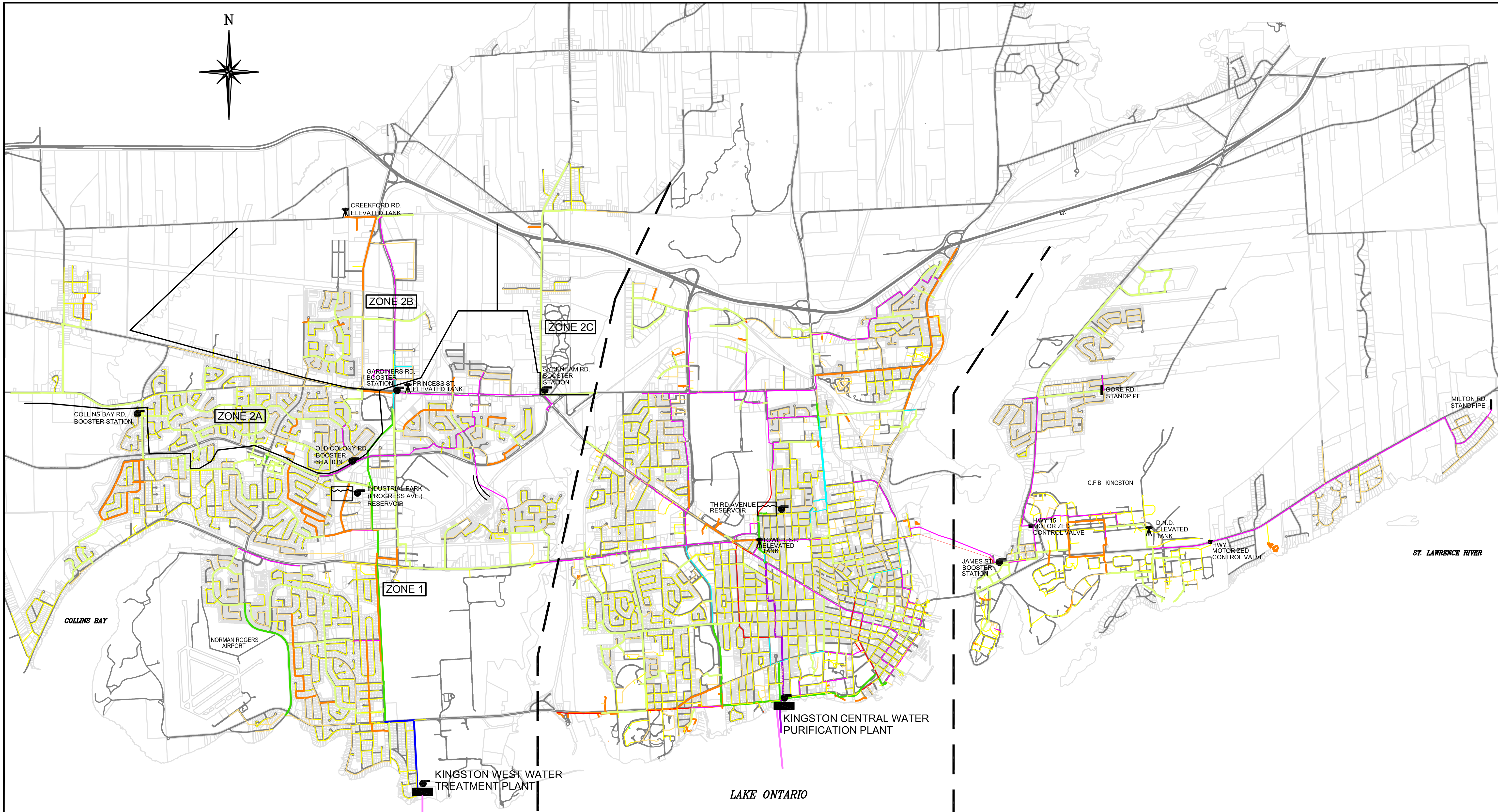
Table 2.1 – Major Recent Upgrades to Kingston West and Kingston Central (including Kingston East) Water Supplies & Distribution Systems

Kingston West
- Fall 2005, Creekford Road Elevated Tank - new elevated water storage tank (6.8 ML) - New watermains to feed Creekford Road Elevated Tank, Henderson Boulevard and new subdivision developments - Summer 2004, Kingston West WTP, O. Reg. 459/00 Compliance Upgrades – conversion of older reservoir to chlorine contact tank, disinfection system upgrades, filter control and metering and filter-to-waste upgrades
Kingston Central (including Kingston East)
- Fall 2005, Kingston Central WPP, Process Waste Facility Project – new residue management facility - Watermain installations/upgrades: Division Street and Railway Street - Fall 2004, new 450 mm diameter watermain crossing of the Great Cataraqui River to Kingston East (installed parallel to the existing 400 mm watermain) - Summer 2004, Kingston Central WPP, Baffling Upgrade – conversion of clear well/reservoir to chlorine contact tank - Spring 2003, Kingston Central WPP, Systems Refurbishment & SCADA System – system upgrades and a new computer based control system - Fall 2001, Kingston Central WPP, Filter Refurbishment – new filter under drains, troughs and filter media

2.2.2 Kingston West

a) Kingston West water supply and distribution system

The Kingston West WTP, located at 80 Sunny Acres Road, supplies water to the Kingston West water distribution system. The Kingston West water distribution system consists of two main pressure zones (Pressure Zone 1 and Pressure Zone 2). In addition to the Kingston West WTP reservoir and High Lift Station, Pressure Zone 1 has one in-ground reservoir and its associated booster station and one elevated tank (Princess Street Elevated Tank). Pressure Zone 2 is comprised of three sub-Pressure Zones (Pressure Zone 2a, 2b and 2c) and is served by one elevated tank (the Creekford Road Elevated Tank) and four water booster stations (see **Figure 2.1** and see **Figure 2.2**, on the following page (**Figure 2.2** also included, full-size, in envelope in **Appendix C,** Tab 11).



NOTES:

1. DATA SOURCES: FIGURE W1, CITY OF KINGSTON URBAN GROWTH STRATEGY, JULY, 2004; UTILITIES KINGSTON FILE INFORMATION

LEGEND

150ø	500ø
200ø	600ø
250ø	750ø
300ø	900ø
400ø	1200ø
450ø	

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UTILITIES KINGSTON
MASTER PLAN FOR WATER SUPPLY

FIGURE 2.2:
YEAR 2006 CITY OF KINGSTON WATER DISTRIBUTION SYSTEM

b) Kingston West Water Treatment Plant

The Kingston West WTP is a three-filter chemically assisted, direct filtration water treatment plant with a “rated” capacity of 45.5 ML/d. Filtered water flows through a chlorine contact tank (a converted older reservoir) prior to entering an on-site, two-cell reservoir.

The on-site, two-cell reservoir has a total storage capacity of 7 ML and a “functional” volume of 2.6 ML, based on a reservoir water level range of 2.5 m to 4.0 m (approximately 78.55 m to 80.05 m).

The Kingston West WTP High Lift Station (HLS) pumps from the reservoir to Pressure Zone 1 of the Kingston West water distribution system. The HLS has five high lift pumps providing a theoretical firm pumping capacity of 68.1 ML/d. The five pumps include:

- Two electric pumps, each rated at 13,622 m^3/d
- One electric/diesel pump rated at 13,622 m^3/d
- One electric pump rated at 27,244 m^3/d
- One diesel pump rated at 27,244 m^3/d

c) Industrial Park Reservoir

The Industrial Park Reservoir (or Progress Avenue Reservoir) is an in-ground reservoir located on Progress Avenue. The Industrial Park Reservoir has a total volume of 6.6 ML, and a “functional” volume of 2.9 ML, based on a reservoir water level range of 2.5 m to 4.5 m (approx. 94.3 m to 96.3 m). Water fed into the Industrial Park Reservoir from Pressure Zone 1, is returned to Pressure Zone 1 by a reservoir booster station. The reservoir booster station has three pumps, providing a theoretical firm pumping capacity of 10.9 ML/d. The three pumps include:

- Two electric pumps, each rated at 5,430 m^3/d
- One diesel pump rated at 8,170 m^3/d

d) Princess Street Elevated Tank

The Princess Street Elevated Tank is located northeast of the Princess Street and Gardiners Road intersection. It provides storage and system pressure stabilization for Pressure Zone 1. The Princess Street Elevated

Tank has a total volume of 1.14 ML and a “functional” volume of 0.35 ML, based on a tank water level range of 6.5 m to 9.25 m (approx. 133.5 m to 136.2 m). The water level at the Princess Street Elevated Tank controls pump operations of the Kingston West WTP HLS and the Industrial Park Reservoir water booster station.

e) Gardiners Road Booster Station (BS)

Water is supplied to Pressure Zone 2b from Pressure Zone 1 by the Gardiners Road BS located at the northeast corner of Princess Street and Gardiners Road and in close proximity to the Princess Street Elevated Tank. Presently, the Gardiners Road BS has three pumps, providing a theoretical firm pumping capacity of 2.94 ML/d. The three pumps include:

- Two electric pumps, each rated at 1,470 m^3/d
- One electric pump rated at 9,850 m^3/d

Gardiners Road BS upgrades are currently in progress by Utilities Kingston now that the Creekford Rd Elevated Tank has been completed in order to address pressure and capacity limitations. The proposed upgraded pumping equipment will include two electric pumps, each rated at 9,850 m^3/d, providing a theoretical firm pumping capacity of 9.85 ML/d (with only one pump operating (the two pumps could operate in parallel to increase the flow, as required). These capacities are considered as existing capacities for study purposes and have been indicated in **Figure 2.1**.

f) Creekford Road Elevated Tank

The Creekford Road Elevated Tank, located on Creekford Road, was completed in the fall of 2005. The Creekford Road Elevated Tank provides water storage and also system pressure stabilization for Pressure Zone 2b. Water is supplied to fill the Creekford Road Elevated Tank from the Gardiners Road BS. The Creekford Road Elevated Tank has a total volume of 6.83 ML and has a “functional” volume of 1.7 ML, based on a tank water level range of 7.5 m to 11.5 m (approximately 155.1 m to 159.1 m). The water level at the Creekford Road Elevated Tank controls pump operations of the Gardiners Road BS.

g) Old Colony Road Booster Station

The Old Colony Road Booster Station (BS) is located at the corner of Taylor-Kidd Boulevard and Old Colony Road. The Old Colony Road BS supplies water to Pressure Zone 2a (from Pressure Zone 1) and has two variable speed pumps, providing a theoretical firm pumping capacity of 5.18 ML/d. The two pumps include:

- Two electric pumps, each rated at 5,180 m^3/d.

Pump operations and speed are controlled to maintain a pressure differential of 140 kPa (20 psi) across the pump (i.e., pump suction from Pressure Zone 1 to pump discharge to Pressure Zone 2a).

h) Collins Bay Road Booster Station (BS)

The Collins Bay Road BS is located on Collins Bay Road in the vicinity of Woodbine Road. The Collins Bay Road BS also supplies water to Pressure Zone 2a (from Pressure Zone 1) and has two pumps providing a theoretical firm pumping capacity of 4.35 ML/d. The two pumps include:

- Two electric pumps, each rated at 4,350 m^3/d.

A pressure relief valve is used to maintain the Collins Bay Road BS discharge pressure below 640 kPa (92.8 psi).

i) Sydenham Road Booster Station (BS)

The Sydenham Road BS is located at the corner of Princess Street and Sydenham Road. The Sydenham Road BS supplies water to Pressure Zone 2c (drawing from Pressure Zone 1) and has three pumps providing a theoretical firm pumping capacity of 1.14 ML/d. The three pumps include:

- Two electric pumps, each rated at 570 m^3/d

- One electric pump rated at 7,600 m^3/d

Pressure relief valves are used to maintain the discharge pressure below 640 kPa (92.8 psi).

2.2.3 Kingston Central

a) Kingston Central water supply and distribution system

The Kingston Central Water Purification Plant (WPP), located at 302 King Street West, supplies water to the Kingston Central water distribution system, which also, in turn, supplies water to the Kingston

East water distribution system. The Kingston Central and Kingston East water distribution systems function as separate pressure zones. In addition to the Kingston Central WPP High Lift Station (HLS), one in-ground reservoir and its associated booster station (Third Avenue Reservoir and Booster Station) and one elevated tank (Tower Street Elevated Tank) supply the Kingston Central water distribution system as indicated in **Figure 2.1** and **Figure 2.2**.

b) Kingston Central Water Purification Plant

The Kingston Central WPP is a six-filter, chemically assisted, conventional water filtration treatment plant with a "rated" capacity of 118 ML/d. Filtered water flows through a chlorine contact tank (a converted clear well/high lift reservoir) prior to entering the on-site high lift pumping station.

The on-site chlorine contact tank has a limited amount of "functional" storage for in-plant needs (e.g., filter back washing) only. As a result, there is no storage capacity of drinking water available for the water distribution system demands.

The Kingston Central WPP high lift station (HLS) pumps from the clear wells to the Kingston Central water distribution system. The Kingston Central WPP has seven high lift pumps providing a theoretical firm pumping capacity of 133.6 ML/d. The seven pumps include:

- Two electric pumps, each rated at 19,500 m^3/d
- One electric pump rated at 23,600 m^3/d
- One electric pump rated at 31,800 m^3/d
- One electric/diesel rated at 45,500 m^3/d
- Two diesel pumps, each rated at 19,600 m^3/d

During normal operation the water level in the Tower Street Elevated Tank is the primary control for high lift pump operations.

The high lift pump control logic has been designed to balance and buffer system demand fluctuations by maintaining pre-selected levels in the Tower Street Elevated Tank and the Third Avenue Reservoir, while maintaining a plant high lift discharge pressure within a selected operational range.

c) Tower Street Elevated Tank

The Tower Street Elevated Tank is located on Tower Street, near the intersection of Princess Street and Bath Road. The Tower Street Elevated Tank provides storage and system pressure stabilization for the Kingston Central water distribution system. The Tower Street Elevated Tank has a total volume of 3.4 ML and a “functional” volume of 1.9 ML, based on a tank water level range of 3.0 m to 6.5 m (approximately 134.9 m to 138.4 m). The water level at the Tower Street Elevated Tank provides the primary control of pump operations at the Kingston Central WPP HLS and the Third Avenue Reservoir BS.

d) Third Avenue Reservoir and Booster Station

The Third Avenue Reservoir is an in-ground reservoir located on Third Avenue. The reservoir has a total volume of 23.2 ML and a “functional” volume of 12.8 ML, based on a reservoir water level range of 2.2 m to 5.6 m (approximately 107.2 m to 110.6 m). Water discharged into the Third Avenue Reservoir is returned to the Kingston Central water distribution system by means of a reservoir booster station to maintain pressure in Pressure Zone 1. The Third Avenue Reservoir Booster Station has three pumps, providing a theoretical firm pumping capacity of 31.6 ML/d. The three pumps include:

- Two electric pumps, each rated at 15,800 m^3/d
- One diesel pump rated at 31,800 m^3/d

2.2.4 Kingston East

a) Kingston East water supply and distribution system

All Kingston East drinking water is supplied from the Kingston Central water distribution system through either of two parallel watermains (a 400 mm and a 450 mm watermain) that cross the Great Cataraqui River and converge to supply the James Street Booster Station (BS). The James Street Booster Station provides drinking water to the Kingston East water distribution system, which is a separate pressure zone. In addition to the James Street BS, the Kingston East water distribution system is served by one elevated tank [DND (Canadian Forces Base Kingston) Elevated Tank] and two standpipes (the Gore Road Standpipe and the Milton Avenue Standpipe), all of which have a similar top water level elevation of approximately 151.3 m (see **Figure 2.1** and **Figure 2.2**).

b) James Street Booster Station (BS)

Water is supplied to the James Street BS (located at the western end of James Street) from the Kingston East water distribution system and is then boosted into the Kingston East water distribution system. The James Street BS has been provided with three identical booster pumps, providing a theoretical firm pumping capacity of 18.2 ML/d. The three pumps include:

- Three electric pumps, each rated at 9,100 m^3/d.

A standby diesel generator has been provided with sufficient capacity to operate two of the three pumps.

The water level in the DND Elevated Tank provides the primary control for the James Street BS. Alternately, the Gore Road Standpipe water level may be selected for control. Under normal current conditions, only one booster pump is currently required to operate.

c) DND (Canadian Forces Base Kingston) Elevated Tank

The DND Elevated Tank is located on Somme Avenue at Canadian Forces Base Kingston. The DND Elevated Tank provides water storage and pressure stabilization for the Kingston East and CFB Kingston water distribution systems. The DND Elevated Tank has a total volume of 2.27 ML and a “functional” volume of 0.73 ML based on a tank water level range of 4.26 m to 6.72 m (approximately 148.0 m to 150.4 m). The water level at the DND Elevated Tank primarily controls pump operation at the James Street BS.

d) Gore Road Standpipe

The Gore Road Standpipe is located on Gore Road near Rose Abbey Drive. The Gore Road Standpipe provides water storage and pressure stabilization for the water distribution system in the northern portion of Kingston East. The Gore Road Standpipe has a total volume of 1.22 ML and a “functional” volume of 0.16 ML based on a water level range of 2 m to 6 m (approximately 145.7 m to 149.7 m). The stated total volume does not include the bottom 15.6 m of water depth, as this stored water does not provide adequate water pressure [i.e., greater than 150 kPa (21.75 psi)].

The water level at the Gore Road Standpipe is normally directly maintained and influenced by the water level in the DND Elevated Tank.

To force water usage and turnover within the Gore Road Standpipe, the portion of the water distribution system leading to the Gore Road Standpipe has been provided with a motorized control valve (Kingston Highway 15 valve) for isolation. When the valve is closed (at the standpipe full level), local demand lowers the water level within the standpipe. When the water level in the standpipe drops to the pre-selected low level, the motorized control valve automatically opens and the standpipe fills and will again return to the pre-selected full level.

e) Milton Avenue Standpipe

The Milton Avenue Standpipe is located on Forest Drive close to Milton Avenue. The Milton Avenue Standpipe provides water storage and pressure stabilization for the water distribution system in the southern portion of Kingston East. The Milton Avenue Standpipe has a total volume of 1.28 ML and a "functional" volume of 0.17 ML based on a water level range of 1.5 m to 6 m (approximately 145.2 m to 149.7 m). The stated total volume does not include the bottom 15.6 m of water depth, as this stored water does not provide adequate water pressure [i.e., greater than 150 kPa (21.75 psi)].

The water level at the Milton Avenue Standpipe is normally directly maintained and influenced by the water level in the DND elevated tank. To force water usage and turnover within the standpipe, the portion of the water distribution system leading to the Milton Avenue Standpipe has been provided with a motorized control valve (Highway No. 2 valve) for isolation. When the valve is closed (at the standpipe full level), local demand lowers the water level within the standpipe. When water level in the standpipe drops to the pre-selected low level, the motorized control valve automatically opens and the standpipe fills and will again return to the pre-selected full level.

2.3 Operational considerations and other significant issues

Based on informal meetings with Utilities Kingston operations staff, views and insights to operational considerations and other significant issues were offered with regard to the City of Kingston's water treatment and water distribution systems requirements. A summary of the main items of the meetings and subsequent discussions has been presented in **Table 2.2** and **Table 2.3**, on the following four pages.

Table 2.2 - Kingston West WTP and Water Distribution System

- Additional Kingston West WTP water supply capacity is required. The plant generally has difficulty satisfying existing high demand periods, during which time the water storage would be significantly depleted and extensive recovery time would be required to replenish the system water storage capacities. Plant and system operations could benefit from an updating of the overall control strategy.

- The recent conversion of the Kingston West WTP older reservoir to a chlorine contact tank has significantly reduced the plant's on-site drinking water storage.

- For short durations, the Kingston West WTP would be capable of producing the plant "rated" capacity of 45.5 ML/d. If the Kingston West WTP were required to operate continuously over an extended period of time (e.g., one to two days), the WTP's continuous, "rated" capacity would be reduced. Based on an assumed filter run time of 12 hours during operation at high filtration rates, the cumulative effects of: filter off-line time during backwashing; volume of backwash and filter-to-waste water; clear well recovery of backwash volume and other allowances, result in a reduction of the daily drinking water production of approximately 4.5 ML; accordingly, the Kingston West WTP continuous "functional" capacity has been estimated as 41 ML/d.

- The single plant discharge header should be considered as a critical link that has no existing provision for redundancy. If for no other reason than operational integrity protection, an additional discharge header would be desirable. Additionally, this critical link would be considered to extend into the water distribution system, from the Kingston West WTP to the Industrial Park Reservoir. The single 900 mm plant discharge header extends from the Kingston West WTP to Days Road at Front Rd., then continuing as a 600 mm watermain following Days Road extending northerly to the vicinities of both the Industrial Park Reservoir and the Princess Street Elevated Storage Tank. This 600 mm watermain is the single supply serving all areas north of Bath Road. There is no other watermain connection that extends north of Bath Road.

- More major watermain looping should be considered to be advantageous for drinking water supply and pressure and also for redundancy purposes. There are single feed watermain concerns to Days Road, Bath Road and the Westbrook areas. In addition, there is only one watermain extending north of Bath Road. Potentially, there would be an opportunity to create routing for a new major watermain to extend north of Bath Road in order to extend or loop to the Industrial Park Reservoir (Progress Avenue) or other storage reservoir/tank.

- The newly constructed Creekford Road Elevated Water Storage Tank has a very significant impact on the Princess Street Elevated Tank level and water supply in the O'Connor Drive area during filling operations. The Creekford Road Elevated Water Storage Tank is supplied from the Gardiner's Road Booster Station. When the Creekford Road Elevated Water Storage Tank (in Zone 2) was being emptied, Zone 1 has more water than previous and when the tank was being filled, it draws water from Zone 1; hence, Zone 1 has less water to satisfy the water demand in Zone 1. Presently, the Creekford Road Elevated Water Storage Tank would be filling over an 8 to 10 hour period, during the night, to purposely avoid filling the tank during higher demand, daytime periods in Zone 1. It is not certain if the Creekford Road Elevated Water Storage Tank could be completely filled during the night period under summer, high water demand conditions. The provision of additional water storage and pumping capacity in the vicinity of the Gardiners Road Booster Station and the Princess Street Elevated Tank should be reviewed.

- More storage at the Kingston West WTP or in the system is required. Previous studies have recommended additional in-ground storage and high lift pumping in the vicinity of O'Connor Drive, in close proximity to the Princess Street Elevated Tank. The location, the required storage capacity of a reservoir and the high lift pump requirements (including standby emergency power) in this general vicinity will be further reviewed. It should be noted that an existing 500 mm watermain currently exists on the north side of O'Connor Drive and this could prove to be advantageous. It should also be noted that a single, large capacity water storage reservoir and the associated high lift pumps would generally be more economical, due to the economy of scale.

- Utilities Kingston is currently in the process of installing an additional large booster pump, identical in capacity to the existing large capacity pump of 9.8 ML/d, at the Gardiners Road Booster Station. The proposed two pumps will function as duty and standby; however, the pumps may also be operated in parallel to increase the discharge flow, as required).

- The Kingston West water distribution system pressure zone comments:
  - Some low-pressures have been reported in the water distribution system at the higher Zone 1 elevations of Waterloo North, Kings Landing and Waterloo Village areas.
  - Some low pressures have been reported at the end of the higher Zone 2a elevations[approaching 276 kPa (40 psi)], near the 2a / 2b pressure Zone boundary. At this boundary location, the Zone 2b pressure is approximately 345 kPa (50 psi) higher than the pressure in Zone 2a.
  - The use of pressure reducing valves (in manholes, for access), as required, would generally be preferred over the existing booster stations.
  - Concept – with the Creekford Road Elevated Water Storage Tank and other improved watermain connections, it may be possible to shift the Zone 1 boundary north, shift the Zone 2b boundary south and potentially eliminate Zone 2a (likely).
  - Concept – following water distribution system improvements, shift the Zone 2b boundary east and reduce or most likely eliminate Zone 2c.
  - Concept – with water distribution system improvements, shift the pressure Zone 2b boundary south to service the low-pressure Waterloo Village and Waterloo North areas.

- Regarding the Kingston Central and the Kingston West water distribution system interconnection:
  - It was our understanding that there would be no noticeable effect when the existing inter-connecting valve (located on Bath Road) was opened, since both systems are normally at a relatively similar hydraulic grade line at this location. With the Bath Road valve open, and a "major" fire (with a demand of 378 L/s for six hours) occurring in Kingston West or in Kingston Central, it was well expected that water should flow across the Bath Road valve location towards the direction of the "major" fire.
  - Concept – consider interconnection point booster station with the capability to boost the water pressure into the Kingston West or the Kingston Central water distribution system, if required.
  - Also, it would be possible to combine additional, "localized" storage at the potential interconnection point booster station location.
  - With sufficient interconnecting watermains, potentially the requirement to provide a booster station(s) at the interconnection locations might not be necessary. This will be determined by water distribution system modelling.

Table 2.3 - Kingston Central WPP and Central and East Water Distribution Systems

- Recent conversion of the Kingston Central Water Purification Plant clear well/reservoir to a chlorine contact tank has significantly reduced the plant's on-site drinking water storage. The Kingston Central WPP has no or very little effective high lift pump water storage in the existing on-site reservoir.

- The Kingston Central WPP has a "rated" capacity of 118 ML/d. During an extended period of continuous operation (e.g. 1 - 2 days) the plant's "functional" capacity would be reduced. Based on an assumed filter run time of 12 hours during operation at high filtration rates, the cumulative effects of: filter off-line time during backwashing; volume of backwash and service water; clear well recovery of backwash volume and other allowances, result in a reduction of the daily drinking water production of approximately 23 ML; accordingly, the Kingston Central WPP continuous "functional" capacity has been estimated as 95 ML/d.

- A new process waste facility has recently been brought on line. Based on initial operation observations, process wastewater capacity/through-put could be a constraint on the "functional" capacity of the plant.

- Due to existing inlet and discharge piping/header hydraulic issues, High Lift Pump No. 3 has experienced cavitation problems and is being fitted with a new impeller with changed hydraulics. Other high lift pumps are suspected of experiencing similar conditions.

- Reported existing Kingston Central WPP site constraints:
  - Relatively congested site (no significant space for upgrades or expansion)
  - Located within an historic area (sensitivity to viewing change/reduction)
  - Neighbours are located in very close proximity to WPP
  - The original high lift suction conduit was converted from the conduit installed in the original plant construction. There could be a possible integrity concern/constraint
  - There is inadequate room for any significant expansion on the site
- The James Street Booster Station, when pumping, has a significant impact on the Third Avenue Reservoir and the Tower Street Elevated Tank storage. The booster station pump draws directly from the Kingston Central water distribution system through the watermains across the Great Cataraqui River. Having two watermains at the one crossing location has improved the water supply to Kingston East; however, there would still be a critical link to the water supply if there were any disruption to the local upstream (e.g. Rideau Street area) watermain. Another watermain supply connection to the existing crossing, or another watermain crossing location (e.g. future bridge located at Elliot Avenue and Gore Road) would provide the optimum redundancy and would also allow a desirable looped watermain from Kingston Central to Kingston East.

- Kingston Central and Kingston East water distribution system comments:
  - Some low pressure reports at higher elevations in Rideau Heights.
  - Generally, there are numerous smaller dead ends that would benefit from more looping. Utilities Kingston will continue to flush dead-end watermains on a scheduled basis to address water quality issues (i.e., potentially stale water). This is considered beyond the scope of this Master Plan and Utilities Kingston would address.
  - A new Highway No. 2 watermain, extending from Kingston Highway 15 to the eastern portion of CFB Kingston, has been proposed for construction in the near future. This will provide a direct connection to the Milton area and also allow the Utilities Kingston and the Canadian Forces Base Kingston water distribution

systems to operate relatively independently, if desired.

- Other comments and concepts:
  - High lift pumping capacity would be reduced during power outages and the use of diesel driven pumps.
  - Normal high lift pump control program flow steps currently do not extend beyond approximately 73 ML/d. SCADA/manual operations of diesel pumps provides additional high lift capacity.
  - An additional reservoir and high lift pumping station in the water distribution system or on-site water storage is required.
  - Concept - separate water storage for backwash operations (the plant presently draws from the chlorine contact tank).
  - More storage and pumping capacity in the water distribution system would be desirable (e.g., at the Third Avenue Water Storage Reservoir and James Street Booster Station).
  - Filter air scour for filter backwashing would be desirable. This would reduce the water requirements for filter backwashes.
  - Land would be available for expansion at the Third Avenue Water Storage Reservoir site.
  - Concept – new reduced footprint treatment/filtration technology could be employed for capacity expansion. This would still require increased low lift and high lift capacity and drinking water storage/reservoir for high lift pumps.

- Regarding the Kingston West and the Kingston Central water distribution systems interconnection:
  - The Kingston Central WPP and its water distribution system operation control strategy currently work well. No concerns were noted regarding the operational effect of adding supply demand from the Kingston West WTP with interconnections to the Kingston Central WPP drinking water supply and water distribution system.
  - There has been no noticeable effect when the existing emergency interconnection valve on Bath Road has been opened (normally closed) since both the Kingston West and the Kingston Central water distribution systems at this location are normally at a relatively similar hydraulic grade line. This does not mean that if the valve was opened and there was a fire in Kingston Central or Kingston West that flow would not occur through this interconnecting watermain; in fact, it is certain that flow would occur. The amount of flow is not certain.
  - Concept – consider an interconnection point water booster station with the capability of boosting the water pressure into either system (bi-directional booster station). Prior to modelling, it was not certain that this would be required with the installation of additional Kingston Central to Kingston West interconnecting watermains.
  - If this potential Bath Road water booster station was implemented, it could potentially combine water storage at a location in the vicinity of the interconnection water booster station. This would require water distribution system modelling to determine the possible benefit.

Note: It should be noted that some of the concepts and comments provided in **Table 2.2** and **Table 2.3** were presented at an early stage in the Master Plan undertaking and should be considered as "to potentially be updated" based on further investigations, calculations and water distribution system modelling.

2.4 Historical/existing drinking water supply

Historical water supply rates to Kingston West, Kingston Central and Kingston East are summarized in **Table 2.4** and **Table 2.5**, on the following page. The historical water supply rates are based on 2003 to 2005 flow data. This period of flow data has been considered a representative period, as some recent upgrades were completed at the two water treatment plants that impacted filter flow control and plant operations in 2003.

Table 2.4 – Historical Drinking Water Supply – Summary

	Avg. Day	**Max. Day**	**Peak Hour**	**Max. / Avg.**	**Peak / Avg.**
	(m^3/d)	(m^3/d)	(m^3/d)	(P.F.)	(P.F.)
Kingston West WTP	25,722	41,500	63,533	1.61	2.47
Kingston Central WPP (Central plus East)	57,824	72,858	99,458	1.26	1.72
Kingston East	7,408	11,927		1.61	N/A

Notes:
1. Based on flow data for the period 2003 to 2005, inclusive.
2. Refer to Table 2 for the individual 2003 to 2005 year data

In relation to the total average day volume of water supplied to the City of Kingston, the demand in Kingston West would be approximately 29% of the total volume, the demand in Kingston Central would be approximately 63% of the total volume and the demand in Kingston East would be approximately 8% of the total volume.

Table 2.5 – Historical Flow Data for Years 2003, 2004 and 2005

	Kingston West WTP (m^3/d)					Kingston Central WPP (Central + East) (m^3/d)					Kingston East (m^3/d)		
Year	Avg. Day	Max. Day	Peak Hr.	Max./ Avg.	Peak/ Avg.	Avg. Day	Max. Day	Peak Hr.	Max./ Avg.	Peak/ Avg.	Avg. Day	Max. Day	Max./ Avg.
2003	25,722	41,500	58,400	1.61	2.27	57,824	70,373	90,800	1.22	1.57	7,408	11,708	1.58
2004	22,997	28,900	46,700	1.26	2.03	56,880	71,600	89,160	1.26	1.57	6,641	8,408	1.27
2005	22,143	33,270	54,600	1.50	2.47	56,503	69,600	97,070	1.23	1.72	5,980	9,646	1.61
Average	23,621	34,557	53,233	1.46	2.26	57,069	70,524	92,343	1.24	1.62	6,676	9,921	1.49
Maximum	25,722	41,500	58,400	1.61	2.47	57,824	71,600	97,070	1.26	1.72	7,408	11,708	1.61
Minimum	22,143	28,900	46,700	1.26	2.03	56,503	69,600	89,160	1.22	1.57	5,980	8,408	1.27
Historical Period	**25,722**	**41,500**	**63,533**	**1.61**	**2.47**	**57,824**	**72,858**	**99,458**	**1.26**	**1.72**	**7,408**	**11,927**	**1.61**

Note: The maximum day and peak hour flows for the 'historical period' have been calculated by applying the highest observed maximum day and peak hour factors to the highest observed average day flows.

2.5 Existing drinking water supply requirements and capacity

2.5.1 Water treatment facilities

Water treatment plants are usually designed to deliver a drinking water supply at least equal to the water distribution system's maximum day demand and system storage has been relied upon to accommodate peak demands (i.e. equalization storage) and to provide both fire and emergency storage. A water plant's capability to provide drinking water to the water distribution system should provide an allowance for water required for filter backwashing and in-plant use, for filter downtime (during filter backwashing), wash water recovery and for other operational conditions (e.g., reduced raw water quality, normal control settings/ranges, etc.) that may affect the water treatment plant's drinking water supply capacity.

The existing maximum day flows in comparison to the "rated" capacity and estimated "functional" capacity of the water treatment plants have been indicated in **Table 2.6**. The maximum day flows and water treatment plants capacities are shown for both the separate and interconnected systems.

Table 2.6 – Maximum Day Flow vs. Plant Capacities

	Max. Day Flow		Plant Rated Capacity	Max. Day / Rated Capacity		Plant Functional Capacity	Max. Day / Functional Capacity
	ML/d		ML/d	(%)		ML/d	(%)
Kingston West	41.5		45.5	91.2%		41.0	101%
Kingston Central + East	72.9		118.0	61.8%		95.0	76.7%
Interconnected System (Kingston West + Kingston Central and Kingston East)	114.4		163.5	69.9%		136.0	84.0%

2.5.2 Pumping and booster stations

The current MOE design guidelines recommend that pumping and booster stations have, as a minimum, a firm pumping capacity to supply the maximum day demands in a distribution system with sufficient floating storage for equalization, fire and emergency conditions. If sufficient floating storage were not available, then the pumping and booster stations must have the capacity for the extreme flow conditions that include both peak hour demand and maximum day plus fire flows. Firm pumping capacity is defined by the MOE as:

i) Capacity of a pumping station with the largest unit out of service if the station supplies a pressure zone with floating storage available for fire protection and balancing;

ii) Capacity of a station with the two largest units out of service if the pumping station serves a zone that does not have floating storage available."

The pump capacity, the firm pumping capacity and the emergency standby pumping capacity in the City of Kingston's pumping and booster stations have been summarized in **Table 2.7**, on the following page. Where more than one pumping/booster station supplies a pressure zone, the total firm capacity has been assumed as the cumulative capacity *with the largest unit out of service* in each station. Standby pumping capacity is the pumping capacity provided by pumps capable of being operated by standby power (i.e. diesel generator) or, a diesel engine driver. Where floating storage is available, it would be common to provide an emergency standby pumping capacity adequate for the average day demand, only. Where no floating storage was available for fire protection, it is recommended that full emergency standby power be provided for pumping/booster stations.

Table 2.7 – City of Kingston Pumping and Booster Station Capacity Summary

	Pump #1 (ML/d)	Pump #2 (ML/d)	Pump #3 (ML/d)	Pump #4 (ML/d)	Pump #5 (ML/d)	Pump #6 (ML/d)	Pump #7 (ML/d)	Total Capacity (ML/d)	Firm Capacity (ML/d)	Standby Capacity (ML/d)
Kingston West - Zone 1										
WTP HLPS	13.62	13.62	13.62	27.24	27.24			95.3	68.1	40.9
Industrial Park Reservoir BS	5.43	5.43	8.17					19.0	10.9	8.2
Sub-total								**114.4**	**79.0**	**49.0**
Kingston West – Zone 2										
Gardiners Road BS – 2b	9.85	9.85						19.7	9.9	0.0
Old Colony Road BS - 2a	5.18	5.18						10.4	5.2	0.0
Collins Bay Road BS - 2a	4.35	4.35						8.7	4.4	0.0
Sydenham Road BS - 2c	0.57	0.57	7.60					8.7	1.1	0.0
Sub-total								**47.5**	**20.5**	**0.0**
Kingston Central										
Kingston Central WPP HLPS	19.50	19.50	23.60	31.80	45.50	19.60	19.60	179.1	133.6	84.7
Third Avenue Reservoir	15.80	15.80	31.80					63.4	31.6	31.8
Sub-total								**242.5**	**165.2**	**116.5**
Kingston East										
James Street BS	9.10	9.10	9.10					**27.3**	**18.2**	**18.2**

Notes:
1. Pumping capacities shown are theoretical (i.e. based on nameplate/rated pump equipment capacities).

2.6 Existing City of Kingston water storage capacities and requirements

In systems where the water treatment plant is capable of satisfying only the maximum day demand, the system total storage requirement is calculated as:

Required Storage = A + B + C.

A	=	Fire Storage
B	=	Equalization Storage (25% of maximum day demand)
C	=	Emergency Storage (25% of A + B)

The calculated current water storage requirements (based on the above and other MOE design criteria) in comparison to the existing City of Kingston water storage capacities have been indicated in **Table 2.8**, on the following page.

There was *no* "calculated" water storage surplus in the Kingston West or the Kingston Central and Kingston East systems. The individual water distribution systems and their sub-zones all have a "calculated" water storage *deficit*.

A storage surplus (i.e., existing storage capacity exceeding the calculated storage requirements) exists only for the scenario of an interconnected system (i.e., the current two City of Kingston water supply and distribution systems are combined and considered as only one City of Kingston water supply and distribution system). However, even as single water supply and distribution system there was *no* surplus of equalization storage (i.e., "functional" storage). The total "functional" storage capacity (i.e., the effective volume used for equalization during current typical operations) of existing water storage facilities was approximately 23,000 m^3; whereas, the calculated required equalization storage was approximately 28,000 m^3 for an interconnected water supply and distribution system (i.e., Kingston West plus Kingston Central plus Kingston East).

Table 2.8 – Year 2006 City of Kingston Water Storage Requirements

		Kingston West			Kingston Central and East			Combined
		Zone 1	Zone 2	Subtotal	Central	East	Subtotal	Total
Max. Day Demand[1]	ML/d	24.9	16.6	41.5	61.0	11.9	72.9	114.4
Fire Flow Rate[2]	L/s	318	250	378	378	220	378	378.0
Fire Flow Duration[2]	hr	5.0	4.0	6.0	6.0	3.0	6.0	6.0
Storage Requirements								
a) Fire	m^3	5,724	3,600	8,165	8,165	2,376	8,165	8,165
b) Equalization	m^3	6,225	4,150	10,375	15,250	2,975	18,225	28,600
c) Emergency	m^3	2,987	1,938	4,635	5,854	1,338	6,597	9,191
Total	m^3	14,936	9,688	23,175	29,269	6,689	32,987	45,956
Existing Storage	m^3	14,700	6,800	21,500	26,600	5,370	31,970	53,470
("Functional" Storage[3])	m^3	(5,870)	(1,700)	(7,570)	(14,700)	(1,060)	(15,760)	(23,330)
Storage Surplus	m^3	-236	-2,888	-1,675	-2,669	-1,319	-1,017	7,514

Notes:
1. Maximum day flow based on Table 1. Zone 1 and Zone 2 demand assumed as 60% and 40% of Kingston West maximum day flow, respectively.
2. Fire flow rate and duration based on current MOE guidelines and estimated populations; maximum fire flow would be 378 L/s for 6.0 hours for an equivalent population of 40,000.
3. "functional" storage capacity is the existing effective equalization volume based on typical operations and operating set points.

2.7 Summary of significant items determined

a) Year 2006 water treatment plants capacities

i) The “functional” capacity of the West Water Treatment Plant is *less than* the year 2006 required maximum day demand in Kingston West.

ii) The “functional” capacity of the Central Water Purification Plant is *greater than* the year 2006 required maximum day demand in Kingston Central and Kingston East.

iii) When the existing, two, independent water treatment plants are considered as interconnected drinking water supplies, the “functional” capacity of the two water treatment plants is *greater than* the required year 2006 maximum day demand; accordingly, an interconnected water supply and distribution system would satisfy the 2006 City of Kingston water demands (with no increase in the drinking water supply required).

It was determined that the “rated” capacity of both the Kingston West WTP and Kingston Central WPP could not be achieved during extended periods (one to two days) of continuous operation, based on the required filter runs and associated backwash requirements. Accordingly, throughout this Study, the “functional” water supply capacity of the water treatment plants and the storage facilities versus the ”rated” capacities has been used.

b) Year 2006 water storage capacities

i) There is an existing water storage *deficit* in Kingston West, Kingston Central and Kingston East. There is an existing water storage surplus *only* for an interconnected City of Kingston water treatment plants supplies and distribution system.

ii) For an interconnected water treatment supplies and distribution system, there is a *deficit* of equalization storage (i.e., “functional” water storage).

END

ESTIMATED FUTURE DRINKING WATER REQUIREMENTS

3 Estimated Future Drinking Water Requirements

3.1 General

The water demands for the near term (year 2011), the intermediate term (year 2016) and the long term (year 2026) for the City of Kingston's preferred growth alternative [Growth Alternative 2 (West and East)] identified in the City of Kingston Urban Growth Strategy, Final Report, 2004, have been estimated. The study area for Growth Alternative 2 [GA2 (West and East)] has been indicated in **Figure 3.1**, on the following page.

In addition, an "expanded study area" has also been considered for the long term (designated year 2026A) and has also been indicated in **Figure 3.1**. The "expanded study area" has been based on the City of Kingston's comprehensive secondary planning areas. A plan identifying these areas has been included as **Figure 3.2**, on the following page. The "expanded study area" would include Growth Alternatives 3, 4 and 5 as identified in the Urban Growth Strategy, Final Report, 2004, as well as four additional areas indicated as: A, B, C, and D in **Figure 3.1**.

The future water treatment plants capacities, the system water storage and the associated pumping facilities and booster stations, required to satisfy the projected drinking water demands, have also been reviewed.

3.2 Future average day demand

The projection of the future demands has been divided into the following three demand components:

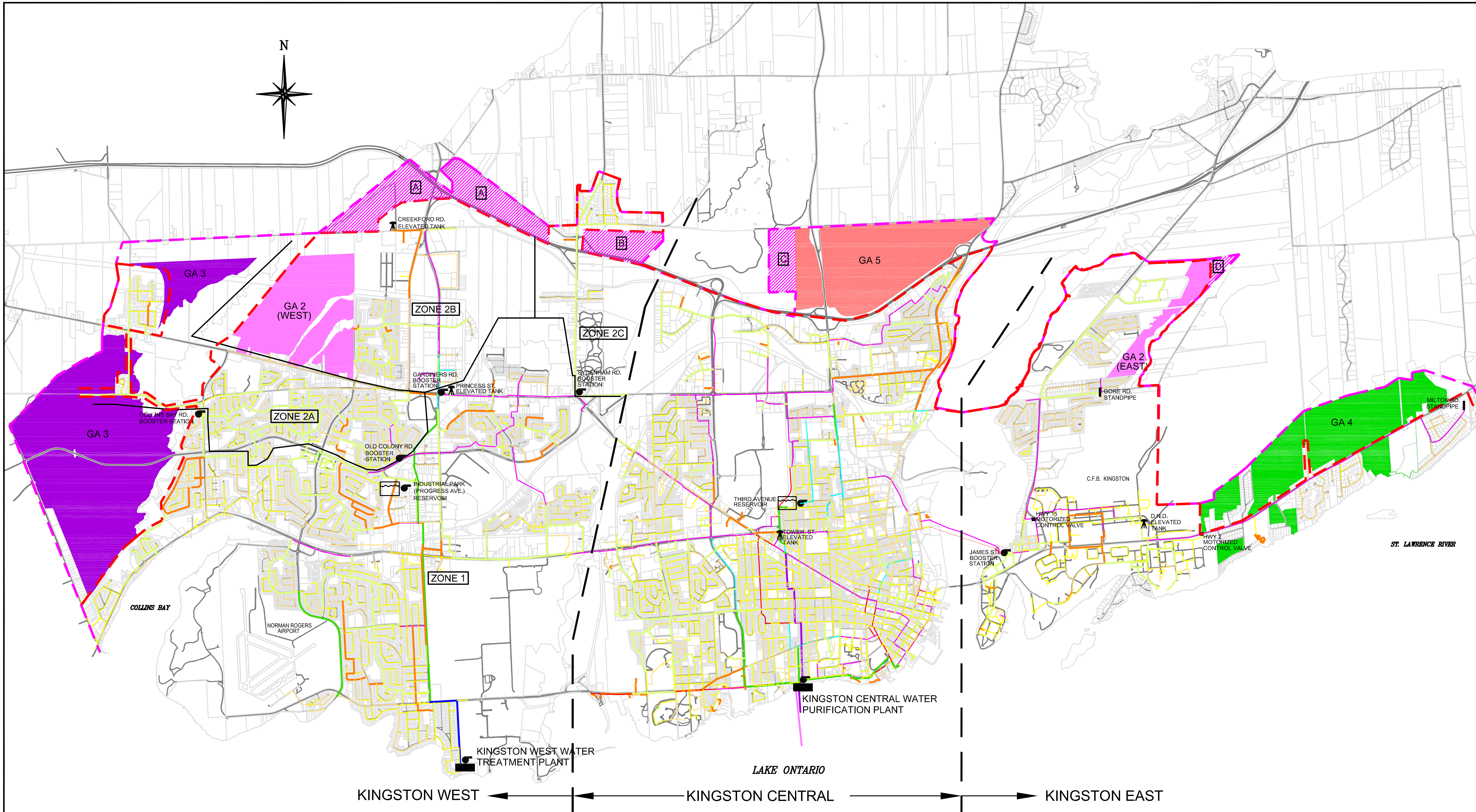
i) Residential demand

ii) Industrial, commercial and institutional (ICI) demand

iii) "Unaccounted for" water

The year 2006 demands are based on historical metered flow data for the Kingston West WTP and the Kingston Central WPP (for the years 2003, 2004 and 2005), as indicated in Sub-Section 2.4, above. The demands established for the year 2006 have been indicated in **Table 3.1** on Page 25.

The year 2006 water demands (demands) were the basis for determining the *future* water demands (demands).



NOTES:

1. DATA SOURCES: FIGURE W1, CITY OF KINGSTON URBAN GROWTH STRATEGY (UGS), JULY, 2004; UTILITIES KINGSTON FILE INFORMATION

LEGEND

- 150ø
- 200ø
- 250ø
- 300ø
- 400ø
- 450ø
- 500ø
- 600ø
- 750ø
- 900ø
- 1200ø
- GA2 STUDY AREA
- EXPANDED STUDY AREA
- ADDITIONAL AREAS
- URBAN GROWTH STRATEGY – GROWTH AREA 2
- URBAN GROWTH STRATEGY – GROWTH AREA 3
- URBAN GROWTH STRATEGY – GROWTH AREA 4
- URBAN GROWTH STRATEGY – GROWTH AREA 5

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UTILITIES KINGSTON
MASTER PLAN FOR WATER SUPPLY

FIGURE 3.1
URBAN GROWTH STRATEGY (GA2) STUDY AREA AND EXPANDED STUDY AREAS

KINGSTON CANADA

Official Plan Amendments

Urban Areas & Order of Development

Schedule 'A-1' to the Official Plan for the City of Kingston
Schedule 'B' to the Official Plan for the Township of Kingston
Schedule 'C-1' to the Official Plan for the Township of Pittsburgh

Legend

- Committed Infrastructure Areas
- Adjoining Infrastructure Area
- Comprehensive Secondary Planning Areas
- Currently Unavailable Areas
- Special Service Area

- Urban / Rural Split
- Former Municipal Boundaries
- Roads
- Railway Centreline

DRAFT

UTILITIES KINGSTON
MASTER PLAN FOR WATER SUPPLY
FIGURE: 3.2

Notes:

1. For land use designations please refer to the appropriate land use schedules.

N

0 495 990 1,980 2,970 Meters

PREPARED BY THE CITY OF KINGSTON, PLANNING & DEVELOPMENT SERVICES PLANNING DIVISION, April 28, 2006.

Table 3.1: Year 2006 Demand Summary

Kingston West WTP (ML/d)					Kingston Central WPP (including Kingston East) (ML/d)				
Avg. Day	Max. Day	Peak Hour	Max./ Avg.	Peak/ Avg.	Avg. Day	Max. Day	Peak Hour	Max./ Avg.	Peak/ Avg.
25,722	41,500	63,533	1.61	2.47	57,824	72,858	125,316	1.26	1.72

In order to project the future residential, ICI and "unaccounted for" water demands, the breakdown of the current residential and non-residential (ICI) water usage has been examined. The highest observed residential and ICI average day demand for Kingston West, Kingston Central and Kingston East (based on billing information provided by Utilities Kingston for the years 2003, 2004 and 2005) have been indicated in **Table 3.2**.

Table 3.2: Residential and ICI water usage breakdown (m^3/day)

	Residential	ICI	Residential + ICI
Kingston West	9,768	4,032	13,800
Kingston Central (including East)	9,960	27,480	37,440
Kingston Central	8,517	18,920	27,437
Kingston East	1,443	5,860	7,303

The sum of the residential and ICI water usage to the average day flows from the Kingston West WTP and the Kingston Central WPP have been compared in **Table 3.3**.

Table 3.3: Water usage totals versus Plant metered totals (m^3/day)

	Residential + ICI	Plant Metered Totals	"Unaccounted for" Water
Kingston West	13,800	25,722	11,922 (46%)
Kingston Central (including) East	37,440	57,824	20,384 (35%)
Kingston Central	27,437	50,416	22,979 (46%)
Kingston East	7,303	7,408	105 (1.4%)
Total	51,240	83,546	32,306 (39%)

It has been indicated in **Table 3.3** that the "unaccounted for" water in Kingston West and Kingston Central is a very high percentage of the total flow from the two water treatment plants. It is important to note that the "unaccounted for" water, as indicated in **Table 3.3**, was not solely lost water but was "any" unbilled water. Unbilled water includes water used for fire fighting, flushing watermains, watermain breaks, meter inaccuracies and actual water losses in the water distribution systems, as a result of watermain and service connections leaks.

Utilities Kingston is currently carrying out an "unaccounted for" water study and preliminary indications have indicated that the water distribution systems leakage rates would be in the range of 15-20% of the total water demand. Accordingly, future demands have been projected based on an initial "unaccounted for" water amount of 20% of the total water demand, decreasing to 15% in future years, as Utilities Kingston would continually be repairing and replacing leaking watermains.

The year 2006 residential and ICI demands have been adjusted (increased) to account for a "decreased" percentage of "unaccounted for" water (20% in Kingston West and Kingston Central and 15% in Kingston East). The adjusted year 2006 residential, non-residential and "unaccounted for" water demands for Kingston West, Kingston Central and Kingston East have been indicated in **Table 3.4**.

Table 3.4: Year 2006 Average Day Demand Breakdown (m^3/day)

	West	Central	East	Entire City
Residential	15,543	19,098	2,634	37,275
ICI	5,035	21,235	4,348	30,617
Unaccounted	5,144	10,083	426	15,654
Total	25,722	50,416	7,408	**83,546**

3.2.1 Residential demand projections

The future residential water demand has been based on population growth and the average day, residential consumption rate. Population growth projections have been determined based on "The City of Kingston Micro Demographic Model" (updated January 2006). This model was used to identify the population in each Census Tract within the study area for each of the years being considered (2006, 2011, 2016, 2026). A listing that indicated the population by census tract for each of the study years has been included in **Appendix D,** Tab 12. The projected population for each year for Kingston West, Kingston Central and Kingston East has been indicated in **Table 3.5**.

Table 3.5: **Population Summary**

Year	West			Central	East	Total
	Zone 1	Zone 2	Total			
2006	33,343	11,065	44,408	54,565	10,247	**109,220**
2011	35,388	16,032	51,420	56,254	11,326	**119,000**
2016	33,752	22,590	56,342	57,103	13,199	**126,644**
2026	34,266	27,862	62,128	61,599	16,933	**140,660**
2026A	34,266	55,888	90,154	72,726	30,405	**193,285**

Note: A shift will occur in the location of the Pressure Zone 1 boundary, south to Princess Street, after the year 2011, therefore a portion of the population in Zone 1, shifts to Zone 2.

The projected population for the year 2026A has been obtained by adding the additional population for the "expanded study area" to the year 2026 population. The additional populations for the year 2026A have been indicated in **Table 3.6**.

Table 3.6: 2026A Additional Population

	GA3	GA4	GA5	A	B	C	D	Total
Land Area (Ha)	515	295	242	139	43	35	9	1,278
Population	20,700	13,110	9,718	5,595	1,731	1,409	362	**52,625**

Notes:
1. Population yields for growth alternatives 3,4 and 5 were provided in the UGS, Final Report 2004.
2. Populations for areas A, B, C, and D have been calculated based on the same average residential densities used to determine the populations for the growth alternatives (UGS, Interim Report No. 2, 2004) i.e., 25 units/gross ha, 2.3 persons per household and 70% residential land use.

The projected residential demands have been indicated in **Table 3.7**. Estimated residential demands have been based on an average day consumption rate of 350 litres per capita per day (Lpcd).

Table 3.7: Projected Residential Average Day Demand (m^3/day)

Year	West	Central	East*	Total
2006	15,423	19,098	2,326	36,847
2011	17,997	19,689	2,699	40,385
2016	19,720	19,986	3,332	43,038
2026	21,745	21,560	4,621	47,926
2026A	31,554	25,454	9,337	66,345

*The population in Kingston East includes a large component of residents in CFB Kingston. Since the CFB Kingston water consumption is billed to Utilities Kingston as one large customer, the population of CFB Kingston (known from Census Tract data) of approximately 3,600 people has been removed from the residential demand calculation. CFB Kingston water usage has been considered as a component of the ICI consumption.

3.2.2 Industrial/commercial/institutional (ICI) demand projections

The estimated future ICI drinking water demand has included the demand from all existing ICI facilities as well as any new ICI development. The year 2006 ICI water demand has been indicated in **Table 3.4**.

The development potential for ICI growth, identified in the Urban Growth Strategy, was 840 additional hectares of ICI land (based on 33,609 jobs and 40 jobs/hectare). The 840 additional hectares (ha) of ICI land was divided into an ICI growth of 821 ha and 19 ha within the "Committed Development Area" and ICI growth within GA2, respectively. Interim Report No. 2 of the Urban

Growth Strategy identified the ICI growth for GA2 to be located in the northerly portion of GA2 (East).

The ICI development potential has been projected throughout the study period in accordance with the rate and location of population growth. The estimated additional ICI water demands, based on a water usage rate of 26 m^3/ha/day, have been indicated in **Table 3.8**. New demands that would occur in future years have been added to the year 2006 demand to obtain the demands for future years.

Table 3.8: Future Additional ICI Demand (CDA* & GA2) m^3/day

	West		Central		East		Total
	CDA	GA2	CDA	GA2	CDA	GA2	
2011	3,603	N/A	868	N/A	555	116	5,142
2016	2,691	N/A	572	N/A	666	91	4,020
2026	4,060	N/A	1,611	N/A	1,532	167	7,370
						Total	16,532

The additional ICI demands for the "expanded study area" (2026A) have been indicated in **Table 3.9**.

Table 3.9: 2026A Additional ICI Demand

	GA3	GA4	GA5	A	B	C	D	Total
Number of Jobs	6200	2,680	2,920	1,680	520	440	120	14,560
ICI Land (Ha)	155	67	73	42	13	11	3	364
ICI Demand (m^3/day)	4,030	1,742	1,898	1,092	338	286	78	**9,464**

Notes:
1. ICI land available for growth alternatives 3, 4 and 5 and the corresponding number of jobs (average of 40 jobs/hectare) was provided in the UGS Final Report 2004.
2. ICI land for areas A, B, C and D has been calculated in the same manner (i.e., ICI land use of 30%).

3.2.3 "Unaccounted for" water

As noted above, Utilities Kingston is currently and will continue to repair and replace older leaking watermains in order to minimize the amount of lost water. Based on the programs initiated by Utilities Kingston, the future percentages of "unaccounted for" water have been indicated in **Table 3.10**.

Table 3.10: Percentages of "Unaccounted for" Water

	West	Central	East
2011	20%	20%	15%
2016	15%	15%	15%
2026	15%	15%	15%
2026A	15%	15%	15%

3.2.4 Projected average day water demand summary

A summary of the average day water demands for Kingston West, Kingston Central and Kingston East for the years 2011, 2016, 2026 and 2026A has been indicated in **Table 3.11**.

Table 3.11: Average Day Demand Projections (m^3/day)

Study Year	West		Central		East		Entire City
2011							
Residential	17,997		19,689		2,699		40,385
ICI	8,638		22,103		5,019		35,760
Unaccounted	6,659		10,448		660		17,767
Total	33,294		52,240		8,378		93,911
2016							
Residential	19,720		19,986		3,332		43,038
ICI	11,329		22,675		5,775		39,779
Unaccounted	5,479		7,528		905		13,913
Total	36,528		50,190		10,013		96,730
2026							
Residential	21,745		21,560		4,621		47,926
ICI	15,389		24,287		7,474		47,149
Unaccounted	6,553		8,091		1,432		16,076
Total	43,686		53,937		13,528		111,151
2026A							
Residential	31,554		25,454		9,337		66,345
ICI	20,838		26,458		9,286		56,582
Unaccounted	9,246		9,161		2,584		20,991
Total	61,638		61,073		21,207		143,917

The projected drop in demand in the Central service area between 2011 and 2016 was the result of the assumed reduction in “unaccounted for” water.

3.3 Projected peaking factors

3.3.1 General

In the following sections, the maximum day and the peak hour to average day demand factors (maximum day factor and peak hour factor, respectively), to be applied to the projected future average day demands, have been determined.

Water supply data for the years 2003, 2004 and 2005, in **Table 2.5**, identified that the Kingston West, and the Kingston Central (including Kingston East) water supply and distribution systems have different historical maximum day and peak hour factors. In the following sections, maximum day and peak hour factors have been determined for Kingston West and Kingston Central (including East) independently, as well as overall for the option of a City of Kingston interconnected water distribution.

It has been previously established that flow data for the years 2003, 2004 and 2005 could be considered representative of the existing system. Data from these three years has been used as the basis for determining the peaking factors for all future years.

It should be noted that the maximum day factor is the factor that *most* impacts the required drinking water supply facilities and the system water storage and pumping facilities. Water treatment plants are designed to treat raw water and to supply drinking water to the water distribution system at the maximum day flow rate, *only*. Water storage is also designed to provide the required storage to supply equalization storage (25% of the maximum day demand) to the respective Pressure Zones of the water distribution systems. The water storage facilities are also designed to “store” fire flows and emergency flows.

All water for fire flow and for peak hour demands would generally be supplied from elevated water storage facilities and ground-level reservoirs and the associated pumping facilities. Booster pumping stations in the water distribution system should also be capable of pumping the peak hour and the maximum day plus fire flows. The James Street BS would be the only exception, as fire flow and peak hour demands would be provided from storage in the water distribution system.

The historical maximum day and peak hour factors have been provided in the following Sub-Sections and the appropriate factors, to apply to the future average day water demand projections, determined.

3.3.2 Maximum day and peak hour factors

For the most recent years, 2003, 2004 and 2005, the maximum day and peak hour factors determined for Kingston West and Kingston Central (including East), based on flow data for the two water treatment plants, have been indicated in **Table 3.12**, on the following page.

Table 3.12: Maximum Day and Peak Hour Factors

	Kingston West		Kingston Central (including East)		City of Kingston (interconnected system)	
	MD	**PH**	**MD**	**PH**	**MD**	**PH**
2003	1.61	2.27	1.22	1.57	1.34	1.76
2004	1.26	2.03	1.26	1.57	1.26	1.7
2005	1.50	2.47	1.23	1.72	1.31	1.93
Maximum	**1.61**	**2.47**	**1.26**	**1.72**	**1.34**	**1.93**

Notes:
1. Maximum day factor (MD) = maximum day flow / average day flow
2. Peak hour factor (PH) = peak hour flow / average day flow
3. Data for the City of Kingston (interconnected system) has been based on the sum of the flows for Kingston West and Kingston Central (including Kingston East)

Based on a review of other Cities of similar size, the factors in **Table 3.12** appeared to be marginally low. To provide peaking factors that would allow a marginal safety factor in the required water supply (maximum day demand) and water distribution system storage (peak hour), the maximum day and peak hour factors have knowledgably been increased by 10%. The maximum day and peak hour factors that have been selected for all water supply and water distribution system storage and pumping have been indicated in **Table 3.13**.

Table 3.13: **Peaking Factor Summary**

Kingston West		Kingston Central (including Kingston East)		City of Kingston (interconnected system)	
MD	PH	MD	PH	MD	PH
1.77	2.72	**1.39**	1.89	**1.50**	2.12

3.3.3 Review of peaking factors for similar municipalities

The population per capita consumption rate for the City of Guelph very closely resembled the population per capita consumption rate for the City of Kingston.

A Draft Final Water Supply Master Plan Report for the City of Guelph was recently completed in September 2006. In this Report, the population per capita consumption rate and the maximum day demand factor values were recommended.

A population per capita consumption rate of 300 Lpcd was recommended and used in the Report as the basis for establishing future water demands.

A maximum day factor of **1.5** was recommended and used in the Report as the basis for establishing future drinking water supply requirements. The maximum day factor for the City of Guelph was the same as the maximum day factor developed and to be used for the water supply requirements for the City of Kingston.

A peak hour factor was not provided in the City of Guelph Master Plan. The maximum day drinking water supply governs for studies/master plans, as was the case for the City of Guelph Master Plan (i.e., the treatment plant capacities are based on the maximum day demand).

3.4 Future water supply requirements

Water treatment plants must be able to provide a water supply equal to the maximum day demand of the water distribution systems being supplied. This Sub-Section has examined the capacities of the Kingston West WTP and Kingston Central WPP as compared to the "projected" maximum day demands.

The projected maximum day demands for Kingston West and Kingston Central (including Kingston East) for the year 2006 and the selected future years has been compared with the "rated" and "functional" capacities of the Kingston West WTP and the Kingston Central WPP, respectively in **Table 3.14**.

Table 3.14: Maximum Day Demand Versus Existing Plant Capacities (Independent Systems)

Study Year	Maximum Day Demand (ML/d)		Plant Rated Capacity (ML/d)	Plant "Functional" Capacity (ML/d)	"Functional" Capacity Surplus (ML/d)
2006					
West	41.5		45.5	41.0	**- 0.5**
Central + East	72.9		118.0	95.0	22.1
2011					
West	58.9		45.5	41.0	**- 17.9**
Central + East	84.3		118.0	95.0	10.7
2016					
West	64.7		45.5	41.0	**- 23.7**
Central + East	83.7		118.0	95.0	11.3
2026					
West	77.3		45.5	41.0	**- 36.3**
Central + East	93.8		118.0	95.0	1.2
2026A					
West	109.1		45.5	41.0	**- 68.1**
Central + East	114.4		118.0	95.0	**- 19.4**

Notes:
Maximum day factor applied for Kingston West: 1.77
Maximum day factor applied for Kingston Central: 1.39

<u>Comments</u>

i) Based on the drinking water demand projections indicated in **Table 3.14**, unless the "functional" capacity of the Kingston West WTP were increased, the Kingston West Water Treatment Plant "functional" capacity would *currently* not be able (or marginally able) to supply the maximum day demand for Kingston West. This was consistent with operator experience; wherein, it has been necessary to actively manage the water supply from the Kingston West Water Treatment Plant, during periods of high demand.

ii) Based on the demand projections and **Table 3.14**, the Kingston Central WPP "functional" capacity could supply the maximum day demand in Kingston Central (including Kingston East) for future years up to 2026, but *not* for the "expanded study area" for the study year 2026A.

iii) Based on the water demand projections indicated in **Table 3.14**, the Kingston Central WPP water supply capacity surplus would be sufficient to accommodate the deficit of the Kingston West WTP, until some period between the year 2006 and the year 2011. This would suggest that interconnecting the Kingston West and Kingston Central water supply and distribution systems would be beneficial in satisfying the "interconnected" drinking water system demands.

It should be noted that the "functional" capacity of the Kingston West WTP should be an *immediate* concern with regard to the "functional" drinking water supply only.

The projected maximum day demands for the option of an interconnected system for the City of Kingston for the year 2006 and the selected future years in comparison with the "rated" and "functional" capacities of the two water treatment plants, combined has been indicated in **Table 3.15**.

Table 3.15: Maximum Day Demand Versus Existing Plants Capacities (Interconnected System)

Year	Maximum Day Demand (ML/d)	Plants "rated" Capacity (ML/d)	Plants "Functional" Capacity (ML/d)	Plants "Functional" Capacity Surplus (ML/d)
2006				
	114.3	163.5	136.0	21.7
2011				
	140.9	163.5	136.0	**- 4.9**
2016				
	145.1	163.5	136.0	**- 9.1**
2026				
	166.7	163.5	136.0	**- 30.7**
2026A				
	215.9	163.5	136.0	**- 80**

Note: A maximum day demand factor of **1.5** has been applied for the option of an interconnected water supply system.

Comments

i) For the option of an interconnected water supply and distribution system for the City of Kingston, the existing "functional" capacities of the Kingston West WTP and the Kingston Central WPP, combined, *would* be able to supply the maximum day demand in the year 2006, but *would not* be able to supply the maximum day demand in the year 2011.

ii) A drinking water supply capacity upgrade for the option of an interconnected water supply and distribution system for the City of Kingston would be necessary prior to the year 2011, based on the selected maximum day demand factor of **1.5** and the water treatment plants "functional" capacity, as indicated in **Table 3.15**.

iii) If the 2026A demands were to be accommodated for the option of an interconnected City of Kingston water supply and distribution system, the required additional drinking water supply capacity would increase by approximately 60%.

3.5 Future water storage requirements

3.5.1 Storage requirement calculations

In systems where the water treatment plant is capable of *only* satisfying the maximum day demand, the total system storage requirement, based on the current MOE Guidelines, would be determined as follows:

Required storage = A + B + C

Where,

A = Fire storage
B = Equalization storage (25% of maximum day demand)
C = Emergency storage (25% of A + B)

The calculated future water storage requirements for the years 2011, 2016, 2026 and 2026A have been indicated in **Tables 3.16**, **3.17**, **3.18** and **3.19** (on the following four pages), respectively, based on the projected maximum day demands. The storage requirements have been indicated for the component parts of the system and for the option of an interconnected system for the City of Kingston.

Table 3.16: **Study Year 2011 City of Kingston Water Storage Requirements**									
		Kingston West			Kingston Central (including Kingston East)			Combined
		Zone 1	Zone 2	Sub-total	Central	East	Sub-total	Total
MOE Fire Flow Requirements								
Population		35,388	16,032	51,420	56,254	11,326	67,580	**119,000**
Historical Max Day Factor		1.77	1.77	1.77	1.39	1.39	1.39	1.5
Maximum Day Demand	(ML/d)	35.4	23.6	58.9	72.6	11.6	84.3	140.9
Fire Flow rate	(L/s)*	358	243	378	378	202	378	378
Fire Flow Duration	(hr)*	5.0	4.0	6.0	6.0	3.0	6.0	6.0
MOE Storage Requirements								
- Fire	(m^3)	6,444	3,499	8,165	8,165	2,182	8,165	8,165
- Equalization	(m^3)	8,838	5,892	14,731	18,153	2,912	21,065	35,216
- Emergency	(m^3)	3,821	2,348	5,724	6,580	1,273	7,308	10,845
- Total	**(m^3)**	**19,103**	**11,739**	**28,620**	**32,898**	**6,367**	**36,538**	**54,226**
Existing Storage								
- Total	(m^3)	**14,700**	**6,800**	**21,500**	**26,600**	**5,370**	**31,970**	**53,470**
- Total Functional	(m^3)	5,870	1,700	7,570	14,700	1,060	15,760	23,330
Storage Surplus								
- Total	**(m^3)**	**-4,403**	**-4,939**	**-7,120**	**-6,298**	**-997**	**-4,568**	**-756**
- Functional		-2,968	-4,192	-7,161	-3,453	-1,852	-5,305	-11,886

*Based on MOE guidelines App N Table 2
It has been assumed that the Pressure Zone 1 maximum day demand would be 60% of the total maximum day demand in Kingston West and that the Pressure Zone 2 maximum day demand would be 40% of the total maximum day demand in Kingston West

Table 3.17: **Study Year 2016 City of Kingston Water Storage Requirements**

		Kingston West			Kingston Central (including Kingston East)			Combined
		Zone 1	Zone 2	Sub-total	Central	East	Sub-total	Total
MOE Fire Flow Requirements								
Population		33,752	22,590	56,342	57,103	13,199	70,302	**126,644**
Historical Max Day Factor		1.77	1.77	1.77	1.39	1.39	1.39	1.5
Max. Day Demand	(ML/d)	35.6	29.1	64.7	69.8	13.9	83.7	145.1
Fire Flow rate	(L/s)*	351	268	378	378	222	378	378
Fire Flow Duration	(hr)*	5.0	5.0	6.0	6.0	3.0	6.0	6.0
MOE Storage Requirements								
- Fire	(m^3)	6,318	4,824	8,165	8,165	2,398	8,165	8,165
- Equalization	(m^3)	8,890	7,274	16,165	17,441	3,478	20,920	36,274
- Emergency	(m^3)	3,802	3,025	6,082	6,401	1,469	7,271	11,110
- Total	**(m^3)**	**19,011**	**15,123**	**30,412**	**32,007**	**7,345**	**36,355**	**55,548**
Existing Storage								
- Total	**(m^3)**	**14,700**	**6,800**	**21,500**	**26,600**	**5,370**	**31,970**	**53,470**
- Total Functional	(m^3)	5,870	1,700	7,570	14,700	1,060	15,760	23,330
Storage Surplus								
- Total	**(m^3)**	**-4,311**	**-8,323**	**-8,912**	**-5,407**	**-1,975**	**-4,385**	**-2,078**
- Functional	(m^3)	-3,020	-5,574	-8,595	-2,741	-2,418	-5,160	-12,944

*Based on MOE guidelines App N Table 2
It has been assumed that the Pressure Zone 1 maximum day demand would be 55% of the total maximum day demand in Kingston West and that the Pressure Zone 2 maximum day demand would be 45% of the total maximum day demand in Kingston West

Table 3.18: **Study Year 2026 City of Kingston Water Storage Requirements**

		Kingston West			Kingston Central (including Kingston East)			Combined
		Zone 1	Zone 2	Sub-total	Central	East	Sub-total	Total
MOE Fire Flows								
Population		34,266	27,862	62,128	61,599	16,933	78,532	**140,660**
Historical Max Day Factor		1.77	1.77	1.77	1.39	1.39	1.39	1.5
Max. Day Demand	(ML/d)	42.5	34.8	77.3	75.0	18.8	93.8	166.7
Fire Flow rate	(L/s)*	354	322	378	378	250	378	378
Fire Flow Duration	(hr)*	5.0	5.0	6.0	6.0	4.0	6.0	6.0
MOE Storage Requirements								
- Fire	(m^3)	6,372	5,796	8,165	8,165	3,600	8,165	8,165
- Equalization	(m^3)	10,633	8,700	19,333	18,744	4,702	23,446	41,685
- Emergency	(m^3)	4,251	3,624	6,874	6,727	2,075	7,903	12,462
- Total	**(m^3)**	**21,256**	**18,120**	**34,372**	**33,636**	**10,377**	**39,513**	**62,312**
Existing Storage								
- Total	(m^3)	**14,700**	**6,800**	**21,500**	**26,600**	**5,370**	**31,970**	**53,470**
- Total Functional	**(m^3)**	5,870	1,700	7,570	14,700	1,060	15,760	23,330
Storage Surplus								
- Total	**(m^3)**	**-6,556**	**-11,320**	**-12,872**	**-7,036**	**-5,007**	**-7,543**	**-8,842**
- Functional	(m^3)	-4,763	-7,000	-11,763	-4,044	-3,642	-7,686	-18,355

*Based on MOE guidelines App N Table 2
It has been assumed that the Pressure Zone 1 maximum day demand would be 55% of the total maximum day demand in Kingston West and that the Pressure Zone 2 maximum day demand would be 45% of the total maximum day demand in Kingston West

Table 3.19: **Study Year 2026A City of Kingston Water Storage Requirements**

		Kingston West			Kingston Central (including Kingston East)			Combined
		Zone 1	Zone 2	Sub-total	Central	East	Sub-total	Total
MOE Fire Flows								
Population		34,266	55,888	90,154	72,726	30,405	103,131	**193,285**
Historical Max Day Factor		1.77	1.77	1.77	1.39	1.39	1.39	1.5
Max. Day Demand	(ML/d)	43.6	65.5	109.1	84.9	29.5	114.4	215.9
Fire Flow rate	(L/s)*	354	378	378	378	325	378	378
Fire Flow Duration	(hr)*	5.0	6.0	6.0	6.0	5.0	6.0	6.0
Storage Requirements								
- Fire	(m^3)	6,372	8,165	8,165	8,165	5,850	8,165	8,165
- Equalization	(m^3)	10,910	16,365	27,276	21,222	7,370	28,592	53,970
- Emergency	(m^3)	4,321	6,133	8,860	7,347	3,305	9,189	15,534
- Total	**(m^3)**	**21,603**	**30,663**	**44,301**	**36,733**	**16,526**	**45,946**	**77,669**
Existing Storage								
- Total	**(m^3)**	**14,700**	**6,800**	**21,500**	**26,600**	**5,370**	**31,970**	**53,470**
- Total Functional	(m^3)	5,870	1,700	7,570	14,700	1,060	15,760	23,330
Storage Surplus								
- Total	**(m^3)**	**-6,903**	**-23,863**	**-22,801**	**-10,133**	**-11,156**	**-13,976**	**-24,199**
- Functional	(m^3)	-5,040	-14,665	-19,706	-6,522	-6,310	-12,832	-30,640

*Based on MOE guidelines App N Table 2
It has been assumed that the Pressure Zone 1 maximum day demand would be 40% of the total maximum day demand in Kingston West and that the Pressure Zone 2 maximum day demand would be 60% of the total maximum day demand in Kingston West

Comments for the year 2011

i) The system water storage for the independent water systems (sub-totals in **Table 3.16**) was **deficient in the year 2006 and currently** and would be more deficient in the year 2011.

ii) The system water storage for the option of an interconnected system (combined total in **Table 3.16**) for the City of Kingston, which was **adequate for the year 2006 and currently**, would become *marginally* deficient in the approximate year 2011.

iii) Water storage deficiencies appeared to be predominantly "functional" (equalization) water storage deficiencies throughout the water systems.

Comments for the year 2016

i) The water storage would be *deficient* for both the independent water systems and the option of an interconnected water system for the City of Kingston, but the total deficiency for the option of independent water systems would be approximately 13,000 m^3 versus 2,000 m^3 for the option of an interconnected water system.

ii) The water storage would be *significantly deficient* in Pressure Zone 2 of the Kingston West water system.

iii) The water storage deficiencies appeared to be predominantly equalization water storage deficiencies throughout the water systems.

Comments for the years 2026 and 2026A throughout the water systems

i) The water storage deficiencies would generally be similar to those that would occur in the study year 2016, only to a *greater extent*.

ii) The total water storage deficiency for an interconnected system for the year 2026 demands would be approximately 9,000 m^3 versus 24,000 m^3 for the study year 2026A.

3.5.2 Water storage requirement summary

The future water storage surplus for each study year for Kingston West and Kingston Central (including Kingston East) has been summarized in **Table 3.20**, on the following page. The future water storage surplus for each study year for the option of an interconnected water distribution system for the City of Kingston have been summarized in **Table 3.21**, on the following page. The calculated storage surplus shown for each study year is the difference between the existing storage and the required storage calculated for that study year, as indicated in **Table 3.16**. A negative surplus would correspond to a storage deficit. The study year 2006 data, presented in **Table 3.20** and **Table 3.21**, has been based on the information provided in **Section 2**.

Table 3.20: Water Storage Requirement Summary (Independent Systems)

	Water Storage Surplus (m^3)	
	Kingston West	Kingston Central (including Kingston East)
2006	-1,675	-1,017
2011	-7,120	-4,568
2016	-8,912	-4,385
2026	-12,872	-7,543
2026A	-22,801	-13,976

Table 3.21: Water Storage Requirement Summary (Interconnected System)

	Water Storage Surplus (m^3)
	Interconnected Water Distribution System
2006	7,514
2011	-756
2016	-2,078
2026	-8,842
2026A	-24,199

When comparing the required storage for Kingston West and Kingston Central (independently) with the storage requirements for the option of an interconnected system, it became apparent that if the two independent systems were interconnected, the required additional storage capacity would be reduced. For the study year 2026, 20,415 m^3 (12,872 m^3+ 7,543 m^3) would be required for Kingston West plus Kingston Central; whereas, for the option of an interconnected system in the study year 2026, 8,842 m^3 would be required.

It was also noted, based on the information presented in **Sub-Section 3.5.1**, that the deficiency of “functional” water storage was consistently greater than the “total” water storage deficiency. This suggested that, in addition to providing new water storage facilities, the operation of the existing water storage facilities should be examined for potential improvements in the available “equalization” storage.

3.6 Preliminary fire flow investigation

3.6.1 2006 water model simulations (maximum day demand plus fire flow)

Fire flow simulations of the H2ONET Water Distribution System model were conducted for the condition of the maximum day demand for the study year 2006 in order to identify system constraints with respect to supplying water to fight a fire under the following conditions:

i) Fire flow requirement = 378 L/s (5,000 gpm)

ii) Residual pressure = 150 kPa (21.75 psi), as recommended by the Kingston Fire Department (friction losses from the watermain to the point of hydrant discharge)

iii) Fire flow duration = 6 hours
(Current MOE Guidelines for fire flow and duration requirements)

Fires were simulated in Kingston West, Kingston Central and Kingston East, for the study year 2006, in selected locations that could most likely require a fire flow of the selected fire flow and duration. In addition, the City of Kingston Fire Department was contacted to provide additional locations of high risk. It should be noted that Invista is currently provided with its own fire mains (non-drinking water) and fire flow pumping equipment (with a dedicated water intake).

The City of Kingston Fire Department identified several high-risk locations including:

i) The Petro Canada fuel storage tanks on Sydenham Road (just south of the 401 on the east side of Sydenham Road). This location is currently serviced by a 300 mm dead-end watermain (with reportedly low pressure) that extends north of the 401 to supply drinking water to City of Kingston users in the Aylesworth area

ii) The commercial area located on Princess Street near Montreal Street (large number of connected, century buildings, generally constructed of wood and in close proximity to the Hospital)

Kingston West – Pressure Zone 2b (Sysco)

Available fire flow: **378 L/s** (5000 gpm)

Fire flow duration: 6 hours

Residual pressure: 150 kPa (21.75 psi)

The Creekford Road Elevated Water Storage Tank and the Gardiners Road Booster Station, together, were able to supply the required fire flow when two 9.85 ML/d pumps were both operating in parallel (upgrade currently in progress).

Kingston West – Pressure Zone 2c (Fuel Storage Tanks on Sydenham Road)

Available fire flow: 105 L/s (1,400 gpm)

Fire flow duration: 6 hours

Residual pressure: 150 kPa

The Industrial Park Reservoir and Sydenham Road Booster Station supply the fire flow to the areas of the fuel storage tanks on Sydenham Road (just south of the 401). It would not be possible to provide a flow of 378 L/s to this area (negative pressures are observed) due to the single, 300 mm watermain that supplies this area. With a residual pressure of 150 kPa, the available amount of water flow would be 105 L/s. It was noted that a 400 mm watermain has been proposed along Cataraqui Woods Drive to connect to Sydenham Road. This watermain would likely improve the fire flow for the Petro Canada fuel tanks location.

Kingston Central (Novelis)

Available fire flow: 310 L/s (4,100 gpm)

Fire flow duration: 6 hours

Residual pressure: 150 kPa

The Third Avenue Reservoir and the Tower Street Elevated Tank supply the fire flow to the northern access point of the Novelis property. For a fire flow of 378 L/s, the required residual pressure (150 kPa) was not available. This was due to high head losses in the watermains providing water flow to this location. With a residual pressure of 150 kPa, the available amount of water flow would be 310 L/s (reasonable).

Kingston Central (Princess at Montreal Street)

Available fire flow: 378 L/s (5,000 gpm)

Fire flow duration: 6 hours
Residual pressure: 150 kPa

The Third Avenue Reservoir and the Tower Street Elevated Tank were able to supply the fire flow to the central business area of downtown Kingston.

Kingston East – Northern portion (Startek)

Available fire flow: 220 L/s (2,900 gpm)

Fire flow duration: 3 hours

Residual pressure: 150 kPa

The Gore Road Standpipe and James Street BS supply the fire flow to the most northern portion of Kingston East. It was possible to provide the required fire flow of 220 L/s, based on the MOE Guidelines, to this area with a residual pressure of 150 kPa. It was noted that the proposed installation of an additional 400 mm watermain north from the Gore Road Standpipe to Innovation Drive In addition to the existing 300 mm and 400 mm watermains) would only serve to further improve, the already sufficient, fire flow (desirable).

Kingston East (CFB Kingston)

Available fire flow: 378 L/s (5,000 gpm)

Fire flow duration: 6 hours

Residual pressure: 150 kPa

The DND Elevated Tank and James Street BS were able to supply the required fire flow in the event of a major fire on the CFB Kingston property.

3.6.2 Fire flow requirements

For *two* independent water supply and distribution systems (and the associated water storage and high lift and booster pumping stations), it would be required that each water supply and distribution system must be able to provide the required water flow for *one* fire that could potentially occur in *both* independent water supply and distribution systems; accordingly, each water supply and distribution system would need to be capable of providing the selected fire flow of 378 L/s (i.e., a major fire would be considered capable of occurring in *each* water supply and distribution system or, *two* fires); hence, increasing the drinking water supply, storage and water distribution system requirements for each of the two independent water supply and distribution systems.

If the two independent water supply and distribution systems were *interconnected* to form only *one* system, the selected fire flow of 378 L/s would be deemed to occur in only *one* location within an interconnected City of Kingston water supply and distribution system; hence, reducing the required fire storage and distribution system requirements. The option of an interconnected water supply and distribution system would *significantly* reduce the required fire water supply storage and distribution system requirements.

Potentially, this could reduce the capital cost for additional water infrastructure and the associated maintenance for Utilities Kingston. If, for the option of an interconnected water supply and distribution system, the capability of fighting *two* major fires, simultaneously, was deemed necessary, this would impact the maximum day plus fire flow requirements significantly. The current Fire Underwriters Survey guidelines indicates that it would *not generally* be necessary to allow for *two* simultaneous major fires in a *single* water supply and distribution system for a combined population of less than 250,000 (the approximate projected future population for the City of Kingston).

3.7 Major water facilities requirements

The future water supply and storage requirements that have been presented in **Sub-Section 3.5** indicate the requirement for certain major infrastructure upgrades to the City of Kingston water supply and distribution systems.

3.7.1 Water supply

Projected future water demands identify that there will be a need for an increase in water treatment plant water supply capacity. The majority of the growth in the City of Kingston has been projected to occur in Kingston West; accordingly, it appears logical that a water treatment plant water supply capacity increase be provided in Kingston West, at the Kingston West WTP.

A new green-field, water treatment plant, to supply all drinking water to an interconnected water supply and distribution system could also be provided at an appropriate location.

3.7.2 Water storage

It was identified in **Sub-Section 3.5** that there will be deficiencies in the required storage throughout the City of Kingston water distribution systems. Kingston West, Pressure Zone 2 is a location with a “significant” water storage deficit. In addition, Kingston West, Pressure Zone 2, is an area where the increase in water demand through the selected future study years will significantly increase. Furthermore, based on the results of the fire flow simulations for the 2006 water model, the Gardiners Road BS has been relied upon to supply the fire flow from Pressure Zone 1 to Pressure Zone 2; accordingly, it has been identified that additional storage within Kingston West, Pressure Zone 2, should be provided to minimize the reliance on the

Gardiners Road BS to supply the required fire flow. Potentially, increased water storage and the associated pumping facilities at the Industrial Park Reservoir and pumping station (generally returning water to Pressure Zone 1) could assist in supplying water to Pressure Zone 1, hence to Pressure Zone 2.

A water storage deficit has also been identified in Kingston East. One of the major areas of growth that will potentially occur would be in the northern portion of Kingston East [UGS, Growth Alternative 2A (East)]. This area will consist of both residential and ICI development. Modelling results of the fire flow simulation for the study year 2006 identified that the Kingston East water distribution system would *not* currently be able to provide the required fire flow to the northern portion of Kingston East; accordingly, an additional water supply to the northern portion of Kingston East would be required to provide this fire flow. The additional water supply could be provided by either an in-ground reservoir and high lift pumping station in the northern portion of Kingston East, along Kingston Highway 15, or a booster pumping station in a similar location and potentially an increased diameter watermain to an elevated water storage tank located at the northern boundary of GA2 (East).

3.8 Preliminary observations and recommendations

The following early observations were further investigated during the more detailed investigations in the Master Plan Report:

i) Water treatment and storage capacity deficiencies would need to be addressed in the *near* term, as well as in the long term.

ii) The option of interconnecting the Kingston West and the Kingston Central (including Kingston East) water supply and distribution systems would reduce the total water storage and treatment water supply capacity deficiencies that would need to be addressed and would also have other distribution benefits (e.g., reducing existing and potential areas of low water pressure and other).

iii) “Equalization” storage in Kingston West would be required for Pressure Zone 2 in the general vicinity of the existing Gardiner's Road Booster Station in conjunction with increased high lift pumping capacity to satisfy the identified fire flow requirements.

iv) Elevated water storage at the north end of GA2 (East) or a below-ground reservoir and high lift pumps at a suitable location would be required to reduce the existing storage deficit in an interconnected City of Kingston system, to provide equalization water storage in Kingston East and to provide the required fire flows in Kingston East.

END

MODELLING ASSUMPTIONS AND CRITERIA FOR THE SELECTION OF ALTERNATIVE SOLUTIONS TO THE "PROBLEM STATEMENT"

4 Modelling Assumptions and Criteria for the Selection of Alternative Solutions to the "Problem Statement"

4.1 Introductory remarks

The modelling assumptions and criteria was submitted to Utilities Kingston for review and confirmation prior to modelling each selected alternative to address the "Problem Statement" for the Master Plan for Water Supply for the City of Kingston Urban Area.

The "Problem Statement" established for this Master Plan and Class Environmental Assessment [to be completed to the end of Phase 2 (selection of the preferred alternative)] has been indicated in **Section 1**.

The following documentation has been provided in **Section 2**:

i) The Kingston West WTP and the Kingston Central WPP "rated" and "functional" capacities.

ii) The Kingston West and Kingston Central (including Kingston East) water distribution systems facilities (including the installed high lift and booster pumps pumping capacities, the water storage "rated" and "functional" capacities and operational considerations).

iii) The study year 2006 Kingston West and Kingston Central (including Kingston East) water storage requirements and the Kingston West and Kingston Central (including Kingston East) water distribution systems operational considerations.

iv) The historical water supply flow data, for the study years 2003, 2004 and 2005, including the calculated historical average day, the maximum day and peak hour flow data and the associated maximum day and peak hour to average day demand factors.

The following documentation has been provided in **Section 3**:

i) Future drinking water demands for the study years 2011, 2016 and 2026 (for Growth Alternative 2 (GA2, East and West) of the City of Kingston, Urban Growth Strategy (UGS) 2004. In addition, the drinking water demands for an "expanded study area" [additional potential development areas, as provided in the UGS 2004, for the study year 2026 (2026A)] was provided.

ii) A review of the historical peaking factors for Kingston West, Kingston Central and Kingston East. Based on this review of the historical peaking factors, the peaking factors to be applied to the projected future average day demands were determined for Kingston West, Kingston Central (including East) and the City of Kingston (interconnected system).

iii) The maximum day demand versus the water treatment plant “functional” capacities for Kingston West, Kingston Central (including Kingston East) and an interconnected City of Kingston drinking water supply system.

iv) The water storage requirements for Kingston West, Kingston Central (including Kingston East) and for an interconnected City of Kingston system for the study years 2011, 2016, 2026(including 2026A).

Distribution system modelling has provided the basis with which technically feasible alternatives were subsequently identified (**Section 5**) and to the alternative solutions to address the problem statement were developed and updated (**Section 7**), including the technical/operations considerations and estimated capital cost comparisons in order to address the “Problem Statement”, following.

In order to proceed with the required modelling of the water distribution system it was first necessary to confirm the water modelling assumptions and criteria and identify the scenarios that would be modelled.

4.2 Year 2006 Water Model update

4.2.1 General

The “Water Distribution System Computer Model” was updated in 2002 and used in 2004 during the Urban Growth Strategy to provide general recommendations for future water supply and distribution system upgrades.

Upon review of the existing water supplies and distribution systems, the water model has been updated to reflect the existing conditions in the year 2006. This updated model was the base model from which future scenarios for the study years 2011, 2016, 2026 and 2026A were developed. The updates incorporated into the year 2002 water model to be representative of the year 2006 Kingston West and Kingston Central (including Kingston East) water supplies and distribution systems have been indicated in **Sub-Section 4.2.2**, following.

Potential future water supply and distribution system upgrades selected for modelling have incorporated a review of previous reports and the existing water supply and distribution system facilities. Watermain installations and other related facilities to potentially interconnect the two independent water supply and distribution systems would also be based on a review of previous reports and a review of the most effective interconnection locations (including the existing watermain sizes). Simulation of the updated 2006 system would also provide an indication of the locations of *existing* water supply and distribution system constraints.

4.2.2 Drinking water supply and distribution facilities upgrades

a) Water treatment plant upgrades

Significant upgrades were completed at the Kingston West WTP and the Kingston Central WPP in the years prior to the year 2003 and these upgrades have been reflected in the flows from both plants for the years 2003, 2004 and 2005. The current “functional” capacities of the two water treatment plants (provided in **Section 2**) have been used in the water system modelling.

b) Water storage facilities upgrades

The Creekford Road Elevated Water Storage Tank has been constructed and has been incorporated into the water model.

The water storage facilities were documented in **Section 2** and **Section 3.** All water storage facilities have been modelled based on the “functional” capacities for average day, maximum day and peak hour demand conditions. For fire flow scenarios, the “rated” capacities of water storage facilities have been modelled, allowing for the water storage reservoir levels to drop below normal “functional” operating ranges in order to supply water to a potential fire.

c) Booster pumping station upgrades

The Gardiners Road BS is in the process of being upgraded [one additional – 9.85 ML/d booster pump (identical to the existing high capacity 9.85 ML/d booster pump)] by Utilities Kingston. The two booster pumps (with identical capacities) would act as a duty and a standby booster pump under normal conditions; however, the two booster pumps would be (and must be) capable of operating in parallel during high water demand conditions. For all modelling, it has been assumed that the current upgrades are in place.

The pump curves for all pumps have been retained from the 2002 Computer Model Update and have been used for all modelling.

d) Watermain installations

The following major watermains upgrades (completed since the 2002 Model Update) have been incorporated into the year 2006 model:

i) A 500 mm watermain on Division Street, from Railway Street to Elliot Street.

ii) A 500 mm watermain from Division Street and Railway Street to Alfred Street and Carlton Street.

iii) A 450 mm watermain across the Great Cataraqui River, from Cataraqui Street to James Street.

iv) A 450 mm easterly leg of the Creekford Road trunk watermain, connecting the Creekford Road Elevated Water Storage Tank to Gardiners Road.

v) A 400 mm Centennial Drive watermain in conjunction with the railway grade separation.

Other new watermains and watermain upgrades were incorporated into the water model based on the AutoCAD water distribution system and contour mapping provided by Utilities Kingston. These included watermains in new development areas; such as, Kingston Highway 15 in the area of Innovation Dr., Cataraqui Woods Subdivision (Juniper Dr. and Peachwood St.), Centennial Dr. in the area of Taylor Kidd Blvd. and Kingsdale Ave., areas north of Princess St. including Centennial Dr., Augusta Dr. and Anderson Dr. and in the area of Bayridge Dr. and Conservatory Dr.

e) Hazen-Williams C factors

The Hazen-Williams 'C' factors used for watermains in the year 2002 distribution system model have been retained. The 'C' factors for any recently constructed or future watermains would be based on the MOE Design Guidelines, as shown in **Table 4.1**.

Table 4.1: Hazen-Williams C Factors

Pipe Diameter (mm)	C Factor
150	100
200-250	110
300-600	120
>600	130

f) Motorized water distribution system control valves

The two motorized control valves in Kingston East (controlling the water flow to the Gore Road Standpipe and the Milton Avenue Standpipe) have been incorporated into the water model.

g) Pressure relief valves

The existing pressure relief valves at the Sydenham Road booster pumping station and the Collins Bay Road booster pumping station (both maintaining the booster station discharge pressure below 640 kPa) have been incorporated into the water model.

4.3 Assumptions and criteria for future modelling

4.3.1 Water demand allocation

The projected average day water demand [including the residential, industrial/commercial/institutional (ICI) and "unaccounted for" water] for study years 2011, 2016, 2026 and 2026A has been indicated in **Section 3**. The method used to allocate the projected water demand throughout the water distribution system, in the water model, has been outlined in the following Items.

a) Average day residential demand

An average day residential demand of 350 litres per capita per day (Lpcd) has been used. Residential demand has been apportioned to nodes throughout the distribution system based on the population in each census tract/dissemination area.

b) ICI water demand

The ICI water demand projections have been indicated in **Section 3**. The ICI water demand includes the 75 largest water users as provided by Utilities Kingston (year 2005 metered usage), as well as all other water demands from industrial, commercial and institutional facilities.

For modelling, the water demand of the largest water users (applied to the nearest node) has been retained. All other future ICI water demand has been apportioned in the following manner: 80% to the nodes in the well-defined, ICI locations and 20% evenly throughout the water distribution systems.

c) "Unaccounted for" water demand

The "unaccounted for" water has been indicated in **Section 3**. The "unaccounted for" water has been apportioned evenly throughout the water distribution systems.

4.3.2 Water demand peaking factors

The demand factors established in **Section 3** have been used in all water modelling for the selected future study years for the alternatives of the continued use of two independent water supply and distribution systems [Kingston West and Kingston Central (including Kingston East)] and an interconnected City of Kingston water supply and distribution system.

A summary of the peaking factors has been indicated in **Table 4.2.**

Table 4.2: Peaking Factor Summary

Kingston West		Kingston Central (including Kingston East)		City of Kingston (interconnected system)	
MD	PH	MD	PH	MD	PH
1.77	2.72	**1.39**	1.89	**1.50**	2.12

4.3.3 Modelling assumptions

The following assumptions have been made in developing the water system model for all scenarios:

i) The “functional” (actual water supplied) versus the “rated” capacity of the existing water treatment plants have been used in all water system modelling.

ii) The “functional” (actual available water) versus the “rated” capacity of the water storage reservoirs has been used in all water system modelling, except for the maximum day plus fire flow condition in which the rated capacities of storage facilities have been modelled.

iii) For modelling the average day and maximum day plus fire flow conditions, it has been assumed that the water levels in all elevated water storage tanks and standpipes and below-ground water storage reservoirs, at the starting points of all modelling runs, would be at the mid-point elevation of the “functional” capacity.

iv) For modelling of the peak hour flow, it has been assumed that the water levels in all elevated water storage tanks and below-ground water storage reservoirs at the starting points of all modelling runs would be at the 25 per cent full elevation of the “functional” capacity.

v) For all modelling, it has been assumed that the Kingston Highway 15 and the MTO Highway 2 motorized control valves would be closed only when the standpipe was full and open only when the water level in standpipe was at the bottom elevation of the “functional” capacity.

4.3.4 Modelling criteria

For all modelling scenarios (alternatives to be considered), the following criteria have been selected.

a) Minimum and maximum required water distribution system pressures

The required minimum water distribution system pressure would be 275 kPa (40 psi).

The maximum allowable water distribution system pressure would be 690 kPa (100 psi).

b) Fire flows

A maximum fire requirement of 378 L/s (5,000 gpm), continuous for six hours at a residual pressure of 150 kPa (21.75 psi), has been used, where appropriate.

4.4 Modelling scenarios

4.4.1 General

The modelling scenarios outlined below have been developed to identify the alternative solutions that would satisfy the future water supply and storage requirements indicated in **Section 3**. Based on the maximum day demand projections, if the two water distributions systems remain independent, the "functional" capacity of the Kingston Central WPP would be sufficient to supply Kingston Central (including Kingston East) until the study year 2026 and the Kingston West WTP would need to be expanded. It was also identified in **Section 3** that if the two systems were interconnected there would be reduced infrastructure requirements and other operational benefits. Accordingly, the modelling scenarios have considered both independent and interconnected systems. The feasibility and additional required infrastructure associated with interconnecting the two water systems has been investigated through modelling.

The modelling scenarios considered practical methods of meeting the water system requirements in each of the study years 2011, 2016 and 2026. Each modelling scenario has been completed with the intent to determine infrastructure upgrades required to satisfy the system pressure and fire flow criteria (e.g., reservoirs, the size and location of potential new watermains and booster stations, as well as changes to existing pressure zone boundaries).

4.4.2 Future scenarios

For each scenario, the changes to the existing City of Kingston water distribution system have been indicated in **Table 4.3**. For each scenario the maximum day demand plus fire flow and the peak hour demand has been simulated.

Table 4.3: Modelling Scenarios

Scenario	Drinking Water Supply	New Water Storage	Interconnection Locations
1 - 2011 Demands Independent systems	Increased supply from Kingston West WTP Maintain "functional" capacity of Kingston Central WPP	West: O'Connor Drive location in-ground reservoir and pumping station Central: Additional storage in 3rd Ave. reservoir or in a new location	N/A
2 - 2011 Demands Interconnected systems	Increased supply from Kingston West WTP Maintain "functional" capacity of Kingston Central WPP	West: O'Connor Drive location in-ground reservoir and pumping station	Open Bath Road valve 400 mm watermain on Princess Street
3 - 2016 Demands Independent systems	Increased supply from Kingston West WTP Maintain "functional" capacity of Kingston Central WPP	West: O'Connor Drive location in-ground reservoir and pumping station Central: Additional storage in 3rd Ave. reservoir or in a new location	N/A
4 - 2016 Demands Interconnected systems	Increased supply from Kingston West WTP Maintain "functional" capacity of Kingston Central WPP	West: O'Connor Drive location in-ground reservoir and pumping station	Open Bath Road valve 400 mm watermain on Princess Street 400 mm watermain on John Counter Blvd. Large diameter watermain connecting the existing Kingston West WTP discharge pipes on Front Road to the end of the 450 mm watermain on King Street.
5 - 2026 Demands Independent systems	Increased supply from Kingston West WTP Maintain "functional" capacity of Kingston Central WPP	West: O'Connor Drive location in-ground reservoir and pumping station Central: Additional storage in 3rd Ave. reservoir or in a new location East: Gore Rd. location in-ground reservoir and pumping station	N/A
6 - 2026 Demands Interconnected systems	Increased supply from Kingston West WTP Maintain "functional" capacity of Kingston Central WPP	West: O'Connor Drive location in-ground reservoir and pumping station East: Gore Rd. location in-ground reservoir and pumping station	Open Bath Road valve 400 mm watermain on Princess Street 400 mm watermain on John Counter Blvd. Large diameter watermain connecting the existing Kingston West WTP discharge pipes on Front Road to the end of the existing 450 mm watermain on King Street

7 - 2026 Demands Interconnected systems	Increased supply from Kingston West WTP to supply entire City of Kingston distributions systems Retire Kingston Central WPP	West: O'Connor Drive location in-ground reservoir and pumping station East: Gore Rd. location in-ground reservoir and pumping station	Open Bath Road valve 400 mm watermain on Princess Street 400 mm watermain on John Counter Blvd. Large diameter trunk watermain connecting the existing discharge headers from the Kingston West WTP and the Kingston Central WPP
8 - 2026 Demands Interconnected systems	New water treatment plant Retire Kingston West WTP Retire Kingston Central WPP	West: O'Connor Drive location in-ground reservoir and pumping station East: Gore Rd. location in-ground reservoir and pumping station	Open Bath Road valve 400 mm watermain on Princess Street 400 mm watermain on John Counter Blvd. Large diameter trunk watermain connecting the existing discharge headers from the Kingston West WTP and the Kingston Central WPP

4.4.3 Discussion regarding scenarios

i) For each scenario, the requirement for additional storage and pumping capacity to supply Pressure Zone 2 has been identified and, based on the infrastructure in place, a reservoir location close to O'Connor Drive has initially been selected. It might be determined through modelling that an alternate location could be more suitable (potential land availability and other).

ii) For each interconnected system scenario, any potential requirement for two-way flow booster pumping stations at some of the potential interconnection locations has been investigated.

iii) For scenarios 2 and 4, the requirement for additional storage in Pressure Zone 1 (Kingston West, Pressure Zone 1 and Kingston Central) has been identified through modelling the maximum day plus fire flow demand and the peak hour demand.

iv) For scenarios 5, 6, 7 and 8, the potential location of an in-ground reservoir and pumping station in the northern portion of Kingston East, along Kingston Highway 15, has been investigated. An in-ground reservoir and pumping station at this location has also been investigated considering the potential provision of a third watermain across the Great Cataraqui River (potentially dependent on the third highway river crossing).

If this interconnecting watermain across the Great Cataraqui River were not provided, potentially an in-ground reservoir and pumping could still address the required water storage requirements to service the most northerly location of Kingston East [including GA2 (East)]. This has been confirmed by modelling. A third Great Cataraqui River watermain has been reviewed based on a “stand-alone” reservoir and pumping station along Kingston Highway 15.

v) For scenario 7, the large diameter trunk watermain (size determined by modelling) would be approximately five kilometres in length with no intermediate connections to the existing water distribution systems. This would allow flows to be delivered directly to the bottom of the existing Kingston Central water distribution system, and subsequently to Kingston East, from an "increased" water supply capacity Kingston West WTP to supply the water demands for the City of Kingston. This large diameter trunk watermain could potentially be installed prior to 2026, as it would provide the “identified” potential emergency drinking water supply to Kingston West and to Kingston Central (including Kingston East).

vi) For scenario 8, for modelling purposes *only*, Lake Ontario Park was selected as the location for a new water treatment plant, as this location is located at the near mid-point of the two existing water treatment plants. This modelled location would be representative of a new water treatment plant positioned at any location from the Kingston West WTP to the Kingston Central WPP. The Lake Ontario Park site has been further addressed in **Item 6.5.2**, iv), in **Section 6**.

vii) For each scenario, new watermains in development areas, including GA2 (West), GA2 (East) and Cataraqui North (including the proposed 400 mm watermain on Cataraqui Woods Drive, from Clyde Court to Sydenham Road), would be installed based on the development schedules.

viii) For each scenario, other necessary water distribution systems modifications have been determined (e.g., watermain and booster pumping station upgrades). This also included the following two items, previously identified: the installation of a second discharge header from the Kingston West WTP to provide a security of supply from the plant to the water distribution system (considered in place for the modelling study year 2016) and the installation of an additional watermain, from the Kingston West WTP to north of Bath Road (potentially along Bayridge Drive), as an additional water supply to Pressure Zone 2.

4.4.4 2026A modelling scenario

The modelling scenario for the 2026A “expanded study area” (identified in **Section 3**) has been determined after a preliminary evaluation of the various scenarios for the study year 2026.

4.5 Master Plan alternatives

The Master Plan alternatives have been provided once the modelling for the listed scenarios (and potentially other scenarios determined during modelling) was completed. Realistic alternatives have been determined, confirmed by modeling, and have been provided in **Section 5** (Technically Feasible Alternatives to Address the Problem Statement for the Master Plan), following.

END

TECHNICALLY FEASIBLE ALTERNATIVES, INCLUDING TECHNICAL CONSIDERATIONS, TO ADDRESS THE "PROBLEM STATEMENT"

5 Technically Feasible Alternatives, Including Technical Considerations, to Address the "Problem Statement"

5.1 Introduction

The support information to provide the technically feasible alternatives, including technical considerations, to address the "Problem Statement" was considerable. In order to provide the information in a concise manner, for ease of presentation, Section 5 has been prepared in a summary format.

The more detailed Section 5, "Technically Feasible Alternatives, Including Technical Considerations, to Address the "Problem Statement", has been provided in **Appendix A**, Tab 10, for reference.

5.2 General

The various scenarios to address the "Problem Statement" have been presented in **Section 4**.

The criteria and assumptions, on which the scenarios were based, were also presented in **Section 4**.

Scenarios were presented for the study years 2026, 2016 and 2011.

Modelling was provided for the year 2006 to determine the status of the water supply and distribution system, as current.

Four technically feasible alternatives have been determined: an independent Kingston West and an independent Kingston Central (including Kingston East) water supply and distribution system, an interconnected City of Kingston water supply and distribution system (with water supplied from both the Kingston West WTP and the Kingston Central WPP), an interconnected City of Kingston water supply and distribution system (with water supplied from an expanded Kingston West WTP, with the Kingston Central WPP no longer in service) and an interconnected City of Kingston water supply and distribution system (with water supplied from a new water treatment plant, with the Kingston West WTP and the Kingston Central WPP no longer in service).

The four identified alternatives have been referred to as:

i) <u>Alternative 1</u> - Independent Kingston West and Kingston Central (including Kingston East) water supplies and distribution systems

ii) <u>Alternative 2</u> - Interconnected water supplies (expand the Kingston West WTP and maintain the Kingston Central WPP in operation) and distribution systems servicing the City of Kingston

iii) Alternative 3 - Interconnected water supply (retire the Kingston Central WPP and provide the total water supply from the Kingston West WTP) and distribution systems servicing the City of Kingston

iv) Alternative 4 - Interconnected water supplies (retire the Kingston Central WPP and retire the Kingston West WTP and provide a new, “green-field” water treatment plant) and distribution systems servicing the City of Kingston

Modelling has been completed for all scenarios (independent and interconnected) for the study years 2011, 2016 and 2026.

The locations for potential “high-risk” fires have been based on knowledge of the City of Kingston and discussions with the City of Kingston Fire Department. The Fire Underwriters Survey and the MOE Guidelines indicates that fighting only one fire for a single water supply and distribution system (similar in size to the future population for the City of Kingston) is generally the accepted practice; accordingly, *one* fire occurrence only has been modelled for each independent water supply and distribution system and for an interconnected City of Kingston water supply and distribution system.

Modelling has also been completed for the expanded City of Kingston study area, referred to as 2026A for the preferred alternative, *only*.

The accepted approach for determining the progressive water supply and water distribution system watermains and facilities requirements in future study years is to model for the most future study year (2026) and then model progressively backwards (i.e., the study year 2026, the study year 2016 and then the study year 2011). This modelling approach would provide additional watermains and infrastructure to be provided in the earlier study years based on the most future design requirements (i.e., avoids the potential need to replace watermains, if sized only to accommodate the more current study year being modelled and would allow potential phasing of water supply and water storage and the associated pumping stations and booster pumping stations).

For additional in-ground storage at high lift pumping and storage facilities throughout the water distribution system, such as the Third Avenue Reservoir and the Industrial Park Reservoir (Progress Avenue Reservoir), it has been assumed that additional expansions would be constructed at elevations generally identical to those of the existing cells. The old and new cells would be hydraulically connected to operate together with the identical overflow levels, top water levels, and low water levels (for pump protection or other constraints). It has been assumed that the cells would act together to “turn over” the water in both the old and new cells (required). The normal operating range would be adjusted to reflect the new total fire and emergency storage volumes below, and the new total equalization storage above the fire storage volume.

5.3 Alternatives

5.3.1 General

Reference should be made to **Section 3** for all values used in this Section.

Modelling of the independent and an interconnected water supply and distribution system scenarios for the study year 2011 identified certain existing water supply and distribution system deficiencies that need to be addressed in the near term. The modelling for the study year 2026 scenario allowed the identified deficiencies to be addressed such that the more immediate, required watermains and water supply and distribution systems facilities could be provided to accommodate the future requirements.

Modelling has been carried out to confirm the technically feasible alternatives presented in this Section.

Additional information relevant to **Section 5** has been provided in **Section 7**; wherein, the Alternatives being considered were further updated, following the Public information Centres, as applicable, and the estimated costs of the "rated" increase in the water treatment plants, the "calculated" water storage capacities to provide the "modelled" storage requirements in the proposed new and expanded reservoirs, the pumping station requirements and all watermain requirements (new distribution and interconnecting watermains) have been listed for each Alternative for the study year 2026, including the estimated costs (**Table 7.7**).

5.3.2 Summary of the "functional" water supply, "functional" water storage, pumping stations, watermains requirements for Alternatives 1, 2, 3 and 4 for the study years 2011, 2016 and 2026

i) Water treatment plants

The "functional" water supply is the water available to be pumped into the water distribution system for use.

The "rated" capacity of the required Kingston West WTP *expansions* (existing "rated" capacity of 45.5 ML/d and a "functional" water supply capacity of 41 ML/d) has been estimated by increasing the "functional" required increase in the water supply capacity of the plant by six per cent (6%), to account for in plant water uses (such as filter back washing). It has been assumed that the "functional" water supply capacity of the Kingston Central WPP will remain as current (95 ML/d) for all study years.

ii) Water storage reservoirs

The “modelled” required storage capacity of proposed new and expansions to existing water storage reservoirs would be increased based on the “calculated” storage capacity required to provide the “modelled” proposed new and expansions to existing water storage reservoirs. The “calculated” proposed new or expansions to water storage reservoirs would be greater in order to account for unusable storage (based on the existing reservoirs “functional” water storage capacity and the practical issues associated with the operation of reservoirs and also the site conditions).

A summary of the “functional” water supply, “functional” water storage, pumping stations, watermains requirements for Alternatives 1, 2, 3 and 4 for the study years 2011, 2016 and 2026 has been provided in **Table 5.1**, on the following page.

It should be noted that the water supply capacities of the Kingston West WTP expansions and the proposed new and expansions to water storage reservoirs have been indicated as the “functional” capacities, only. The “rated” water supply and the “calculated” water storage capacities have been used in the infrastructure cost table (**Table 7.7**) in **Section 7**.

It should also be noted that based on the water supply and water storage requirements for the study years 2011, 2016 and 2026, the provision of the study year 2026 requirements should be provided for the study year 2011. The required watermains should be provided as required for the study years 2011, 2016 and 2026.

Once the preferred solution has been selected, an “expanded study area” (increased development and population) will be reviewed (**Section 9**), based on the selected preferred solution.

Table 5.1 – Required Infrastructure for Alternatives 1, 2, 3 and 4 for the Study Years 2011, 2016 and 2026

Study Year 2011																
	Alternative 1				Alternative 2				Alternative 3				Alternative 4			
Infrastructure Requirements	**West**	**Central**	**East**	**Suggest**	**West**	**Central**	**East**	**Suggest**	**West**	**Central**	**East**	**Suggest**	**West**	**Central**	**East**	**Suggest**
Kingston Water Treatment Plants																
West WTP "functional" increase (ML/d)	18			Provide 36	5			Provide 31	100			Provide 126	Retire			
Central WPP "functional" supply (ML/d)		95				95				Retire				Retire		
New water treatment plant (ML/d)													141			Provide 167
Water Storage Reservoirs																
Industrial Park Reservoir expansion ("modelled")	8.2			Provide 10.1	Not required				Not required				Not required			
New O'Connor Drive Reservoir ("modelled")	7.4			Provide 9.6	6					6		Provide 8	6			Provide 8
Third Avenue Reservoir expansion ("modelled")		No change				4				4		Provide 4.7		4		Provide 4.7
New Kingston Highway 15 Reservoir ("functional")			4.1	Provide 6.4			6.4				6.4				6.4	
Booster and Pumping Stations (BS&PSs)																
Industrial Park Reservoir PS (ML/d)	19.9 (ex. pumps)			Pumps evaluated	19.9 (ex. pumps)			Pumps evaluated	19.9 (Ex. pumps)			Pumps evaluated	19.9 (Ex. pumps)			Pumps evaluated
Third Avenue Reservoir PS (ML/d)		33.7		Replace with 35		33.7		Replace with 35		<29.1		Pumps evaluated		<29.1		Pumps evaluated
New O'Connor Drive PS (ML/d)	35				35				35				35			
New Kingston Hwy. 15 PS (ML/d)			19				19			19				19		
James Street BS			12.5	Existing 18.2			12.5	Ex. 18.2			12.5	Ex. 18.2			12.5	Existing 8.2
Gardiners Road BS	Retired				Retired					Retired				Retired		
Sydenham Road BS	Retired				Retired					Retired				Retired		
Old Colony Road BS	Retired				Retired					Retired				Retired		
Collins Bay Road BS	Retired				Retired					Retired				Retired		
Watermains																
New 900 mm discharge watermain from the Kingston West WTP	X				X				X				N/A			
New 600 mm watermain on Front Rd. (Days Rd. to Bayridge Dr.)	X				X				X				X			
New 600 mm watermain on Bayridge Dr. (Acadia Dr. to Taylor Kidd Blvd.)	X				X				X				X			
New 600 mm watermain on O'Connor Dr. (O'Connor Drive PS to Gardiners Rd.)	X				X				X				X			
New 600 mm watermain on Gardiners Rd. (O'Connor Dr. to Cataraqui Woods Dr.)	X				X				X				X			
New 400 mm watermain on Avenue Rd. (Princess St. to McMahon Ave.)	X				X				X				X			
New 500 mm watermain on Third Ave. (MacDonnell St. to Alfred St.)		X				X				X				X		
New interconnecting 400 mm watermain on Princess St.					X				X				X			
New interconnecting 400 mm watermain on John Counter Blvd.					X				X				X			
New interconnecting 1050 mm on Front Rd./King St. W. required length (km)									2				5			Complete

Study Year 2016																
	Alternative 1				Alternative 2				Alternative 3				Alternative 4			
Infrastructure Requirements	**West**	**Central**	**East**	**Suggestions**	**West**	**Central**	**East**	**Suggestions**	**West**	**Central**	**East**	**Suggestions**	**West**	**Central**	**East**	**Suggestions**
Kingston Water Treatment Plants																
West WTP "functional" increase (ML/d)	18			Provide 36	9			Provide 31	104			Provide 126	Retire			
Central WPP "functional" supply (ML/d)		95				95				Retire				Retire		
New water treatment plant													145			Provide 167
Water Storage Reservoirs																
Industrial Park Reservoir expansion ("modelled")	8.2			Provide 10.1	Not required				Not required				Not required			
New O'Connor Drive Reservoir ("modelled")	7.4			Provide 11.3	6.5			Provide 8	6.5			Provide 8	6.5			Provide 8
Third Avenue Reservoir expansion ("modelled")		5.8		Provide 6.2		4.7				4.7				4.7		
New Kingston Highway 15 Reservoir ("functional")			6.4				6.4				6.4				6.4	
Booster and Pumping Stations (BS&PSs)																
Industrial Park Reservoir PS (ML/d)	19.9 (existing)			Pumps evaluated	19.9 (existing)			Upgrade Pumps	19.9 (Ex.)			Upgrade Pumps	19.9 (existing)			Pumps evaluated
Third Avenue Reservoir PS (ML/d)		33.7		Replace with 35		33.7		Replace with 35		<29.1		Pumps evaluated		<29.1		Pumps evaluated
New O'Connor Drive PS (ML/d)	9.6				7.4			Provide 9.6	7.4			Provide 9.6	7.4			Provide 9.6
New Kingston Hwy. 15 PS (ML/d)			19				19				19				19	
James Street BS			15	Existing 18.2			15	Existing 18.2			15	Existing 18.2			15	Existing 18.2
Gardiners Road BS	Retire															
Sydenham Road BS	Retire															
Old Colony Road BS	Retire															
Collins Bay Road BS	Retire															
Watermains																
New 900 mm discharge watermain from the Kingston West WTP	X				X				X							
New 600 mm watermain on Front Rd. (Days Rd. to Bayridge Dr.)	X				X				X				X			
New 600 mm watermain on Bayridge Dr. (Acadia Dr. to Taylor Kidd Blvd.)	X				X				X				X			
New 600 mm watermain on O'Connor Dr. (O'Connor Drive PS to Gardiners Rd.)	X				X				X				X			
New 600 mm watermain on Gardiners Rd. (O'Connor Dr. to Cataraqui Woods Dr.)	X				X				X				X			
New 400 mm watermain on Avenue Rd. (Princess St. to McMahon Ave.)		X				X				X				X		
New 500 mm watermain on Third Ave. (MacDonnell St. to Alfred St.)		X				X				X				X		
New interconnecting 400 mm watermain on Princess St.					X				X				X			
New interconnecting 400 mm watermain on John Counter Blvd.					X	X			X	X			X	X		
New interconnecting 1050 mm watermain on Front Rd./King St. W. (km)									2	3		5 (complete)	2	3		5 (complete)

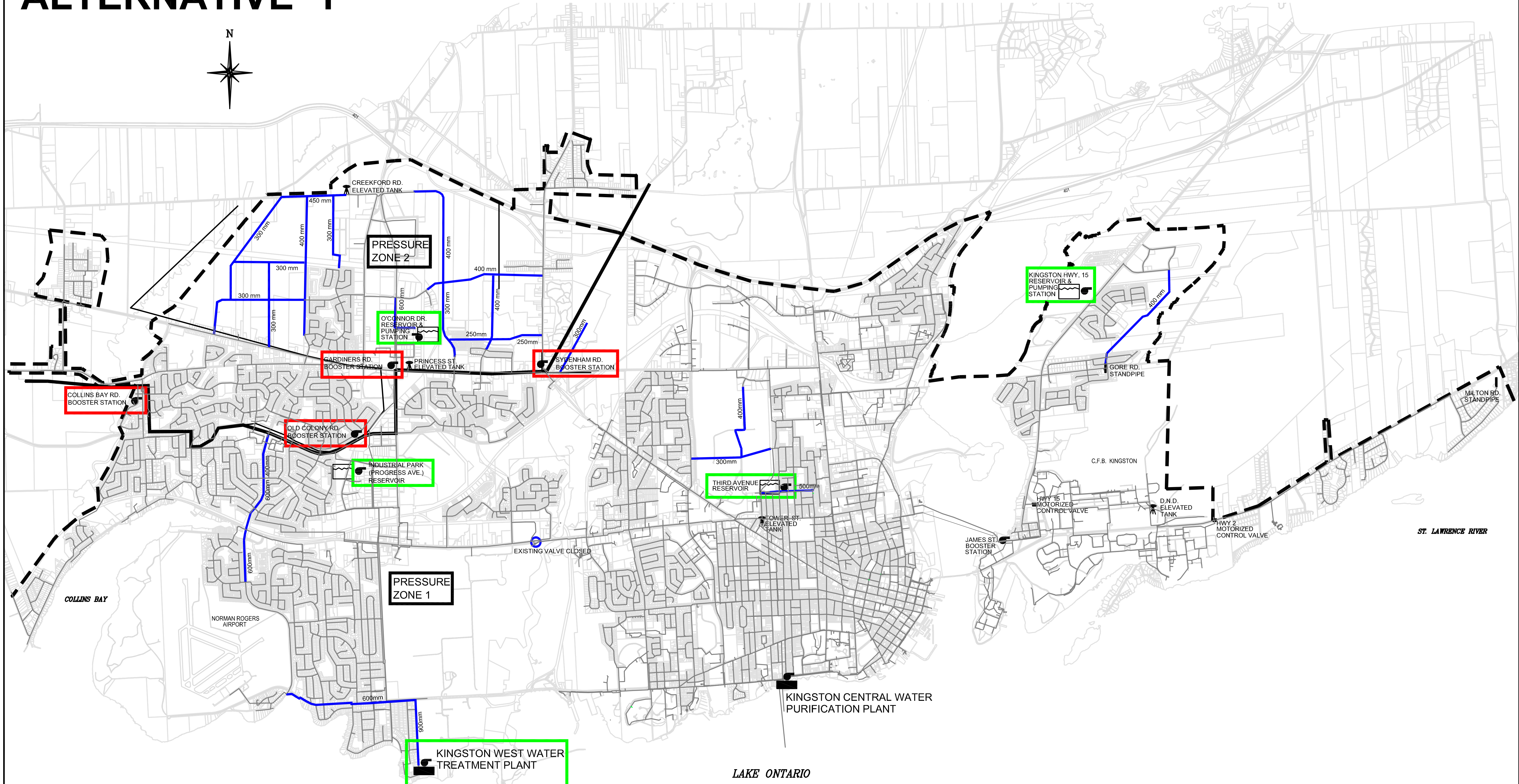
Study Year 2026																
	Alternative 1				**Alternative 2**				**Alternative 3**				**Alternative 4**			
Infrastructure Requirements	**West**	**Central**	**East**	**Suggestions**	**West**	**Central**	**East**	**Suggestions**	**West**	**Central**	**East**	**Suggestions**	**West**	**Central**	**East**	**Suggestions**
Kingston Water Treatment Plants																
West WTP "functional" increase (ML/d)	36				31				126				Retire			
Central WPP "functional" supply (ML/d)		95				95				Retire				Retire		
New water treatment plant													167			
Water Storage Reservoirs																
Industrial Park Reservoir expansion ("modelled")	10.1				Not required				Not required				Not required			
New O'Connor Drive Reservoir ("modeled")	9.6				8				8				8			
Third Ave. Reservoir expansion ("modeled")		6.2				4.7				4.7				4.7		
New Kingston Hwy. 15 Reservoir (“functional”)			6.4				6.4				6.4				6.4	
Booster and Pumping Stations (BS&PSs)																
Industrial Park Reservoir PS (ML/d)	19.9			Pumps evaluated	19.9			Pumps evaluated	19.9			Pumps evaluated	19.9			Pumps evaluated
Third Avenue Reservoir PS (ML/d)		35		Replace pumps		33.7		Replace with 35		29.1		Pumps evaluated		29.1		Pumps evaluated
New O'Connor Drive PS (ML/d)	35 (min.)				35 (min.)				35 (min.)				35 (min.)			
New Kingston Hwy. 15 PS (ML/d)			19				19				19				19	
James Street BS			20.3	Existing 18.2 (Adequate)			20.3	Existing 18.2 (adequate)			20.3	Existing 18.2 (adequate)			20.3	Existing 18.2 (adequate)
Gardiners Road BS	Retired				Retired				Retired				Retired			
Sydenham Road BS	Retired				Retired				Retired				Retired			
Old Colony Road BS	Retired				Retired				Retired				Retired			
Collins Bay Road BS	Retired				Retired				Retired				Retired			
Watermains																
New 900 mm discharge watermain from the Kingston West WTP	X				X				X							
New 600 mm watermain on Front Rd. (Days Rd. to Bayridge Dr.)	X				X				X				X			
New 600 mm watermain on Bayridge Dr. (Acadia Dr. to Taylor Kidd Blvd.)	X				X				X				X			
New 600 mm watermain on O’Connor Dr. (O’Connor Drive PS to Gardiners Rd.)	X				X				X				X			
New 600 mm watermain on Gardiners Rd. (O'Connor Dr. to Cataraqui Woods Dr.)	X				X				X				X			
New 400 mm watermain on Avenue Rd. (Princess St. to McMahon Ave.)		X				X				X				X		
New 500 mm watermain on Third Ave. (MacDonnell St. to Alfred St.)		X				X				X				X		
New 300 mm watermain – Novelis (E/W)		X				X				X				X		
New 400 mm watermain – Novelis (north)		X				X				X				X		
New interconnecting 400 mm watermain on Princess St.					X				X				X			
New interconnecting 400 mm watermain on John Counter Blvd.					X	X			X	X			X	X		
New interconnecting 1050 mm watermain on Front Rd./King St. W. (km)					2	3		5 (complete)	2	3		5 (complete)	2	3		5 (complete)

5.3.3 Required infrastructure for Alternatives 1, 2, 3 and 4 for the study year 2026

The required infrastructure for Alternatives 1, 2, 3 and 4 for study year 2026 have been indicated in **Figure 5.1, 5.2, 5.3 and 5.4**, on the following four pages (also included, full size in the envelope at the end of this Section).

END

ALTERNATIVE 1



NOTES:

1. DATA SOURCES: FIGURE W1, CITY OF KINGSTON URBAN GROWTH STRATEGY, JULY, 2004; UTILITIES KINGSTON FILE INFORMATION

LEGEND

URBAN BOUNDARY	NEW/UPGRADED FACILITY
EXISTING WATERMAINS	RETIRED
NEW WATERMAINS	
PRESSURE ZONE BOUNDARY	

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SCALE: N.T.S.

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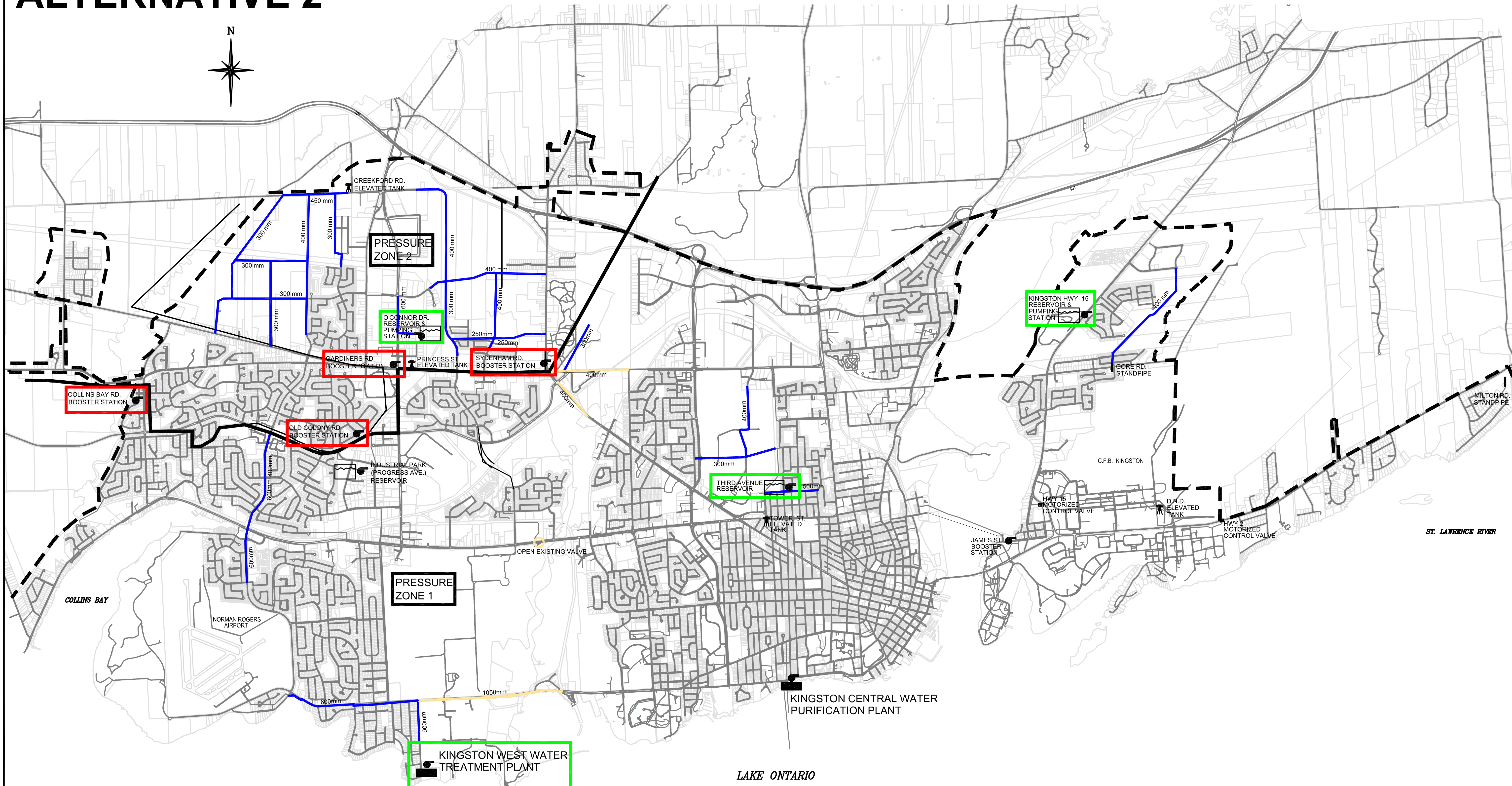
UTILITIES KINGSTON
MASTER PLAN FOR WATER SUPPLY

FIGURE 5.1: CITY OF KINGSTON WATER DISTRIBUTION SYSTEM ALTERNATIVE 1 – YEAR 2026

ALTERNATIVE 2



NOTES:

1. DATA SOURCES: FIGURE W1, CITY OF KINGSTON URBAN GROWTH STRATEGY, JULY, 2004; UTILITIES KINGSTON FILE INFORMATION

LEGEND

(thick dashed line)	URBAN BOUNDARY
(thin line)	EXISTING WATERMAINS
(blue line)	NEW WATERMAINS
(yellow line)	INTERCONNECTING WATERMAINS
(thick black line)	PRESSURE ZONE BOUNDARY
(green box)	NEW/UPGRADED FACILITY
(red box)	RETIRED

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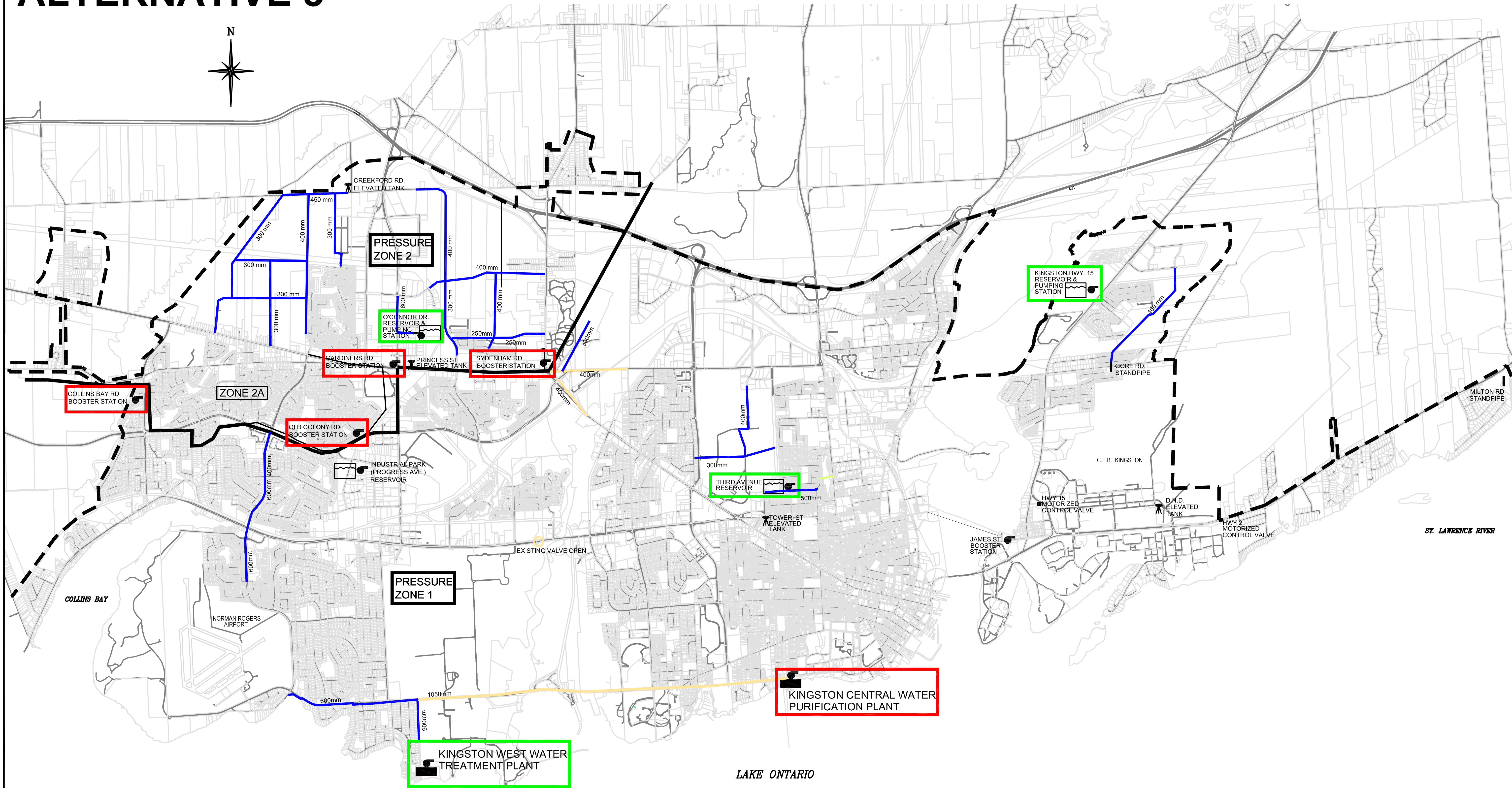
FIGURE 5.2: CITY OF KINGSTON WATER DISTRIBUTION SYSTEM ALTERNATIVE 2 – YEAR 2026

ALTERNATIVE 3



NOTES:

1. DATA SOURCES: FIGURE W1, CITY OF KINGSTON URBAN GROWTH STRATEGY, JULY, 2004; UTILITIES KINGSTON FILE INFORMATION

LEGEND

URBAN BOUNDARY	NEW/UPGRADED FACILITY
EXISTING WATERMAINS	RETIRED
NEW WATERMAINS	
INTERCONNECTING WATERMAINS	
PRESSURE ZONE BOUNDARY	

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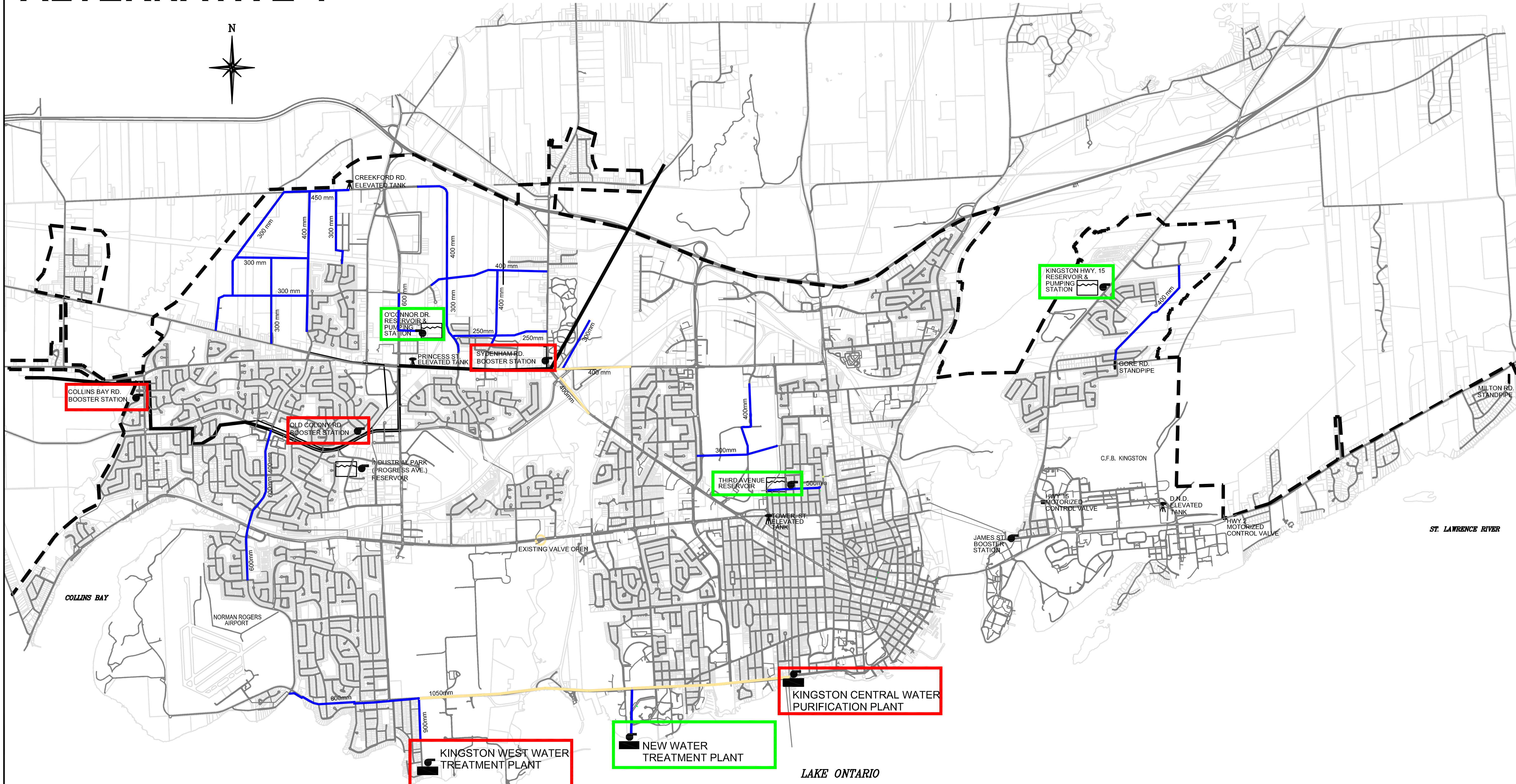
UTILITIES KINGSTON
MASTER PLAN FOR WATER SUPPLY

FIGURE 5.3: CITY OF KINGSTON WATER DISTRIBUTION SYSTEM ALTERNATIVE 3 – YEAR 2026

ALTERNATIVE 4



NOTES:

1. DATA SOURCES: FIGURE W1, CITY OF KINGSTON URBAN GROWTH STRATEGY, JULY, 2004; UTILITIES KINGSTON FILE INFORMATION

LEGEND

- URBAN BOUNDARY
- EXISTING WATERMAINS
- NEW WATERMAINS
- INTERCONNECTING WATERMAINS
- PRESSURE ZONE BOUNDARY
- NEW/UPGRADED FACILITY
- RETIRED

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UTILITIES KINGSTON
MASTER PLAN FOR WATER SUPPLY

FIGURE 5.4: CITY OF KINGSTON WATER DISTRIBUTION SYSTEM ALTERNATIVE 4 – YEAR 2026

ALTERNATIVE 1

NOTES:

1. DATA SOURCES: FIGURE W1, CITY OF KINGSTON URBAN GROWTH STRATEGY, JULY, 2004; UTILITIES KINGSTON FILE INFORMATION

LEGEND

URBAN BOUNDARY	NEW/UPGRADED FACILITY
EXISTING WATERMAINS	RETIRED
NEW WATERMAINS	
PRESSURE ZONE BOUNDARY	

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UTILITIES KINGSTON
MASTER PLAN FOR WATER SUPPLY

FIGURE 5.1: CITY OF KINGSTON WATER DISTRIBUTION SYSTEM ALTERNATIVE 1 – YEAR 2026

ALTERNATIVE 2

NOTES:

1. DATA SOURCES: FIGURE W1, CITY OF KINGSTON URBAN GROWTH STRATEGY, JULY, 2004; UTILITIES KINGSTON FILE INFORMATION

LEGEND

URBAN BOUNDARY	NEW/UPGRADED FACILITY
EXISTING WATERMAINS	RETIRED
NEW WATERMAINS	
INTERCONNECTING WATERMAINS	
PRESSURE ZONE BOUNDARY	

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UTILITIES KINGSTON
MASTER PLAN FOR WATER SUPPLY

FIGURE 5.2: CITY OF KINGSTON
WATER DISTRIBUTION SYSTEM
ALTERNATIVE 2 – YEAR 2026

ALTERNATIVE 3

NOTES:

1. DATA SOURCES: FIGURE W1, CITY OF KINGSTON URBAN GROWTH STRATEGY, JULY, 2004; UTILITIES KINGSTON FILE INFORMATION

LEGEND

URBAN BOUNDARY	NEW/UPGRADED FACILITY
EXISTING WATERMAINS	RETIRED
NEW WATERMAINS	
INTERCONNECTING WATERMAINS	
PRESSURE ZONE BOUNDARY	

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UTILITIES KINGSTON
MASTER PLAN FOR WATER SUPPLY

FIGURE 5.3: CITY OF KINGSTON WATER DISTRIBUTION SYSTEM ALTERNATIVE 3 – YEAR 2026

ALTERNATIVE 4

NOTES:

1. DATA SOURCES: FIGURE W1, CITY OF KINGSTON URBAN GROWTH STRATEGY, JULY, 2004; UTILITIES KINGSTON FILE INFORMATION

LEGEND

- URBAN BOUNDARY
- EXISTING WATERMAINS
- NEW WATERMAINS
- INTERCONNECTING WATERMAINS
- PRESSURE ZONE BOUNDARY
- NEW/UPGRADED FACILITY
- RETIRED

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UTILITIES KINGSTON
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FIGURE 5.4: CITY OF KINGSTON WATER DISTRIBUTION SYSTEM ALTERNATIVE 4 – YEAR 2026

CLASS ENVIRONMENTAL ASSESSMENT

6 Class Environmental Assessment (Class EA)

6.1 General

The Master Plan for Water Supply for the City of Kingston Urban Area has followed the Municipal Class Environmental Assessment Planning and Design Process, June 2000, prepared by the Municipal Engineers of Ontario, to the end of Phase 2. This process included a public consultation process consisting of Notices of Study activities in local newspapers and on Utilities Kingston's website, newsletters to interested parties and two Public Information Centres held to present the "Problem Statement", the alternatives being considered, the proposed evaluation criteria to select the "preferred solution" and to solicit input from concerned parties and governing authorities.

6.2 Notice of Commencement of Project

A Notice of Study Commencement was prepared and advertised in the local newspapers (below).

PUBLIC NOTICE

NOTICE DATE: JULY 11, 2006

NOTICE

Notice Of Study Commencement
Master Plan for Water Supply for the City of Kingston Urban Area
Class Environmental Assessment

Details:

Utilities Kingston has initiated a Master Plan Study to identify improvements and works required to meet the water supply needs of the City of Kingston urban area. The Master Plan study area and planning horizon are based primarily on the preferred growth scenario and projections identified in the City of Kingston's Urban Growth Strategy - Final Report (July 2004).

The Master Plan approach is intended to provide an inter-related study of the Kingston West, Kingston Central, and Kingston East water treatment and supply systems/facilities and an assessment of the City's water supply requirements. Utilities Kingston wishes to optimize existing system resources, and identify works and modifications that will implement a cohesive water treatment and distribution plan.

Utilities Kingston has retained Simcoe Engineering Group Limited to complete the Master Plan study for Water Supply for the City of Kingston. This study will be undertaken in accordance with the Master Planning requirements of a Schedule B project under the Municipal Class Environmental Assessment, June 2000.

A public consultation process is planned for this study and we will be asking for your input soon.

If you have questions regarding this study or if you would like to be included on the study mailing list, please contact watermasterplan@utilitieskingston.com or:

Cameron Smith, P.Eng.	Chantal Chiddle, P.Eng.
Project Manager	Utilities Engineer
Simcoe Engineering Group	Utilities Kingston
1020 Bayridge Drive	1211 John Counter Blvd
Suite 200	Kingston ON K7L 4X7
Kingston ON K7P 2S2	Tel: 613-546-1181 ext. 2356
Tel: 613-389-1661	Fax 613-542-1463
Fax: 613-389-2442	

6.3 Public Information Centre No. 1

6.3.1 General

Public Information Centre No. 1 was held on November 29, 2006 at Portsmouth Olympic Harbour in the Press Room.

Attendees were provided with an Information Handout describing the purpose of the Public Information Centre and the information that was being displayed.

The information handout and display boards provided a description of the purpose of the Master Plan for Water Supply for the City of Kingston, which was following the Municipal Class EA process. The alternative solution concepts were identified including both non-infrastructure related alternatives and infrastructure related alternatives.

The “non-infrastructure” related alternatives solutions that were considered are:

i) Do nothing

ii) Limit City of Kingston growth

i) Reduce water consumption

The infrastructure related alternative solutions that were being considered include the following components:

i) Additional watermains

ii) Additional water storage reservoirs and the associated water pumping stations

iii) Expansion of the Kingston West WTP and/or the Kingston Central WPP to provide the required additional water supply (this would require the interconnection of the two existing, independent water distribution systems).

iv) The potential retirement of one or both of the two existing water treatment plants and the construction of a single, large capacity water treatment plant to supply all drinking water to the entire City of Kingston (this would require the interconnection of the two existing, independent water distribution systems).

v) The potential removal of existing water booster pumping stations in Kingston West.

As a result of the preliminary screening of the advantages and disadvantages of the alternative solutions being considered, the three “non-infrastructure” related alternatives were eliminated from further consideration based on the fact that they could not provide a solution to the “Problem Statement”.

Water conservation measures and on-going replacement of leaking older watermains continue to remain a high priority with Utilities Kingston.

Attendees were also provided with a Questionnaire (including the potential evaluation criteria proposed for use to evaluate the alternatives that were being considered to select the preferred solution and that would be presented in more detail at a second Public Information Centre.

The attendees were requested to complete the Questionnaire prior to leaving or to forward the Questionnaire to Utilities Kingston.

Twenty-two persons attended Public Information Centre No. 1. This was considered to be a relatively low turnout.

Copies of the Questionnaires received and letters received from concerned parties and governing authorities have been provided in **Appendix E,** Tab 13.

6.3.2 Advertisement in local newspapers

A copy of the Public Notice for Public Information Centre No. 1 was prepared and advertised in the local newspapers. A copy of the Public Notice has been provided on the following page.

PUBLIC NOTICE

NOTICE DATE: NOVEMBER 21, 2006

NOTICE

PUBLIC INFORMATION CENTRE #1
Master Plan for Water Supply for the City of Kingston Urban Area
Class Environmental Assessment

Details:

Wednesday, Nov. 29 - 4p.m. to 7 p.m.
Portsmouth Olympic Harbour - 53 Yonge Street

Utilities Kingston has initiated a Master Plan Study to identify improvements and works required to meet the water supply needs of the City of Kingston urban area. The Master Plan study area and planning horizon are based on the preferred growth scenario and projections identified in the City of Kingston's Urban Growth Strategy - Final Report (July 2004).

The Master Plan approach is intended to provide an inter-related study of the Kingston West, Kingston Central and East water treatment and supply systems/facilities and an assessment of the city's water supply requirements. Utilities Kingston wishes to optimize existing system resources, and identify works and modifications that will implement a cohesive water treatment and distribution plan.

Utilities Kingston has retained Simcoe Engineering Group Limited to complete the Master Plan Study for Water Supply for the City of Kingston. This Master Plan Study will proceed to the end of Phase 1 and Phase 2 all in accordance with the Master Planning requirements under the Municipal Class Environmental Assessment, June 2000, up to selection of the preferred alternative to allow confirmation of the required schedule to proceed with development of alternative design concepts.

A Notice of Study Commencement was first issued on July 11, 2006.

A public consultation process is planned for this study. Utilities Kingston will be holding a Public Information Centre on Wednesday, November 29, 2006 from 4:00 p.m. to 7:00 p.m. at Portsmouth Olympic Harbour, 53 Yonge Street, Kingston in the Press Room. We invite those interested to attend to obtain your input regarding the current status of the study and the various water supply and distribution alternatives investigated to date. If you are unable to attend but would like to be included in future notifications please email watermasterplan@utilitieskingston.com or contact either of the project managers listed below. A second Public Information Session Centre will be held in early 2007 to present the alternatives selected and the preferred alternative.

For questions regarding this study, please contact:

Larry Manley, P.Eng.	Chantal Chiddle, P.Eng.
Kingston Manager	Utilities Engineer
Simcoe Engineering Group	Utilities Kingston
1020 Bayridge Drive	1211 John Counter Blvd
Suite 200	Kingston ON K7L 4X7
Kingston ON K7P 2S2	Tel: 613-546-1181 ext. 2356
Tel: 613-389-1661	Fax 613-542-1463
Fax: 613-389-2442	

6.3.3 Questionnaires received and verbal discussions

Upon reviewing the public input from the Public Information Centre, (written and verbal) the following key comments were noted:

i) The interconnection of the Kingston West and Kingston Central (including Kingston East) water supplies and distribution systems would provide a security of water supply for the entire City of Kingston.

ii) The logical location for a WTP expansion would be the Kingston West WTP as a large portion of the City's growth would occur in Kingston West and land was available on the existing site.

iii) A new "green-field" water treatment plant in a new location was considered to be a costly endeavour.

iv) Maintaining two plants in operation would provide a redundancy of supply (if the systems were interconnected).

6.4 Public Information Centre No. 2

6.4.1 General

Public Information Centre No. 2 was held on March 19, 2007 at Portsmouth Olympic Harbour in the Press Room.

Attendees were provided with an Information Handout (provided at the end of this Section), which summarized the information presented at Public Information Centre No. 1 and presented the various water supply and distribution system alternatives under consideration. Attendees were again provided with the proposed evaluation criteria to be used in the selection of the preferred solution.

The four identified alternative solutions presented at the Public Information Centre were as follows:

<u>Alternative 1</u> – Independent Kingston West and Kingston Central (including Kingston East) water supply and distribution systems.

<u>Alternative 2</u> – Interconnected water supplies (expand the Kingston West WTP and maintain the Kingston Central WPP in operation) and distribution systems servicing the City of Kingston.

<u>Alternative 3</u> – Interconnected water supplies (retire the Kingston Central WPP and provide the total City of Kingston water supply from an expanded Kingston West WTP) and distribution systems servicing the City of Kingston.

Alternative 4 – Interconnected water supplies (retire the Kingston Central WPP and retire the Kingston West WTP and provide a new, "green-field", water treatment plant to supply water to the entire City of Kingston.

Attendees were also provided with a Questionnaire, including the proposed evaluation criteria to be used in the evaluation the four alternatives presented.

The evaluation criteria provided included the following:

i) Overall system operations

ii) Design considerations

iii) Economics

iv) Natural environment

v) Historical significance

vi) Public health

vii) Social impact:

The attendees were requested to complete the Questionnaire prior to leaving or to forward the Questionnaire to Utilities Kingston.

Seven people attended Public Information Centre No. 2. This was considered to be a very low turnout.

Copies of the Questionnaires received and letters received from concerned parties and governing authorities have also been included in **Appendix E,** Tab 13.

6.4.2 Advertisement in local newspapers

A copy of the Public Notice for Public Information Centre No. 2 was prepared and advertised in the local newspapers. A copy of the Public Notice has been provided, on the following page.

Public Notice

NOTICE DATE: MARCH 13, 2007

NOTICE

NOTICE OF SECOND PUBLIC INFORMATION CENTRE
Master Plan for Water Supply for the City of Kingston Urban Area
Class Environmental Assessment

Details:

Monday, March 19, 2007 - 4 p.m. to 7 p.m.
Portsmouth Olympic Harbour - 53 Yonge Street

Utilities Kingston has initiated a Master Plan Study to identify improvements and works required to meet the water supply needs of the City of Kingston urban area. The Master Plan study area and planning horizon are based primarily on the preferred growth scenario and projections identified in the City of Kingston's Urban Growth Strategy - Final Report (July 2004).

The Master Plan approach is intended to provide an inter-related study of the Kingston West, Kingston Central, and Kingston East water treatment and supply systems/facilities and an assessment of the City's water supply requirements. Utilities Kingston wishes to optimize existing system resources, and identify works and modifications that will implement a cohesive water treatment and distribution plan.

Utilities Kingston has retained Simcoe Engineering Group Limited to complete the Master Plan study for Water Supply for the City of Kingston. This Master Plan study will proceed to the end of Phase 1 and Phase 2 all in accordance with the Master Planning requirements under the Municipal Class Environmental Assessment, June 2000 (selection of the preferred alternative to allow confirmation of the required schedule to proceed to alternative design concepts for the preferred alternative).

A Notice of Study Commencement was first issued in the local newspapers on July 11, 2006. A previous Public Information Centre (No. 1) was held on Wednesday, November 29, 2006.

The public consultation process is an essential part of this study. Accordingly, Utilities Kingston will be holding a second Public Information Centre (an informal presentation) on Monday, March 19, 2007, from 4 p.m. to 7 p.m. at the Portsmouth Olympic Harbour, 53 Yonge Street, Kingston, Ont. in the Press Room. We invite all Kingston residents to attend and provide input regarding the current status of the Study, the various water supply and distribution alternatives selected, and the preferred alternative. For more details on the 'Master Plan for Water Supply for the City of Kingston Urban Area' and how you can be involved, visit www.utilitieskingston.com. If you have questions regarding this study or if you would like to be included on the study mailing list, please contact watermasterplan@utilitieskingston.com or:

Larry Manley, P.Eng.	Chantal Chiddle, P.Eng.
Kingston Manager	Utilities Engineer
Simcoe Engineering Group	Utilities Kingston
1020 Bayridge Drive	1211 John Counter Blvd
Suite 200	Kingston ON K7L 4X7
Kingston ON K7P 2S2	Tel: 613-546-1181 ext. 2356
Tel: 613-389-1661	Fax 613-542-1463
Fax: 613-389-2442	

6.4.3 Questionnaires received and verbal discussions

Upon reviewing the public input from Public Information Centre No. 2, (written and verbal) the following key comments, in addition to those summarized above for Public Information Centre No. 1, were noted:

i) The interconnection of the Kingston West and Kingston Central (including Kingston East) water supply and distribution systems could reduce the required additional water supply and would provide increased operational flexibility.

ii) Water conservation should be an important initiative to reduce water consumption for the entire City of Kingston.

A display indicating Utilities Kingston water conservation measures was provided at the Public Information Centre. Public education plays a major role in this initiative and was presented as a component of the "Triple Bottom-Line Sustainability" display to ensure a sustainable water supply for the City of Kingston. This display was presented to provide thought for ranking the evaluation criteria used in the selection of the preferred solution.

iii) Of note, two members of the public attending the Public Information Centre indicated that a new "green-field" water treatment plant could be desirable (it would be a new water treatment plant and would allow the potential to implement advanced water treatment technology for the entire water supply to the City of Kingston).

6.5 Input received from governing authorities

6.5.1 Ontario Ministry of the Environment

Written correspondence was received from the Ontario Ministry of the Environment (MOE) in December 2006, included in **Appendix E,** Tab 13.

The MOE indicated that the Master Plan for Water Supply for the City of Kingston Urban Area should follow the Master Plan process as outlined in the Class Environmental Assessment document June 2000, prepared by the Municipal Engineers of Ontario. It was indicated that the Master Plan document should clearly explain the Class Environmental Assessment process being followed in the preparation of the Master Plan and list the schedule of the potential projects that would be carried out in the future and identify the future environmental assessment requirements.

6.5.2 Cataraqui Region Conservation Authority

A representative from the Cataraqui Region Conservation Authority attended both Public Information Centre No. 1 and Public Information Centre No. 2. Following Public Information Centre No. 2, the CRCA submitted a response to the Questionnaire provided at Public Information Centre No. 2, which has been included in **Appendix E,** Tab 13. A brief summary of the comments provided is as follows:

i) The interconnection of the Kingston West and Kingston Central (including Kingston East) water supply and distribution systems requires the provision of a large diameter watermain on Front Road / King Street. The installation of this watermain would involve crossing the mouth of the Little Cataraqui Creek and the Cataraqui Region Conservation Authority requested that they be consulted during final design and installation (following the submission and acceptance of the Master Plan (to be completed to the end of Phase 2, only).

ii) There are limitations to expanding at the Kingston Central WPP and it would be more logical to expand the Kingston West WTP than the Kingston Central WPP.

iii) An advantage to continuing operation of both the Kingston Central WPP and the Kingston West WTP would be planned redundancy in the event of emergency conditions.

iv) Although the construction of a new ”green-field” water treatment plant would allow for advanced treatment technology and could reduce the cost of daily operations, Lake Ontario Park (a potential location presented) is a public space, highly valued by members of the Kingston community, and is located immediately downstream of the both the Kingston West WPCP and the outlet of Little Cataraqui Creek. Following the Public Information Centre, it has been reported that Lake Ontario Park would be used for park-related facilities and would no longer be considered as a potential site for a potential new water treatment plant.

With regard to Lake Ontario Park, it was indicated at Public Information Centre No. 2 that with a potential new water treatment plant located at Lake Ontario Park, following the retirement of the Kingston West WTP and the Kingston Central WPP, potentially, this land would become parkland of a size greater than that required for a new water treatment plant. Following Public Information Centre No. 2, it was reported that Lake Ontario Park would no longer be considered as a potential site for a potential new water treatment plant, as indicated above.

With regard to the location of a potential new water treatment plant, it was indicated that the land immediately adjacent to the existing Kingston West WTP would be a suitable location (pending future discussions with the land owner, Invista). The site of the existing Kingston West WTP and the immediately adjacent land are west of Little Cataraqui Creek outlet and this would be a more receptive, potential location for a potential new water treatment plant by the Cataraqui Region Conservation Authority.

v) Water conservation and the replacement of leaking watermains should be explicitly included within each of the Alternatives.

vi) A ranking of the evaluation criteria as presented in **Sub-Section 8.3**, was recommended by the CRCA and has been incorporated into the ranking presented in **Table 8.1**, on page 100.

vii) The "Natural Environment" evaluation criterion should be modified to include the term "ecological" to the phrase "aquatic and terrestrial systems", and the phrase "impact on flood conveyance and storage". The criterion was so revised.

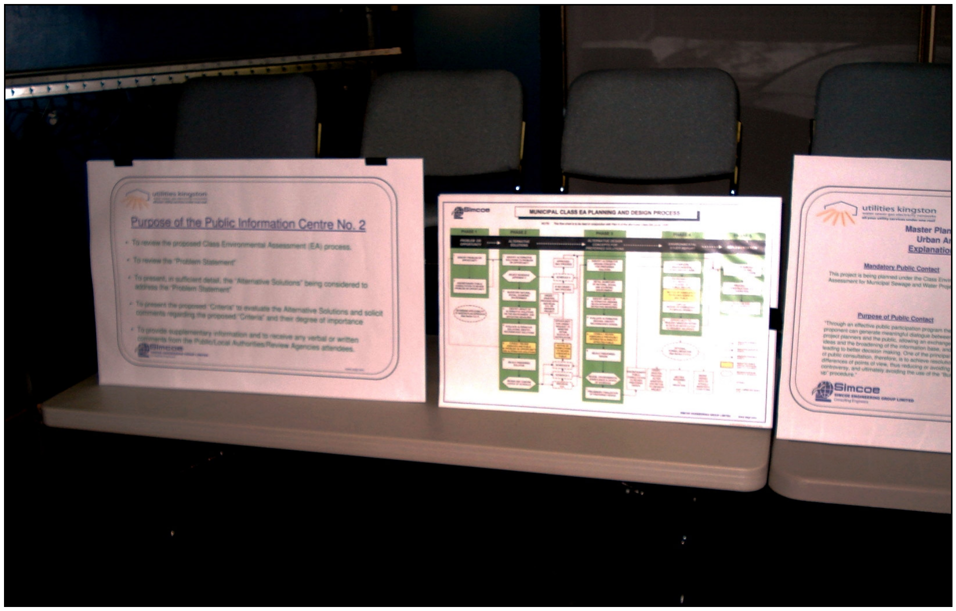
viii) The "Economics" criterion should acknowledge the need for life cycle costing of all infrastructure components.

As a result of this comment (it was considered to be a justifiable evaluation criteria), "maintenance costs" was added to the list of evaluation criteria.

ix) The "Public Health" criterion should evaluate the potential use of advanced treatment technologies (such as the application of ultraviolet disinfection) in the various alternatives.

6.6 Photographs taken at Public Information Centre No. 2

Photographs taken at Public Information Centre No. 2 have been provided on the following two pages.



Display Boards illustrating the Municipal Class EA Process

Members of the Public Viewing Display Boards at Public Information Centre No.2

Member of the Public Viewing Display Boards at Public Information Centre No. 2

END

UPDATED ALTERNATIVES, TECHNICAL CONSIDERATIONS AND ESTIMATED COSTS

7 Updated Alternatives, Technical Considerations and Estimated Costs

7.1 General

The four alternatives, to address the "Problem Statement", were presented at Public Information Centre No. 2. As presented above, Public Information Centre No. 2 was held on March 19, 2007. At the Public Information Centre, the four alternatives were presented, including the proposed evaluation criteria to be used to select the preferred solution. At Public Information Centre No. 2, it was also indicated that the four alternatives would be further reviewed in more detail and updated, as required.

The four alternatives have been indicated in **Section 5**, "Technically Feasible Alternatives to Address the "Problem Statement" for the "Master Plan for Water Supply for the City of Kingston Urban Area".

Following Public Information Centre No. 1 and No. 2 and further investigations following, the four alternatives being considered were further updated, including the input received at Public Information Centre No. 1 and Public Information Centre No. 2, the Questionnaires and letters received, the technical considerations, the estimated costs of the alternatives and discussions regarding the implementation of the alternatives.

In order to further confirm the infrastructure requirements and the required year that the infrastructure should be provided for the Alternatives being considered, certain modelling was reviewed again (including water model simulations, as required) and further design details investigated.

In addition, certain options for the study year 2011 have been presented for consideration with regard to *pending* infrastructure requirements.

7.2 Additional modelling

7.2.1 Retiring the Old Colony Road BS and the Collins Bay BS

Retiring the Old Colony Road BS and the Collins Bay BS in Kingston West (to form a single pressure zone, as opposed to Pressure Zone 2a and 2b) could be considered a high priority issue in order to minimize on-going maintenance costs and the potential requirement to replace the existing booster pumps, standby power considerations and other.

For confirmation, Alternatives 1 and 2 were modelled a second time for the study year 2011 and Alternatives 2 and 3 were modelled a second time for the study year 2026, both at peak hour conditions (worst case condition), in order to confirm that sufficient pressures would be available at the high ground elevation of 108 m in Westbrook and at the area of a higher, ground elevation of 113 m (worst case condition) between the Old Colony Road BS and the Collins Bay BS (generally in the area of the intersection of Lancaster Drive and Chancery Street).

In **Table 7.1** below, the available pressures, at peak hour demand conditions, for the above-noted, four modelling conditions have been presented to provide a comparison of the available pressures at the high ground elevation of 113 m, with the Old Colony Road BS and the Collins Bay BS remaining in operation (i.e., Pressure Zone 2a still in place) and with both the Old Colony Road BS and the Collins Bay BS retired (i.e., Pressure Zone 2a no longer in place – Pressure Zones 2a and 2b combined to form one pressure zone).

Table 7.1 - Pressure Zones 2a and 2b Independent and Combined for the Peak Hour Demand Condition

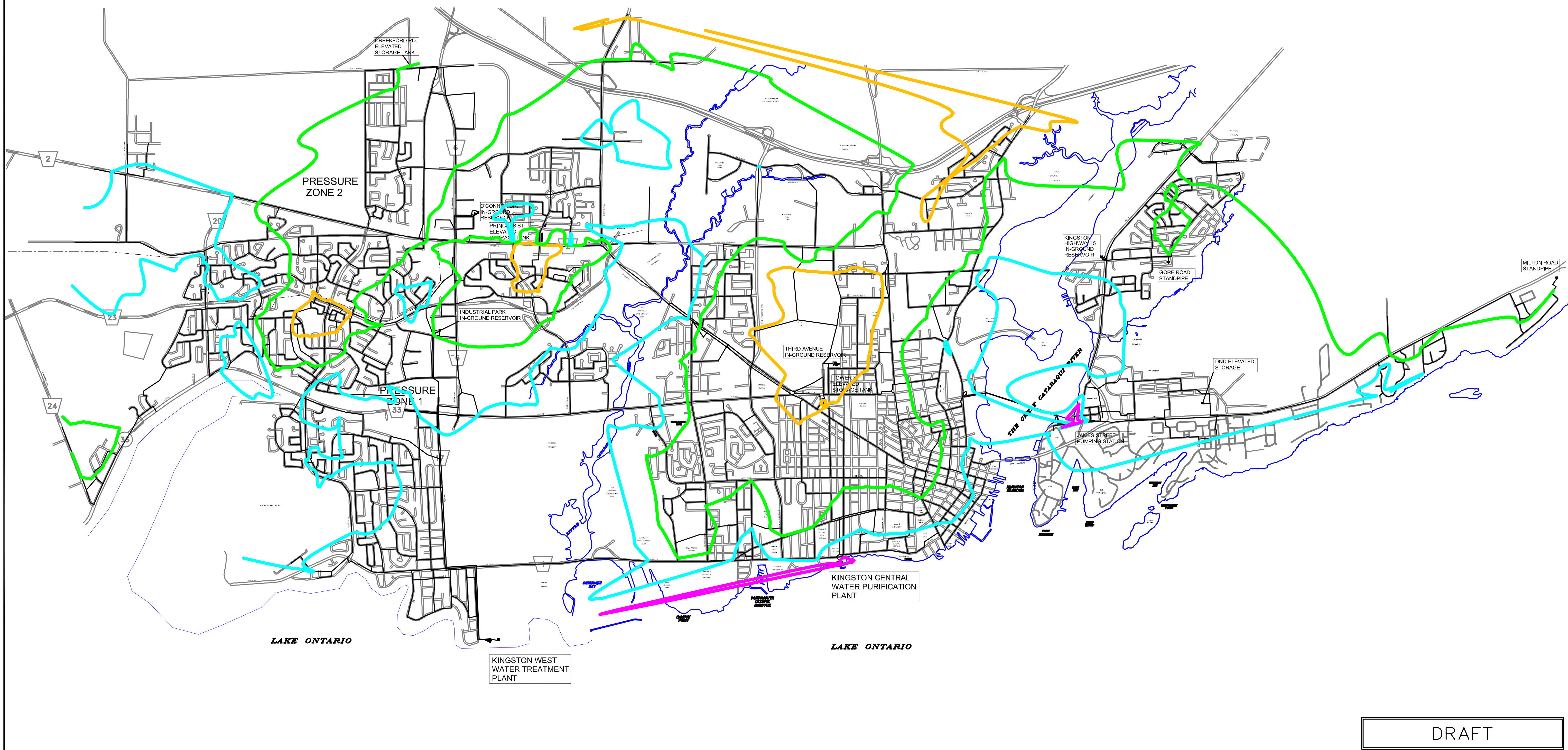
Study year	Alternative	Pressure Zone 2a independent from Pressure Zone 2b	Pressure Zones 2a & 2b, combined
2011	1	350 kPa (51 psi)	315 kPa (46 psi)
2011	2	410 kPa (59 psi)	355 kPa (51.5 psi)
2026	2	430 kPa (62.5 psi)	370 kPa (53.5 psi)
2026	3	430 kPa (62.5 psi)	350 kPa (51 psi)

It should be noted that during peak hour demand conditions, a water pressure of 275 kPa (40 psi) should be considered acceptable. The *modelled* system pressures are significantly above 275 kPa for the key locations and the governing peak hour demand conditions for Alternatives 1, 2 and 3 (the same results, presented in **Table 7.1**, would also apply to Alternative 4). Pressure contour plans for the study years 2011 and 2026 (**Figures 7.1 and 7.2**) have been included on the following two pages (also included, full-size, in envelope in **Appendix F,** Tab 14).

For the study year 2011, in order to retire the Old Colony Road BS and the Collins Bay BS (Pressure Zones 2a and 2b combined, to form one pressure zone), the planned (imminent) 400 mm watermain on Bayridge Drive (from Cedarwood Drive to Creekford Road) would need to be extended south to Woodbine Road, replacing the existing 200 mm watermain currently in place. If this 420 m long, 400 mm watermain connection were *not* provided, the peak hour demand system pressure in the area of the intersection of Lancaster Drive and Chancery Street in Pressure Zone 2a (worst case condition at the highest ground elevation of 113 m) would *not* be sufficient and the continued use of the Old Colony Road BS and the Collins Bay BS would still be required. The cost of replacing the 200 mm watermain with a 400 mm watermain would need to be compared to the cost of the continued operation of the two booster stations and the priority, to be established by Utilities Kingston, for the retirement of the two booster stations.

YEAR 2011 PEAK HOUR DEMAND PRESSURE CONTOURS

(PRESSURE ZONES 2A, 2B AND 2C COMBINED INTO A SINGLE PRESSURE ZONE 2)



LEGEND:

WATERMAINS

PRESSURE CONTOURS (kPa)

300

400

500

600

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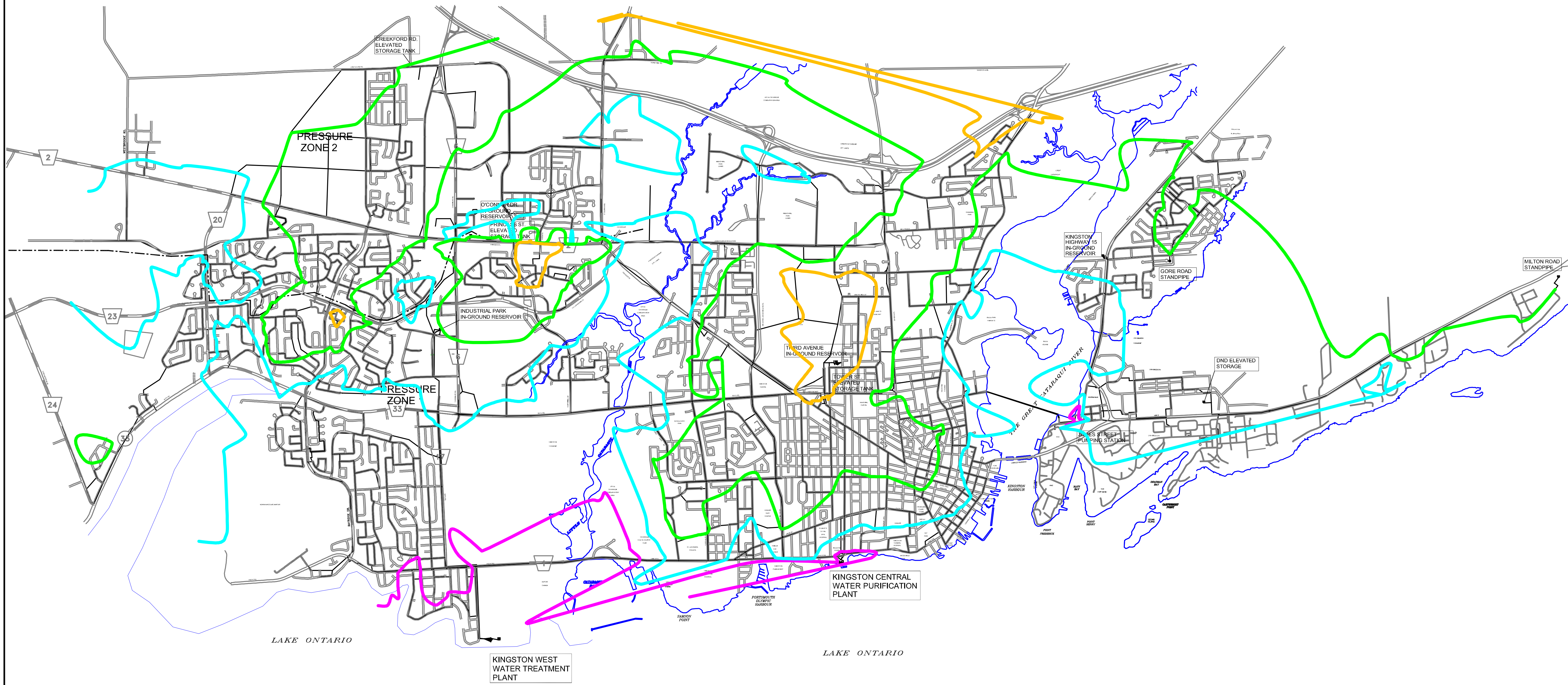
FIGURE 7.1: ALTERNATIVE 2
YEAR 2011 PEAK HOUR DEMAND
PRESSURE CONTOUR PLAN

P:\....\10424\Master Plan Figures\Fig 7_1

YEAR 2026 PEAK HOUR DEMAND PRESSURE CONTOURS

(PRESSURE ZONES 2a, 2b AND 2c COMBINED INTO A SINGLE PRESSURE ZONE 2)



DRAFT

LEGEND:

WATERMAINS

PRESSURE CONTOURS (kPa)

300

400

500

600

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FIGURE 7.2: ALTERNATIVE 2
YEAR 2026 PEAK HOUR DEMAND
PRESSURE CONTOUR PLAN

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If the 400 mm watermain connection were not provided, it would be necessary to delay the retirement of both booster stations *until* the watermains in GA2 West had been installed (based on private development) before interconnecting Pressure Zone 2a and Pressure Zone 2b.

Depending on the priority determined for retiring the Old Colony Road BS and the Collins Bay BS, potentially, it could be prudent to replace the existing 200 mm watermain with the required 400 mm watermain, once the 400 mm watermain (being sequentially installed by a developer) has been provided. The anticipated date for the installation of the 400 mm development watermain is not known.

In addition and as presented in **Item 3.3**, following, the provision of an O'Connor Drive Reservoir and Pumping Station would also be required for the study year 2011. An O'Connor Drive Reservoir and Pumping Station would be required in addition to the 400 mm replacement watermain on Bayridge Drive to Woodbine Road, in order to allow the Old Colony Road BS and the Collins Bay BS to be retired for the study year 2011.

7.3 Reservoirs

7.3.1 General

For existing reservoir expansions and, to a reduced extent, for potential new water storage reservoirs, the total storage capacity that would be required has been "calculated" to be somewhat greater than the "modelled" operating storage capacity required, in order to account for unusable storage (based on the existing reservoirs "available" water storage capacity and practical issues with regard to the operation of the reservoirs and the existing site conditions.

Due to existing chlorine contact time (acceptable for a "functional" capacity of 95 ML/d) and other in-plant water uses at the Kingston Central WPP, no additional water supply from the Kingston Central WPP to the water distribution system could be provided (i.e., the "functional" capacity of the plant would remain as 95 ML/d).

The available on-site water reservoir at the Kingston West WTP has not been included in the required storage requirements for Kingston West. The existing water storage (2.6 ML) would be required for chlorine contact time and other in-plant uses. In order to increase the water supply from the Kingston West WTP, additional on-site water storage would be required to provide the required chlorine contact time, prior to discharge into the water distribution system. A six per cent increase in the "functional" water supply capacity (including on-site storage) at the Kingston West WTP has been provided for Alternatives 1, 2 and 3 to provide the increase in the "rated" plant capacity.

All required additional water storage to provide the required storage to accommodate the peak hour and the maximum day plus fire flow conditions would be provided in storage facilities in the water distribution system (i.e., on-site water storage at the plants would be used to provide the require chlorine contact time and for other in-plant water uses.

7.3.2 An O'Connor Drive Reservoir

A new O'Connor Drive Reservoir would be required for the study year 2011 for both the independent and interconnected systems alternatives.

To retire the Old Colony Road BS and the Collins Bay BS, the storage capacity would need to be increased (due to the fact that the Old Colony Road BS and the Collins Bay BS currently draw water from Pressure Zone 1 as opposed to Pressure Zone 2), once retired. Since the water would be drawn from Pressure Zone 2, as opposed to Pressure Zone 1, more water would be available to Pressure Zone 1, partially supplied from the Industrial Park Reservoir; accordingly, there should be a close balance in the additional water storage requirements in Pressure Zone 1 and Pressure Zone 2 (one storage requirement basically off-setting the other).

For Alternative 1 and for Alternative 2, the required storage for the study year 2011 would be 6 ML. For the study years 2016 and 2026, the modelled storage requirement would be 7.4 ML and 9.6 ML, respectively. Assuming that Alternative 2 was selected as the preferred solution, it would be logical to provide the "modeled" 9.6 ML storage capacity for the study year 2011 (a future expansion of only 2.2 ML would not be prudent with regard to the small storage capacity increase and the future construction activities impact and the certain increased cost of construction).

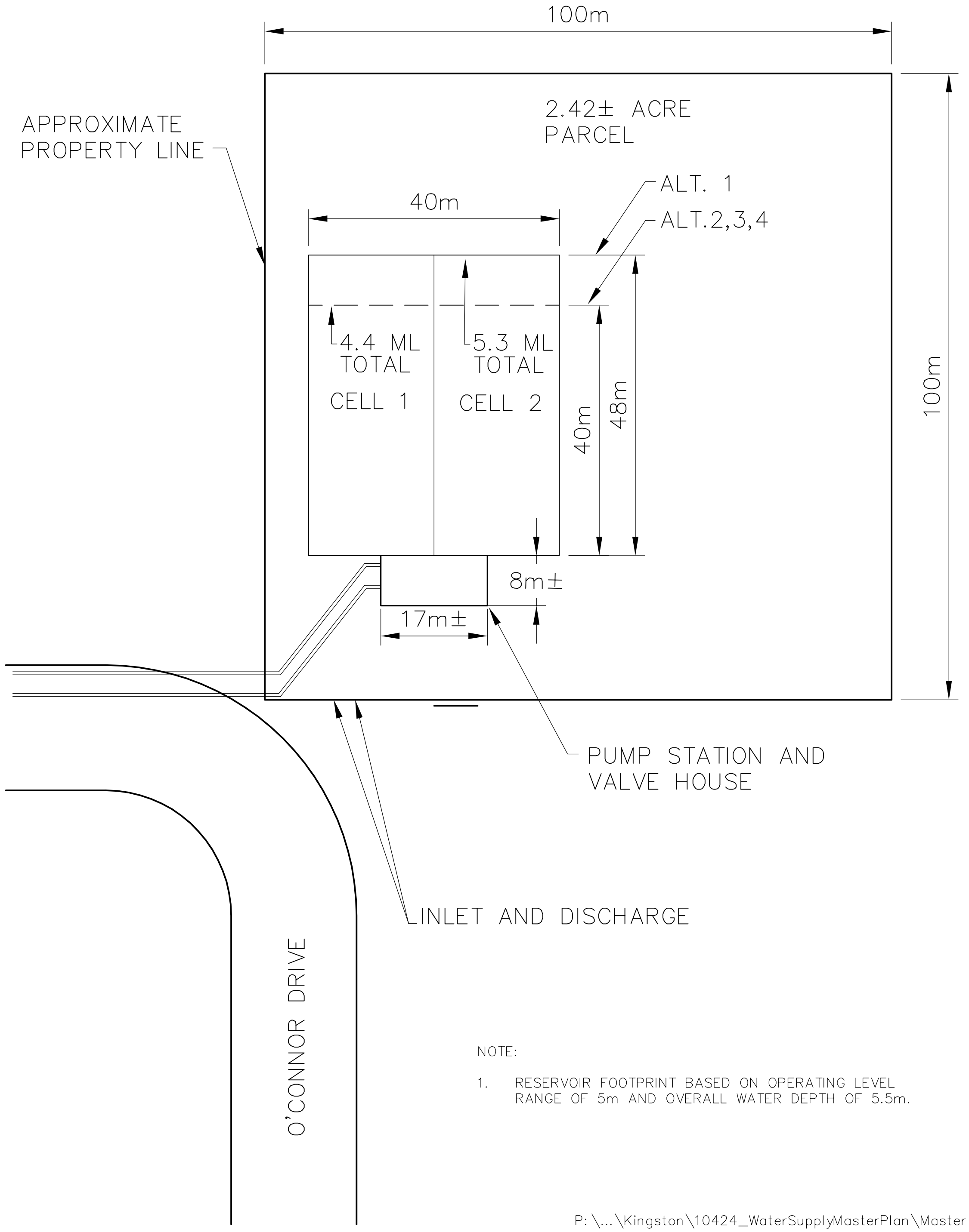
The "calculated" storage capacity that would need to be provided for the study year 2026, based on the modelled requirement to provide a storage capacity of 9.6 ML would be **10.6 ML** (provided in two cells).

A plan of an O'Connor Drive Reservoir and the required footprint and storage capacity for the study year 2026 (required for the study year 2011) has been presented in **Figure 7.3**, on the following page.

7.3.3 A Kingston Highway 15 Reservoir

A new Kingston Highway 15 Reservoir would be required for the study year 2011 for both the independent and interconnected systems alternatives.

The required storage would be 6.4 ML for all four Alternatives for the study year 2011 and the study years 2016 and 2026.



NOTE:

1. RESERVOIR FOOTPRINT BASED ON OPERATING LEVEL RANGE OF 5m AND OVERALL WATER DEPTH OF 5.5m.

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FIGURE 7.3: O'CONNOR DRIVE RESERVOIR

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The “calculated” storage capacity that would need to be provided for the study year 2026, based on the modelled requirement to provide a storage capacity of 6.4 ML would be **7 ML** (provided in two cells).

A plan of a Kingston Highway 15 Reservoir and the required footprint and storage capacity for the study years 2026 (required for the study year 2011) has been provided in **Figure 7.4**, on the following page.

7.3.4 Industrial Park Reservoir

It should be noted that for Alternative 1, based on modelling, for the study year 2011 and for the study year 2016, an additional 8.2 ML of storage capacity *would be* required; however, *no* expansion would be required for Alternatives 2, 3 and 4.

For **Alternative 1,** only, the required storage capacity (based on modelling) for the study year 2026 would be 10.1 ML (the “calculated” storage capacity required would be **11.6 ML**). This additional storage would be required for the study year 2011.

A plan of the existing Industrial Park Reservoir and the required footprint and required storage capacity expansion for Alternative 1, for the study year 2026 (required for the study year 2011), has been provided in **Figure 7.5**, on the following page. The required reservoir expansion could be provided on the existing City-owned site.

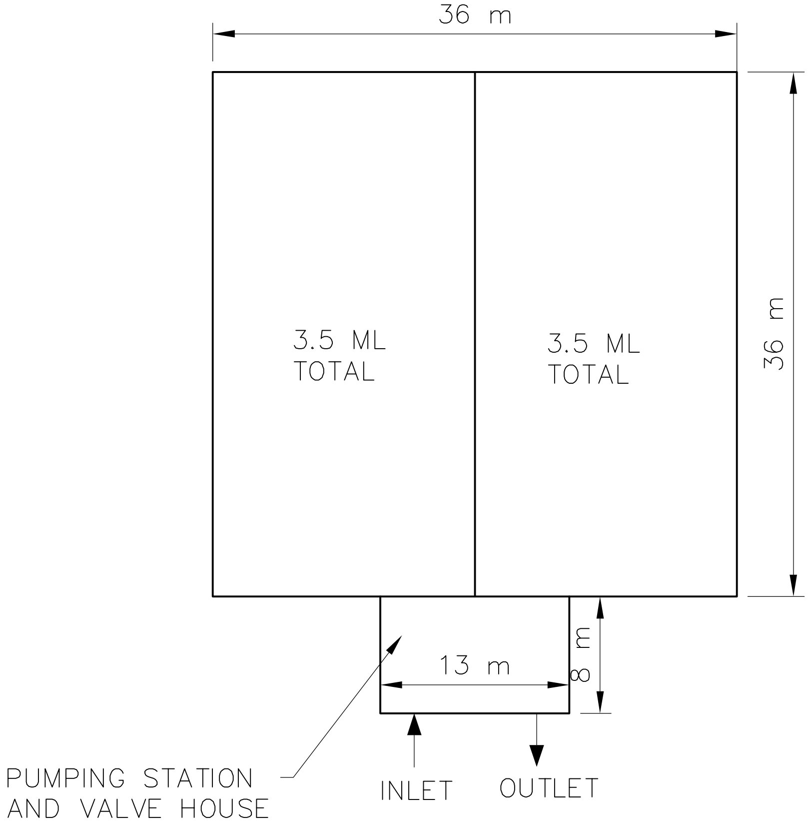
7.3.5 Third Avenue Reservoir

It should be noted that, based on modelling, the required expansion of the Third Avenue Reservoir would be approximately 1.7 ML less for the study years 2011, 2016 and 2026 for Alternative 1 versus Alternative 2.

For Alternative 1, the “calculated” storage capacity expansion that would need to be provided for the study year 2026, based on the modelled expansion requirement for the study year 2026 of 6.2 ML, would be **9.2 ML** (provided in two cells).

For Alternative 2, the “calculated” storage capacity expansion that would need to be provided for the study year 2026, based on the modelled requirement to provide a storage capacity of 4.7 ML, would be **7.1 ML** (provided in two cells), a difference from Alternative 1 of 2.1 ML (9.2 ML – 7.1 ML).

A plan of the existing Third Avenue Reservoir and the required footprint and storage capacity for the expansion for Alternative 2 for the study year 2026



NOTES

1. STORAGE AND PUMPING STATION FOR FIRE FLOWS ONLY.
2. FOOT PRINT BASED ON OPERATING LEVEL RANGE OF 5 m AND OVERALL DEPTH OF 5.5 m.
3. LAND REQUIRED: 3120 $m^2 \pm$ (APPROXIMATELY 0.77 ACRES)
4. RESERVOIR APPLIES TO ALTERNATIVES 1,2,3 AND 4.
5. PUMPING STATION/VALVE HOUSE INCREASED IN LENGTH BY 2–3 m FOR OPTION 1.

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FIGURE 7.4:
HIGHWAY 15 RESERVOIR

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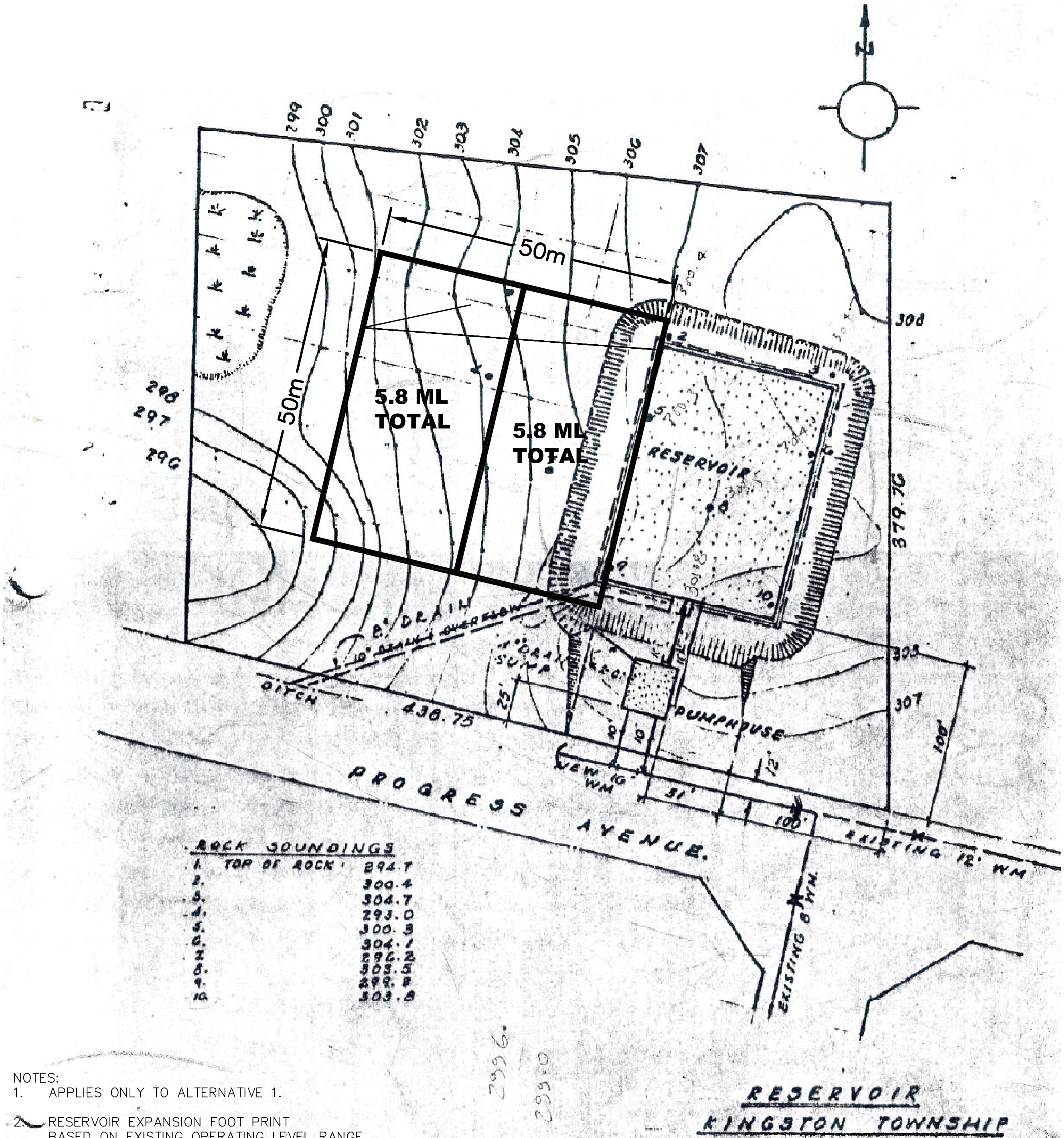

NOTES:
1. APPLIES ONLY TO ALTERNATIVE 1.
2. RESERVOIR EXPANSION FOOT PRINT BASED ON EXISTING OPERATING LEVEL RANGE OF 4.0m AND OVERALL WATER DEPTH OF 4.6m.
3. TOTAL EXPANSION VOLUME 11.6 ML FOR OPERATING VOLUME 10.1 ML
4. ROCK EXCAVATION MAY BE REQUIRED.
5. ENGINEERED FILL REQUIRED IN SOUTH WEST CORNER OF EXPANSION.

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FIGURE 7.5:
INDUSTRIAL PARK
RESERVOIR

(required for the study year 2011) has been presented in **Figure 7.6**, on the following page (second figure).

7.3.6 Required capacities of Kingston Central WPP and Kingston West WTP

a) General

The required increase in the water supply capacity of the Kingston West WTP for Alternatives 2 and 3 is dependent on the water supply available from the Kingston Central WPP. For this reason, it was necessary to assess the ability of the Kingston Central WPP to be able to supply the "functional" capacity of 95 ML/d assigned to this plant. It should be noted that the requirement to operate the Kingston Central WPP to supply 95 ML/d to the water distribution system on a continuous basis has not been necessary to date, as the current system water demand is much reduced from the increased water demands required in future years (requiring the plant to ensure a continuous supply of 95 ML/d to the water distribution system).

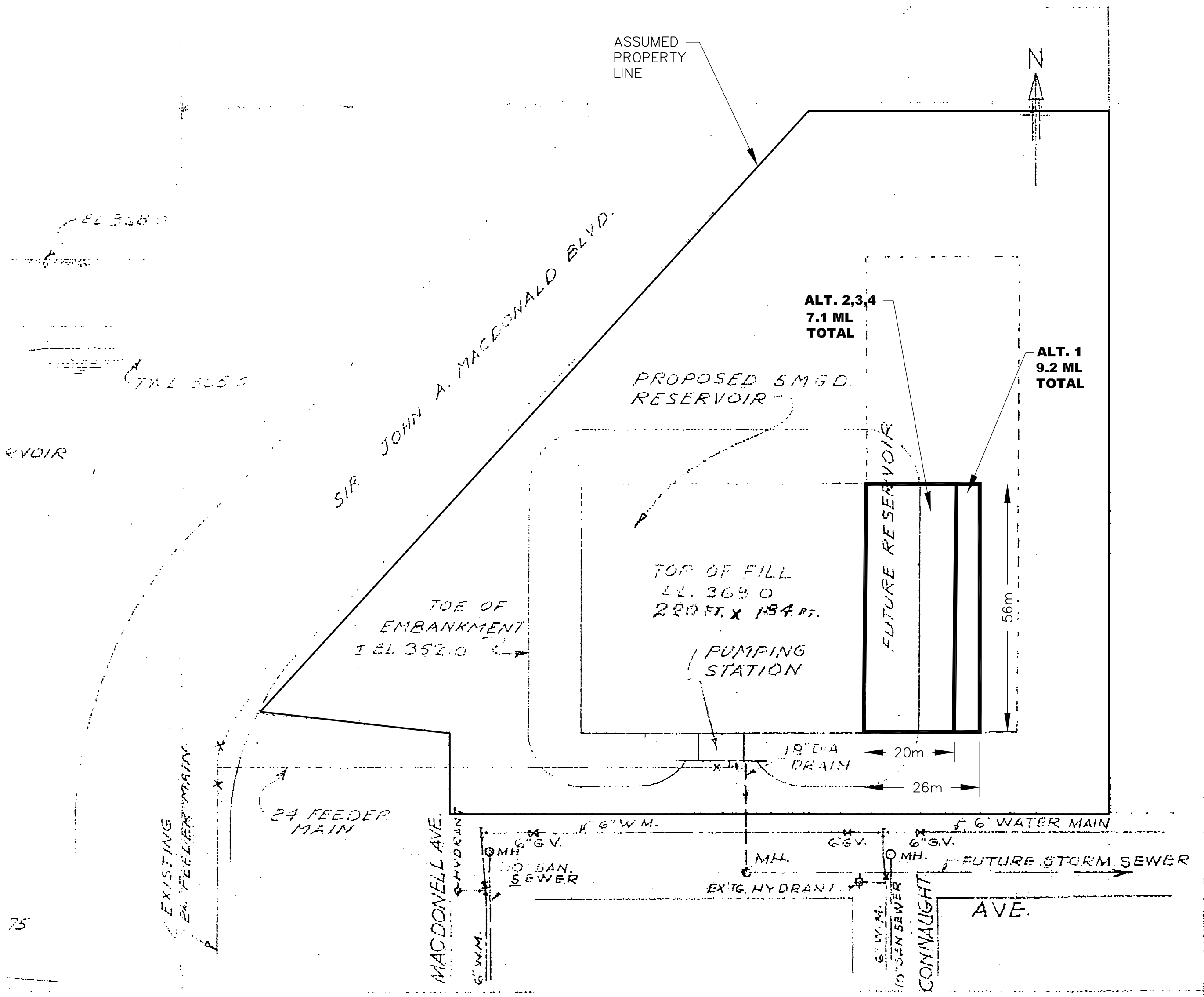
b) Kingston Central WPP

Based on investigation and comments from Utilities Kingston Operation's, the existing on-site water storage at the Kingston Central WPP is marginally sufficient to continue providing the required chlorine contact time; however, the marginal on-site water storage impacts, and will continue to impact, the operation of the plant, particularly the backwashing of filters. In order to *maintain* a "functional" capacity of 95 ML/d at the Kingston Central WPP, additional on-site water storage would be required to continue to provide the required chlorine contact time and the water required for plant use. To potentially increase the "functional" capacity of the plant, on-site water storage, in addition to the current required on-site water storage, would be required.

To provide this on-site water storage, land would be required immediately adjacent to the Kingston WPP would be required. Based on a review of land availability, it is considered that there is insufficient land available at the plant to provide this required additional, on-site storage.

There could be other considerations as to why the "functional" capacity of the Kingston Central WPP could not be increased.

Another potential operational scenario that would indicate that the "functional" capacity of the Kingston Central WPP could not be increased beyond 95 ML/d has been presented, following.



NOTE:

1. FOOTPRINT OF EXPANSION BASED ON EXISTING FUNCTIONAL OPERATING LEVEL RANGE 4.3m AND OVERALL WATER DEPTH OF 6.3m ± FOR EXPANSION.

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FIGURE 7.6:
THIRD AVENUE RESERVOIR

To achieve the “rated” capacity of 118 ML/d (26 MGD) from six filters, each 6.4 m (21 ft) by 12.8 m (42 ft), a filtration rate of 0.18 m^3/m^2 (3.57 gpm/ft^2) would be required.

Since 0.18 m^3/minute/m^2 (3.57 gpm/ft^2) would be a reasonable filtration rate, with all other things being more or less equal, a “rated” capacity for the plant of 118 ML/day would also be reasonable.

The term “functional” capacity is not defined, so the “functional” capacity might be in doubt.

While all six filters might be able to remove solids satisfactorily when operated at 0.18 m^3/minute/m^2 (3.57 gpm/ft^2), the GAC filters have another purpose, the removal of dissolved organics.

The GAC filters would be constrained by the maximum depth of the media. With the bottom of the media as low as physically possible, the top of the media would need to be low enough; such that, when the media expands during backwash, it would not be high enough in the filter box that it would be carried over into the troughs (not desirable). As constructed, the maximum depth of GAC would be present.

While the effluent piping could readily accommodate flow rates equivalent to 0.30 m^3/minute/m^2 (6 gpm/ft^2), the depth of the GAC media would need to be sufficient in order to provide the design value for *empty bed contact time*. Once an empty bed contact time has been established, the maximum flow through the filter would need to be such that the empty bed contact time would always be obtained. For example, if the rate of flow were 0.18 m^3/minute/m^2 (3.57 gpm/ft^2), equivalent to 0.174 m/minute (0.57 ft/minute), 2.6 metres of media would be required to obtain the required 15 minutes empty bed contact time.

Potentially, the filtration rate required to meet the established empty bed contact time, with the installed GAC depth, would be less than 0.18 m^3/minute/m^2 (3.57 gpm/ft^2); accordingly, the “functional” capacity of those filters, when functioning as adsorbers, would be reduced. Potentially, this would establish the overall plant water supply capacity (GAC and dual-media) established as 95 ML/d.

GAC performance would only be important when the raw water contained significant concentrations of organics.

In addition, the “capacity” of the filters would be dependent on the filter influent suspended solids load, since the suspended solids loading in the filters would need to be low enough such that, the “limiting” head loss was not reached in less than the “preferred” filtration run time.

c) Kingston West WTP

For Alternative 1, the required increase in the water supply capacity of the Kingston West WTP would be **36 ML/d** for the study year 2026.

For Alternative 2, it was indicated in **Table 5.1**, **Section 5**, page 63, that the required increase in the water supply capacity of the Kingston West WTP would be 5 ML/d for the study year 2011 and 9 ML/d for the study year 2016.

The required increase in the water supply capacity of the Kingston West WTP is dependent on the water supply available from the Kingston Central WPP. The required increase in water supply capacity of the Kingston West WTP has been based on the "functional" capacity of the Kingston Central WPP remaining as 95 ML/d.

Additional on-site storage could be provided at the Kingston West WTP; however, the *maximum* increase in the "functional" capacity would be 4.5 ML/d, which would be less than the considered minimum "functional" capacity increase of 9 ML/d.

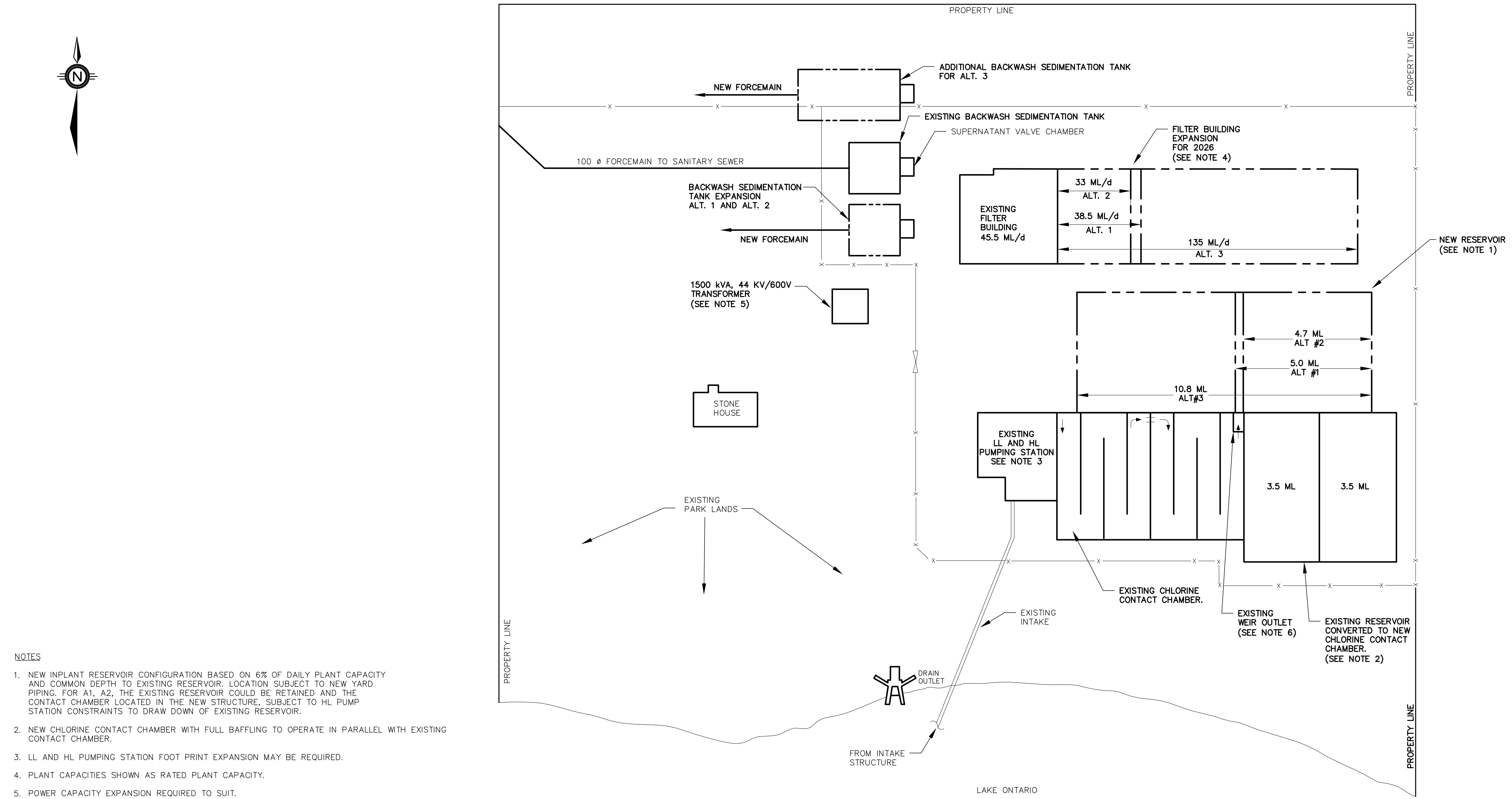
Accordingly, the potential to increase in the "functional" capacity of the two water treatment plants by 9 ML/d has not been considered an option.

For Alternative 3, it was indicated in **Table 5.1**, **Section 5**, page 63, that the required *increase* in the water supplied from the Kingston West WTP would be **126 ML/d** (167 ML/d – 41 ML/d) for the study year 2026.

A plan of possible expansions of the existing Kingston West WTP and the required footprint for Alternatives 1, 2 and 3 for the study year 2026 has been presented in **Figure 7.7** on the following page. Expansion capacities are determined by assuming that the net expansion of the water supply capacity is the difference between the applicable 2026 maximum day demand and the existing "functional" capacity of the Kingston West WTP. The net expansion water supply capacity is then increased by approximately 6%, to account for in-plant water requirements (such as back washing filters and other), to determine the required "rated" expansion capacity, indicated in **Figure 7.7**.

In addition, it has been assumed that the "functional" water supply capacity of the Kingston Central WPP would remain as 95 ML.

Assuming that the increase in the water supply capacity should be the 20-year design water supply capacity, an expansion in the "rated" capacity of **38.5 ML/d** and **33 ML/d** would be required for the study year 2011 for Alternative 1 and Alternative 2, respectively.



NOTES

1. NEW INPLANT RESERVOIR CONFIGURATION BASED ON 6% OF DAILY PLANT CAPACITY AND COMMON DEPTH TO EXISTING RESERVOIR. LOCATION SUBJECT TO NEW YARD PIPING. FOR A1, A2, THE EXISTING RESERVOIR COULD BE RETAINED AND THE CONTACT CHAMBER LOCATED IN THE NEW STRUCTURE, SUBJECT TO HL PUMP STATION CONSTRAINTS TO DRAW DOWN OF EXISTING RESERVOIR.
2. NEW CHLORINE CONTACT CHAMBER WITH FULL BAFFLING TO OPERATE IN PARALLEL WITH EXISTING CONTACT CHAMBER.
3. LL AND HL PUMPING STATION FOOT PRINT EXPANSION MAY BE REQUIRED.
4. PLANT CAPACITIES SHOWN AS RATED PLANT CAPACITY.
5. POWER CAPACITY EXPANSION REQUIRED TO SUIT.
6. WEIR OUTLET MODIFICATIONS MAY BE NEEDED INTO NEW RESERVOIR STRUCTURE.

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KINGSTON WATER SUPPLY MASTER PLAN

FIGURE 7.7:
KINGSTON WEST WTP

P:\......\10424\Master Plan Fig 7_7.dwg

For Alternative 3, an increase in the "rated" capacity of **135 ML/d** would be required for the study year 2026; however, implementation of Alternative 3 would be based on a selected timeframe for the retirement of the Kingston Central WPP.

7.4 Technical aspects with regards to the alternatives, including system control

7.4.1 System control

a) Water treatment plants

The only impact that could occur at the water treatment plants would be the total dynamic head of the high lift, plant discharge pumps and this would *not* be the case. With the provision of the second 900 mm watermain from the Kingston West WTP, the required total dynamic head for the high lift pumps at the Kingston West WTP and at the Kingston Central WPP would remain the *same* as in the year 2006.

b) Kingston West, Pressure Zone 1

The system control would remain the *same* as in 2006.

In order to maintain two pressure zones (Pressure Zone 1 and Pressure Zone 2) a 500 mm butterfly valve, normally closed (N/C) would be required in a valve chamber at the intersection of O'Connor Drive and Gardiners Road.

The 500 mm butterfly valve (normally closed) would be located in a 500 mm section of watermain, between the existing 500 mm tee provided for the watermain installed on O'Connor Drive and the connection connecting tee of the 600 mm watermain discharge from an O'Connor Drive Pumping Station to the existing 500 mm watermain installed northerly on Gardiners Road (eventually discharging into the Creekford Road Elevated Tank).

If the 500 mm butterfly valve (normally closed) were not provided, the required, increased water pressure from an O'Connor Drive Pumping Station and the static pressure from the Creekford Road Elevated Tank would allow water to flow back into Pressure Zone 1 [the top water level of the Creekford Road Elevated Tank is 159.8 m and the top water level of the Princess Street Elevated Tank is 136.5 m (a minimum difference of 23.3 m or, 230 kPa) and the discharge pressure from an O'Connor Drive Pumping Station would be slightly greater than the top water level of the Creekford Road Elevated Tank].

The second option (likely) is to provide no interconnection between the 500 mm watermain on Gardiners Road at the 500 mm tee to allow flow to an O'Connor Drive Reservoir and the location where the 600 mm watermain connects to the existing 500 mm watermain on Gardiners Road. This second option would not allow flow to be directed to Pressure Zone 1 under a "potential" emergency condition. Depending on the potential for an emergency flow from Pressure Zone 2 to Pressure Zone 1, Utilities Kingston could decide the option to be implemented. The method of connection would be addressed during the next Phase of the Class Environmental Assessment.

c) Kingston West, Pressure Zone 2

The Gardiners Road BS would be abandoned once an O'Connor Drive Reservoir and Pumping Station had been provided.

There is an existing 500 mm watermain on Gardiners Road from Princess Street to O'Connor Drive and on O'Connor Drive from Gardiners Road to the proposed site of an O'Connor Drive Reservoir.

The supply to an O'Connor Drive Reservoir would be provided by extending the 500 mm watermain from O'Connor Drive.

Two valves would control the flow into an O'Connor Drive Reservoir. The most upstream valve would be a 500 mm electrically actuated butterfly valve (non-modulating) that would be controlled by a programmable logic controller to open once the reservoir water level dropped to the pre-determined low operational level (above the fire storage) and close once the water level rose to the pre-determined high operational level (below the overflow level). The second valve would be a 500 mm pneumatic, pressure-sustaining valve set to close based on the pressure at the low operating level at the Street Elevated Tank [i.e., water below the low operating level of the Princess Street Elevated Tank (at which level the high lift pumps at the Kingston West WTP are programmed to start) would not be allowed to flow into an O'Connor Drive Reservoir].

The actuated butterfly valve would also act as a shut-off valve to allow the potential removal of the pressure-sustaining valve.

The water level in the Creekford Road Elevated Tank would control the starting and stopping of the pumps at an O'Connor Drive Reservoir and Pumping Station (as previous for the Gardiners Road BS).

The supply to and the discharge from an O'Connor Drive Reservoir and Pumping Station would be addressed during the next Phase of the Class Environmental Assessment.

d) Kingston Central

The system control would remain the *same* as in 2006.

e) Kingston East, south of the control valve on Kingston Highway 15

The system control would remain the *same* as in 2006.

f) Kingston East, north of the control valve on Kingston Highway 15

A 500 mm watermain would be installed from the existing 500 mm watermain on Kingston Highway 15 to a Kingston Highway 15 Reservoir and a 500 mm discharge watermain would be provided from a Kingston Highway 15 Pumping Station to the existing 500 mm watermain on Kingston Highway 15.

A 500 mm electrically actuated butterfly valve, upstream of a pneumatic pressure sustaining valve (set at the low operating level of the Gore Road Standpipe), would be required on the inlet to the reservoir; such that, once the pumps were programmed to start, the normally open (normally open) butterfly valve would close to prevent recirculation of the discharge flow back into the reservoir during the period that the pumps would be programmed to operate.

It is known that the reason for maintaining the motorized control valve on Kingston Highway 15 is to allow turnover of the water stored in the Gore Road Standpipe. Maintaining this valve in operation would now be important to allow turnover of the water in the Gore Road Standpipe and a Kingston Highway 15 Reservoir.

The Gore Road Standpipe and a Kingston Highway 15 Reservoir would both require an operational level (during which the motorized control valve on Kingston Highway 15 was closed); accordingly, a reduction in the operational levels for both facilities should be considered in order to allow water flow from the James Street BS to be added to both facilities (allowing turnover of the stored water). The provision of residual adjustment facilities at a Kingston Highway 15 Reservoir and Pumping Station would reduce the impact of declining free chlorine residuals in the water distribution system.

A free chlorine residual analyzer, a flow meter and a sodium hypochlorite residual adjustment system would be required to ensure that the free chlorine residual, pumped from a Kingston Highway 15 Reservoir, was in the range of 0.6 mg/L to 1.0 mg/L (or as otherwise determined by Utilities Kingston).

During the final design phase, the controls required to ensure that water flow from the Gore Road Standpipe into a Kingston Highway 15 Reservoir, once the water level in the Gore Road Standpipe dropped to the low operational level, would also need to allow an operating level in a Kingston Highway 15 Reservoir to ensure that the water retained in the reservoir is also used in the system. If a Kingston Highway 15 Reservoir were not provided with an operating level, as provided in the Gore Road Standpipe, there would be no turnover of water (not desirable as retaining only for a fire condition would eventually reduce the free chlorine residual in a Kingston Highway 15 Reservoir to below the required minimum free chlorine residual of 0.20 mg/L, as required by the Safe Drinking Water Act, 2007).

The water level in the Gore Road Standpipe would control the stopping and starting of the pumps at a Kingston Highway 15 Pumping Station.

7.5 Estimated capital costs of infrastructure

7.5.1 General

The capital cost associated with each alternative was an important component in the evaluation of the alternatives and the selection of a preferred solution; accordingly, the capital cost for the various Alternatives were estimated (provided in **Table 7.2**, on page 92).

7.5.2 Estimated capital cost for additional/expansions to water storage reservoirs

For existing reservoir expansions and, to a reduced extent, for potential new water storage reservoirs, the total storage capacity that would be required has been **"calculated"** to be somewhat greater than the **"modelled"** storage capacity required, in order to account for unusable storage (based on the existing reservoirs "available" water storage capacity and practical issues with regard to the operation of the reservoirs and site conditions.

The cost per ML has been applied to the reservoirs **"calculated"** water storage capacity.

Based on research and experience, the estimated cost/m^3 for the construction of a new reservoir or an expansion to an existing reservoir would be \$375/cubic metre (m^3) plus 16% engineering or, \$435/m^3 (\$435,000/ML) or, \$2.00/gallon.

The estimated costs (including 16% engineering) have been provided in **Table 7.2**, on page 92.

7.5.3 Estimated capital cost for water pumping stations for new reservoirs

The estimated costs (including 16% engineering) have been provided in **Table 7.2**, on page 92.

For purposes of cost estimates, pumping stations are assumed to be belowground concrete structures with access at-grade, to be attached to the new reservoir structures, and to include pumps, electrical power, standby power, and all facility valves, with related controls and SCADA.

Multiple pumps of identical size are assumed to provide redundancy and flexibility. All pumps but the spare would be operated for maximum day plus fire flow demand, and one or more pumps would be operated for peak hour demand. Assumed pump combinations are as follows for the applicable alternatives:

Pumping Station	Alternative1	Alternatives 2-4
O'Connor Drive	5x161 L/s @ 57 m TDH	5x135 L/s @ 55 m TDH
Kingston Highway 15	4x75 L/s @ 46 m TDH	3x110 L/s @ 46 m TDH

7.5.4 Estimated capital cost for water treatment plants

The required **"functional"** water supply expansion has been increased by approximately six per cent (6%), to account for in-plant water requirements (such as filter back washing), resulting in the required **"rated"** water supply expansion.

The estimated cost for water treatment plants would be \$675/cubic metre (m^3) plus 16% engineering or, \$780/m^3 (\$780,000/ML) (\$3.55/gallon).

The cost per ML/d has been applied to the plant **"rated"** capacity.

The estimated costs (including 16% engineering) have been provided in **Table 7.2**, on page 92.

7.5.5 Estimated capital cost for watermains

a) General

The costs for future planned watermains in the GA2 (East and West) and Cataraqui North development areas have not been included in the cost for the Alternatives.

The cost for all watermains required to interconnect Kingston West with Kingston Central (including Kingston East) has been included. In addition, the cost for additional watermains, which have been identified "to be required" but are not currently planned in the future, has been included.

b) 300 mm watermains

The estimated cost would be $750/metre ($650/metre plus 16% engineering).

c) 400 mm watermains

The estimated cost would be $950/metre ($800/metre plus 16% engineering).

d) 500 mm watermains

The estimated cost would be $1,150/metre ($1,000/metre plus 16% engineering).

e) 600 mm watermains

The estimated cost would be $1,300/metre ($1,150/metre plus 16% engineering).

f) 900 mm watermains

The estimated cost would be $1,550/metre ($1,350/metre plus 16% engineering).

g) 1050 mm watermains

The estimated cost would be $1,750/metre ($1,500/metre plus 16% engineering).

The estimated costs (including 16% engineering) have been provided in **Table 7.2**, on page 97.

7.5.6 Land costs

Land costs have not been included. A Kingston Highway 15 Reservoir and Pumping Station would require the purchase of land and potentially the purchase of land could be required for expansions at the Kingston West WTP.

7.6 Estimated capital costs of the alternatives

7.6.1 General

The estimated costs for the four alternatives for the study year 2026 have been provided in **Table 7.2**, on the following page.

It should be noted that the estimated costs in **Table 7.2** have been provided strictly for the Alternatives without yet incorporating the sequence in which the infrastructure, and the associated capital costs, should be provided.

A suggested sequence for the provision of required Infrastructure has been addressed in **Sub-Section 7.7**, on page 93.

Table 7.2 - Estimated Costs for Alternatives 1, 2, 3 and 4 for the Study Year 2026

Infrastructure Description	Unit	Unit Cost	Alternative 1		Alternative 2		Alternative 3		Alternative 4	
			Size[1]	Cost	Size[1]	Cost	Size[1]	Cost	Size[1]	Cost
Increase in the Kingston West WTP "rated" capacity	ML/day	$780,000	38.5	$30,030,000	33	$25,740,000	135	$105,300,000	N/A	N/A
New Water Treatment Plant "rated" capacity	ML/day	$780,000	N/A	N/A	N/A	N/A	N/A	N/A	177	$138,060,000
Expansion of the existing Industrial Park Reservoir "rated" storage capacity	ML	$435,000	11.6	$5,046,000	N/A	N/A	N/A	N/A	N/A	N/A
New O'Connor Dr. Reservoir "rated" storage capacity	ML	$435,000	10.6	$4,617,000	8.8	$3,828,000	8.8	$3,828,000	8.8	$3,828,000
New O'Connor Dr. Pumping Station		N/A	N/A	$1,900,000	N/A	$1,900,000	N/A	$1,900,000	N/A	$1,900,000
Expansion of the existing Third Avenue Reservoir "rated" storage capacity	ML	$435,000	9.2	$4,002,000	7.1	$3,088,500	7.1	$3,088,500	7.1	$3,088,500
New Kingston Hwy 15 Reservoir "rated" capacity	ML	$435,000	7	$3,045,000	7	$3,045,000	7	$3,045,000	7	$3,045,000
Replace pumps at Third Avenue Reservoir PS			N/A	$250,000	N/A	$250,000	N/A	$250,000	N/A	$250,000
New Kingston Highway 15 Pumping Station		N/A	N/A	$1,600,000	N/A	$1,600,000	N/A	$1,600,000	N/A	$1,600,000
Retire four existing Booster Stations		N/A	N/A	$200,000	N/A	$200,000	N/A	$200,000	N/A	$200,000
New 900 mm discharge watermain from the Kingston West WTP	metres	$1,550	1,740	$2,697,000	1,085	$1,681,750	1,085	$1,681,750	1085	$1,681,750
New 600 mm watermain on Front Rd. (Days Rd. to Bayridge Dr.)	metres	$1,300	1,370	$1,781,000	1,370	$1,781,000	1,370	$1,781,000	1370	$1,781,000
New 600 mm watermain on Bayridge Dr. (Acadia Dr. to Taylor Kidd Blvd.)	metres	$1,300	2,083	$2,707,900	2,083	$2,707,900	2,083	$2,707,900	2,083	$2,707,900
New 600 mm watermain on O'Connor Drive (from O'Connor Drive Pumping Station to Gardiners Road)	metres	$1,300	230	$299,000	230	$299,000	230	$299,000	230	$299,000
New 600 mm watermain on Gardiners Rd. (O'Connor Dr. to Cataraqui Woods Dr.)	metres	$1,300	631	$820,300	631	$820,300	631	$820,300	631	$820,300
New 400 mm watermain on Avenue Rd. (Princess St. to McMahon Ave.)	metres	$950	398	$378,100	398	$378,100	398	$378,100	398	$378,100
New 500 mm watermain on Third Ave. (MacDonnell St. to Alfred St.)	metres	$1,150	645	$741,750	645	$741,750	645	$741,750	645	$741,750
New 300 mm watermain across the Novelis property (East-West)	metres	$750	N/A	N/A	1,119	$839,250	1,119	$839,250	1119	$839,250
New 400 mm watermain on the Novelis property (North from the 300 mm watermain, above)	metres	$950	N/A	N/A	765	$726,750	765	$726,750	765	$726,750
New 1050 mm interconnecting wm. - Front Rd./King St.	metres	$1,750	N/A	N/A	2,000	$3,500,000	5,000	$8,750,000	5,000	$8,750,000
New 400 mm interconnecting wm. on Princess St.	metres	$1,200	N/A	N/A	1,000	$1,200,000	1,000	$1,200,000	1,000	$1,200,000
New 400 mm interconnecting watermain on John Counter Blvd.	metres	$1,150	N/A	N/A	1,300	$1,495,000	1,300	$1,495,000	1,300	$1,495,000
Total				**$60,100,000**		**$55,850,000**		**$140,650,000**		**$173,300,000**

Notes: **1.** The increases in the water supply capacities indicated are the **"rated"** increases in the water supply capacities (**not** the **"functional"** increases in the water supply capacities) and the reservoir water storage capacities (new or expansions) are the **"calculated"** water storage capacities (**not** the **"modelled"** capacities). **2.** All costs have been provided in year 2007 $ dollars. The costs would increase over time, based on the inflation rate and the Toronto Construction Cost ENR Index. **3.** All costs include 16% engineering.

7.7 Suggested sequence for the provision of expanded or new water supply and distribution system infrastructure

7.7.1 General

Regardless of whether the Kingston West water supply and distribution system remained independent or was interconnected with Kingston Central (including Kingston East) water supply and distribution system, certain expanded or new infrastructure in the water distribution system would be required for the study year 2011. It has been assumed that the provision of the expanded or new infrastructure in the water distribution systems would be dependent on Utilities Kingston's ability to implement the provision of the required infrastructure (budget constraints would be an issue).

7.7.2 Water treatment plant expansion

Regardless of the preferred solution selected, an expansion of the Kingston West WTP would be required, as soon as possible.

The minimum size of the required expansion should be sufficient to accommodate the demands for the study year 2016. It should be noted that, immediately following the study year for which the expanded water supply capacity was provided, the system demands would require an additional expansion, immediately thereafter. This must be considered when selecting the increase in the initial design water supply capacity to be provided.

7.7.3 Reservoirs and associated pumping stations

An O'Connor Drive Reservoir and Pumping Station would be required for the study year 2011.

A Kingston Highway 15 Reservoir and Pumping Station would be required for the study year 2011, or shortly thereafter.

An expansion of the Third Avenue Reservoir and replacement of the pumps at the Pumping Station would be required for the study year 2011.

If Alternative 2 were selected as the preferred solution, *no* expansion of the Industrial Park Reservoir would be required; however, upgrades at the existing Pumping Station could be required. For Alternative 1, an expansion of the Industrial Park Reservoir and the upgrades at the Pumping Station *would be* required for the study year 2011.

7.7.4 Booster pumping stations

The priority placed on potentially retiring al four booster stations (the Gardiners Road BS, the Sydenham Road BS, the Old Colony Road BS and the Collins Bay Road BS) would be established by Utilities Kingston.

The Gardiners Road BS and the Sydenham Road BS could only be retired once an O'Connor Drive Reservoir and Pumping Station were provided (required by the study year 2011). In addition, in order to retire the Sydenham Road BS, the 400 mm watermain on Cataraqui Woods Drive would need to be extended to the existing 300 mm watermain on Sydenham Road.

The Old Colony Road BS and the Collins Bay BS could only be retired once an O'Connor Reservoir and Pumping Station (required by the study year 2011) were provided. In addition, the 400 mm watermain on Bayridge Drive (from Cedarwood Drive to Creekford Road) would also need to be extended south to Woodbine Road, replacing the existing 200 mm watermain, currently in place; unless, the watermains in GA2 West had been installed (based on private development schedules).

7.7.5 Watermains

a) Interconnecting watermains (Alternative 2)

In order to provide an interconnected City of Kingston water supply and distribution system, the following watermains and the study year for providing the same would be as follows:

i) A 400 mm watermain on Princess Street and a 400 mm watermain on John Counter Boulevard (and open Bath Street valve) for the study years 2011 and 2016.

   It should be noted that the required interconnection watermain on Princess Street (approximately one kilometer in length) would pose significant design considerations due to the bridge, railway crossing and the wetlands. This would increase the cost for this watermain above a "normal" installation. This has been incorporated into the estimated cost per metre of the watermain, as provided in **Table 7.1**.

ii) An interconnection is not required on Front Road/King Street West for the study year 2016. This interconnection watermain *would* be required following the study year 2016, as appropriate.

b) Watermains, of note, required for peak hour and maximum day plus fire flow demand and other conditions

i) A second 900 mm discharge watermain from the Kingston West WTP to Front Road is required as soon as possible to provide a redundancy for the existing plant discharge to Front Road. For Alternative 1, the 900 mm watermain would need to be extended westerly to the existing 600 mm watermain on Front Road (1,740 metres). For Alternative 2, the 900 mm watermain could be terminated at the intersection with Front Road (i.e., the 1,085 metre long, 900 mm watermain extension to the west would *not* be required).

ii) For Kingston West, Pressure Zone 2, a 400 mm watermain on Cataraqui Woods Drive would need to be extended to Sydenham Road for a peak hour or a maximum day plus fire flow condition, in order to retire the Sydenham Road BS.

iii) A 400 mm watermain on Bayridge Drive (from Cedarwood Drive to Creekford Road) would need to be extended south to Woodbine Road, replacing the existing 200 mm watermain (420 metres), currently in place, in order to retire the Old Colony Road BS and the Collins Bay BS, prior to the watermains in GA2 West being installed, based on private development. An O'Connor Reservoir and Pumping Station would also need to be provided.

It is understood that a 400 mm watermain on Bayridge Drive, from Creekford Road to Cedarwood Drive, would be constructed by the study year 2011 (based on private development). Potentially, the replacement of the 200 mm watermain on Bayridge Drive (between Cedarwood Drive and Woodbine Road) could be constructed at the same time.

The cost to install this replacement watermain could be considered low enough for Utilities Kingston to consider replacing this section of watermain at an earlier date in order to allow the retirement of the Old Colony Road BS and the Collins Bay BS.

iv) A 600 mm watermain from the discharge of an O'Connor Drive Reservoir and Pumping Station to the intersection of Gardiners Road and O'Connor Drive would be required for the study year 2011.

The existing 500 mm watermain, reducing to a 400 mm watermain, from O'Connor Drive to Cataraqui Woods Drive would require replacement with a 600 mm watermain (i.e., a 600 mm watermain from the intersection of Gardiners Road and O'Connor Drive to the intersection of Gardiners Road and Cataraqui Woods Drive) prior to the study year 2026.

v) The existing 300 mm watermain on Sydenham Road, from Cataraqui Woods Drive to the Petro Canada fuel storage tanks, should be replaced with a 400 mm watermain, together with the 400 mm watermain to be constructed on Cataraqui Woods Drive (from east of Gardiners Road to Sydenham Road), in order to increase the available fire flow at the Petro Canada fuel storage tanks site and to accommodate the peak hour demands at the north end of Sydenham Road (north of Highway 401).

The remaining required watermains have been summarized in **Section 5**, above, and provided in detail in **Appendix A**, Tab 10.

END

PREFERRED SOLUTION TO THE “PROBLEM STATEMENT”

8 Preferred Solution to the "Problem Statement"

8.1 General

The four alternatives that were evaluated in order to address the "Problem Statement" and to identify the preferred solution have been presented in detail in **Section 5**.

This section has identified the selected, preferred solution to the "Problem Statement" and the methodology employed for the selection, based on the evaluation criteria established and presented at the two Public Information Centres for public and governing authorities input.

8.2 Evaluation Criteria

8.2.1 Items of Note

i) Water conservation measures have always been considered to be a high priority item for any alternatives being considered; accordingly, water conservation has not been included as an "evaluation criteria". Utilities Kingston continues to undertake measures to reduce water loss throughout the water supply and distribution systems to the level generally considered acceptable for cities the size of the City of Kingston. A display indicating Utilities Kinston's water conservation measures was provided at both Public Information Centres.

ii) The majority of the comments provided at the two Public Information Centres indicated that watering restrictions were not desired and were generally not followed to the letter of the law (extremely difficult to enforce).

iii) Although water rates were raised as an issue, the general response did indicate that water rates should not be considered as an additional evaluation criterion. The "economics" evaluation criteria somewhat addresses this issue; however, it should be noted that a small minority of interested parties did indicate that since the Kingston Central WPP required no increase in water supply capacity in the short to mid term, an interconnection that would allow this current excess water supply capacity at the Kingston Central WPP to be used to address development in Kingston West, could impact the water rates for residents in Kingston Central (considered undesirable).

The general response provided to this concern was that the existing independent water supplies and distribution systems was being considered as an alternative; however, the preferred solution to the "Problem Statement" should be selected based on the City of Kingston, considered as one entity

8.3 Evaluation Criteria

The evaluation criteria were developed to address the broad definition of the impact that the infrastructure-related alternatives could potentially have on the environment, as a whole, as presented in the Class Environmental Assessment, Municipal Engineers Association June 2000.

It should be noted that design and operations and social impact and historical significance were provided as separate criteria at the two Public Information Centres. Design and operations and historical impact and social impact could both be combined; however, the four criteria were deliberately presented individually, as the relative importance, specific to operations and historical significance (particularly at the Kingston Central WPP) were specific criteria wished to be known (relative to the other five criteria).

As noted in **Item 6.5.2**, "maintenance costs" has been added to the evaluation criteria (a request from the Cataraqui Region Conservation Authority).

The selected evaluation criteria (in no particular order), as presented at the Public Information Centres, plus the maintenance cost criterion, are as follows:

i) Design

This criterion would generally relate to technical suitability aspects of the alternatives. The ability to implement new water treatment technologies would also be a design consideration.

ii) Operations

This criterion would generally relate to how the overall operation of the undertaking would be impacted.

iii) Economics

This criterion would generally relate to the cost and budgeting impact of the alternatives.

iv) Natural environment

This criterion would generally relate to the potential impact that the alternatives could pose on the environment (both natural and physical).

The environment would be composed of land, water, air, humans, ecological, aquatic and terrestrial systems, terrestrial vegetation and wildlife and operational noise.

v) Public health

This criterion generally relates to the ability of the alternatives to provide a *reliable* supply of *safe* drinking water to the population at large, as regulated under the Safe Drinking Water Act (SDWA), 2007.

vi) Social impact

This criterion generally relates to the potential of the alternatives to impact the community such as residents, neighbourhoods, social interaction and character. The social impact should also address the development objectives of the community to encourage the wellbeing of the residents and the vitality of the community, including the potential for increased employment (always a significant consideration).

vii) Historical significance

This criterion generally relates to the historical and heritage features that apply to the undertaking. Heritage and historical features would be of concern if greater than limited impact of any undertaking were to occur. Historical and heritage features cannot be replaced; accordingly, these features must either be incorporated (i.e., the features would be incorporated into the architectural components of the undertaking) or the undertaking would need to work around these features (still incorporating the architectural components of the undertaking).

viii) Maintenance costs

Since maintenance costs was not included in the Questionnaires for ranking of the relative degree of importance of the evaluation criteria, relative to one another, maintenance costs were subsequently assigned the same ranking as system operations for evaluation purposes.

8.3.1 Relative importance of evaluation criteria based on Questionnaires received

The importance of the eight evaluation criteria, relative to each other (0 to 8, with 1 being the most significant, including the additional criterion of maintenance costs), based on the Questionnaires received, has been presented in **Table 8.1**, on the following page.

Table 8.1 – Relative Importance of Evaluation Criteria

Evaluation Criteria	Overall Ranking
System Operations	5
Design Considerations	4
Economics	3
Natural Environment	2
Historical Significance	7
Public Health	1
Social Impact	8
Maintenance Costs **	5

** Added as a result of Public Information Centre No. 2

8.4 Evaluation of Alternatives

8.4.1 General

A weighting of the relative importance of the "eight" evaluation criteria was applied to the overall rating of the four alternatives, presented in matrix form, in **Table 8.2**, on page 102. Each of the eight evaluation criteria has been weighted, taking into account the ratings provided in **Table 8.1**. The weightings established determined the importance to be placed on each of the evaluation criteria as applied during the evaluation of the four alternatives.

The evaluation of the alternatives could vary based on the considered short-term (2011), mid-term (2016) and long-term (2026) water supply and distribution system requirements, as indicated in the "Problem Statement". The short-term and mid-term requirements should be considered as progressive steps toward the long-term requirements; accordingly, only the long-term study year 2026 has been evaluated.

8.4.2 Methodology to present the evaluation of alternatives

In order to present the evaluation in a clear and visual manner, the relative degree of impact of the eight criteria, relative to each of the four selected alternatives, has been indicated in a matrix format with the relative degree of impact of the eight criteria indicated in a "pictogram" format for each alternative. A totally white pictogram would indicate the "least impact" and a totally black pictogram would indicate the "most severe impact".

8.4.3 Evaluation matrix of the four alternatives

An evaluation of the four alternatives, based on the seven evaluation criteria provided in the Questionnaires and the additional maintenance costs criterion, added after Public Information Centre No. 2 (in response to the letter and Questionnaire provided by the Cataraqui Region Conservation Authority), has been presented in **Table 8.2**, on the following page.

It should be noted that “Triple Bottom-line Accountability” (provided as a display at Public Information Centre No. 2, prior to the proposed “Evaluation Criteria” display) was taken into account as part of the evaluation.

Table 8.2 – Evaluation of the Four Alternatives

Evaluation Criteria	Alternative 1	Alternative 2	Alternative 3	Alternative 4
System Operations	- Would remain as current; except for activities associated with the expansion of Industrial Park Reservoir - Retirement of water booster stations would reduce operations requirements	- Would remain relatively the same as current - Additional system flexibility would reduce critical operations interventions - Retirement of water booster stations would reduce operations requirements - Operators would be required to learn to operate interconnected system (not major)	- Should be easier to operate and maintain (one water treatment plant) and large new expansion - Additional system flexibility would reduce critical operations interventions - Operators would be required to learn to operate interconnected system (not major) - Retirement of water booster stations would reduce operations requirements	- A single water treatment plant would be the easiest system to operate and maintain - Additional system flexibility would reduce critical operations interventions - Operators would be required to learn to operate interconnected system (not major) - Retirement of water booster stations would reduce operations requirements
Design Considerations	- The required expansion of Kingston West WTP would be 4 ML/d greater than for Alternative 2 - Would likely use existing plant technology (direct filtration) - Kingston West WTP retrofit design required	- The required expansion of Kingston West WTP would be 4 ML/d less than for Alternative 1 - Requires 2 km of 1050 mm trunk watermain - Would likely use existing plant technology (direct filtration) - Kingston West WTP retrofit design required - The provision of the 1050 mm trunk watermain, prior to the long-term study year 2026, would allow potential retirement of Kingston Central WPP, as required	- The required expansion would be 127 ML/d - Requires 5 km long 1050 mm trunk watermain, complete - Would allow potential "partial" latest technology - Kingston West WTP retrofit design required	- The required expansion would be 168 ML/d - Still requires 1050 mm trunk watermain, complete - Would allow latest technology
Economics	- Alternative 1 would cost more than Alternative 2	- Alternative 2 would cost less than Alternative 1 (marginally reduced cost implications) - The 2 km long 1050 mm interconnection watermain would not be required until after the mid-term study year 2016 - Could be marginally easier to allocate funding, as the more immediate reduced Kingston West WTP expansion would marginally reduce budget implications	- Cost much higher than Alternatives 1 & 2, but less than Alternative 4 - Provision of the 1050 mm trunk watermain would allow Alternative 4 to be a longer term option	- Highest cost alternative - Provision of the 1050 mm trunk watermain would be required - Land would be required for new water treatment plant - A new water treatment plant would not require a retrofit design required
Natural Environment	- No significant environmental impact	- Construction of the two new interconnections would increase impact as compared to Alternative 1 - All else would remain the same as Alternative 1 except no expansion of the industrial Park Reservoir would be required - Little Cataraqui Creek crossing required	- Same impact as Alternative 2 - 1050 mm trunk watermain still required - Little Cataraqui Creek crossing would be required	- Most significant impact if a new intake was installed - 1050 mm trunk watermain still required - Little Cataraqui Creek crossing would be required
Historical Significance	- No change, until longer term - Assumes the Kingston Central WPP remains functional and preserved	- No change, until longer term - Assumes the Kingston Central WPP remains functional and preserved	- Retirement of Kingston Central WPP would allow other uses of land (park or new architecturally pleasing building	- Retirement of Kingston Central WPP would allow other uses of land (park or new architecturally pleasing building)
Public Health	- Potential retirement date of Kingston Central WPP unknown - Ontario SDWA requires a safe and *reliable* water supply	- Could provide a safe and more *reliable* longer-term water supply by expanding the Kingston West WTP, as required - Kingston Central WPP could not be expanded	- Could provide a safe and a significantly more reliable longer-term water supply by expanding Kingston West WTP	- Would supply a safe and the most reliable longer-term water supply
Social Impact	- For the long-term study year 2026, the Kingston Central WPP would require expansion and the plant could/should not practically be expanded due to age, site constraints and neighbourhood impact	- The Kingston West WTP could be expanded on the existing site once the Kingston Central WPP was retired, when required (no change to social impact)	- The Kingston West WTP could be expanded on the existing site once the Kingston Central WPP was retired, when required - The land where the Kingston Central WPP is located could become parkland, if desired	The land where the Kingston Central WPP and the land where the Kingston West WTP (at a later date) is located could become parkland, if desired - Land required for new water treatment plant
Maintenance Cost	- Alternative 1 and 2 would have similar maintenance costs	- Alternative 1 and 2 would have similar maintenance costs - The industrial Park Reservoir expansion would not be required; hence, reducing maintenance costs	- Retirement of the Kingston Central WPP would significantly reduce maintenance costs	- Retirement of the Kingston Central WPP would significantly reduce maintenance costs - A single new water treatment plant would significantly reduce maintenance costs
OVERALL EVALUATION				

LEGEND				
	LOWEST IMPACT MOST PREFERRED	MEDIUM IMPACT	MEDIUM TO HIGH IMPACT	HIGHEST IMPACT LEAST PREFERRED

8.4.4 Discussion regarding the alternatives rating matrix

i) It was anticipated that the relative rankings of the four Alternatives could be similar. There would be benefits associated with the provision of a new water treatment plant with regards to allowing new technology and reduced operation and maintenance costs; however, by maintaining the two existing water treatment plants, there would be significant economic benefits as well as environmental impact benefits.

ii) In conjunction with the alternatives rating matrix, a “Triple Bottom-line Sustainability” approach was used to measure success (arriving at the preferred solution) by looking at three main types of goals: maintaining a healthy community, supporting the economic vitality of the community and maintaining a sustainable natural environment. All undertakings (alternatives) should aim to simultaneously create environmental, social and economic benefits and value. The selection of the preferred solution should incorporate community involvement, be based and emphasize the transparency of the methods to arrive at the preferred solution, be equitable, ensure accountability, as well as providing monitoring and continuous improvement towards a healthy community, the economic vitality of the community and a sustainable natural environment.

iii) The evaluation appeared to indicate that the existing two water treatment plants should continue to be used to supply drinking water to the City of Kingston since it appears that with a limited expansion of the Kingston West WTP and maintaining the existing “functional” capacity of the Kingston Central WPP, the long-term study year 2026 water demands could be provided. With the provision of the two-kilometre long, 1050 mm interconnection watermain on Front Road and King Street West, by extending this 1050 mm watermain an additional three kilometres, connecting the discharge location of the Kingston West WTP, at Front Road to the discharge location from the Kingston Central WPP, at King Street West, the opportunity to implement *both* Alternative 3 and 4 would remain as viable future options (desirable).

8.5 Preferred solution to the “Problem Statement”

8.5.1 General

The preferred solution has been selected based on the rating of the four alternatives, based on the evaluation criteria from the interested parties and internal input.

As indicated in the “Problem Statement”, the preferred solution must accommodate the current (2007), the near-term (2011), the mid-term (2016) and the long-term (2026) water supply and distribution system requirements for the urban area of the City of Kingston as presented in the Urban Growth Strategy (UGS), 2004, as approved by Council of the City of Kingston.

It should be noted that, regardless of the selected preferred solution to the "Problem Statement", additional water supply for Kingston West is required *as soon as possible*. For this reason alone, construction activities would be taking place at the Kingston West WTP regardless of whether Alternative 1, 2 or 3 was selected. Since the water supply would be required as soon as possible, Alternative 4 would likely not be available for the short-term study year 2011 (significant infrastructure, and the associated cost, would be required).

It should also be noted that the Kingston Central WPP could be used to supply the "functional" capacity of 95 ML/d; however, due to the age and uncertainty with regards to the structural integrity at the lowest levels of the plant, continued operation to the long-term study year 2026 remains somewhat uncertain. The continued use of the Kingston Central WPP beyond the long-term study year 2026 would be even more uncertain.

The potential interconnection of the Kingston West and the Kingston Central water supplies and distribution systems would only require the opening of the Bath Road valve (normally closed) and the installation of the 400 mm interconnection watermains on Princess Street and John Counter Boulevard to accommodate the study year 2016 water demands for the City of Kingston.

Regardless of the selected preferred solution to the "Problem Statement", additional water storage would be required in both water distribution systems particularly in Kingston West.

Again, regardless of the selected preferred solution, the significant number of required infrastructure for the short-term study year 2011 could pose considerable budget issues for Utilities Kingston.

8.5.2 Preferred Solution

The evaluation of all four Alternatives were very close; however, based on the overall evaluation of the four alternatives, **Alternative 2** has been selected (marginally) as the **preferred solution**, as indicated in the final row of the evaluation matrix (**Table 8.2**).

Discussions with regard to the short-term requirements as applicable to the mid-term and long-term requirements for the preferred solution have been provided, in **Section 4**.

8.5.3 Comments regarding the preferred solution

Although Alternative 2 has been selected as the preferred solution, Alternative 3, and potentially Alternative 4, would remain open as viable options following the long-term study year 2026, or potentially sooner. Through the selection of Alternative 2 as the preferred solution, the potential opportunities of Alternative 3, and potentially Alternative 4, could be considered when providing the required additional infrastructure in the distribution system and determining the design water supply capacity increase at the Kingston West WTP.

For the evaluation, the provision of the two-kilometre long 1050 mm interconnecting watermain was required prior to the study year 2026.

It should be noted that the provision of a 1050 mm trunk watermain, from the discharge locations from the Kingston West WTP on Front Road to the discharge locations from the Kingston Central WPP on King Street West, should remain as a *high priority* prior the long-term study year 2026, or sooner, in order to maintain Alternative 3 and, potentially, Alternative 4, as readily viable, long-term options.

The selection of an option that allows potential future changes in the method of providing a safe and secure drinking water supply for the City of Kingston was considered to be a very significant contributing factor for the selection of Alternative 2 as the alternative that would satisfy not only the short-term (2011), mid-term (2016) and long-term (2026) water supply and distribution system requirements, but would also be able to satisfy the water demands for the City of Kingston *well beyond* the long-term study year 2026.

The eventual provision of the 1050 mm trunk watermain on Front Road and King Street West was considered to be a very significant infrastructure component in order to allow Alternative 3 and, potentially, Alternative 4 to be further considered in *more* future years.

For Alternative 2, the provision of the interconnection as a 1050 mm watermain, for the long-term study year 2026, or sooner, should be considered as the “first step” towards the provision of the “complete” 1050 mm trunk watermain interconnection between the supply points from the existing Kingston West WTP and the Kingston Central WPP (highly desirable).

Alternative 4 would always remain available in *more* future years, allowing for complete new water treatment technologies in a new water treatment plant to remain as a viable alternative, beyond the long-term study year 2026, or sooner.

8.6 Implementation of the Preferred Solution

8.6.1 General

The implementation of the preferred solution could prove to be a significant challenge for Utilities Kingston, based on the fact that many infrastructure requirements would be required for the study year 2011 and budget constraints would definitely be an issue. For this reason, the implementation of the preferred solution must take budget constraints into consideration and, although required for the short-term study year 2011, prioritize the major infrastructure requirements to suit. This would require input from Utilities Kingston regarding the proposed priority for the provision of the required additional infrastructure.

The confirmed ability to retire all four, existing booster pumping stations should be considered a very significant benefit (much reduced operation and maintenance costs).

The required infrastructure for the near-term study year (2011) have been presented below in the proposed sequential order of importance, relative to one another; although, again, the infrastructure so indicated have all been identified as required for the short-term study year 2011.

8.6.2 Proposed sequence for the provision of infrastructure required for the short-term study year 2011

a) Industrial Park Reservoir

No expansion is required for the preferred solution.

b) Expansion of the Kingston West WTP

The expansion of the Kingston West WTP must remain as the *highest* priority to supply drinking water (particularly for Kingston West). Without this additional drinking water supply, the other required infrastructure, indicated as required for the short-term study year 2011, would be of much reduced value.

In order to accommodate the projected additional water demands for the short-term and mid-term study years 2011 and 2016, the required increase in the water supply capacity of the Kingston West WTP would be 5 ML/d and 9 ML/d, respectively (assuming the “functional” capacity of 95 ML/d remained available from the Kingston Central WPP).

In order to accommodate the projected additional water demands for the long-term study year 2026, the required increase in the water supply capacity of the Kingston West WTP would be 31 ML/d (assuming the “functional” capacity of 95 ML/d remained available from the Kingston Central WPP).

Expansions to water treatment plants are normally provided to accommodate the water demands for a *minimum* of 20 years. Based on the small incremental increases in the expansions required at the Kingston West WTP for the study years 2011 and 2016, the expansion in the “functional” water supply capacity for the study year 2011 should be **31 ML/d**.

It should be noted that an investigation of the intake crib and the intake should be undertaken during the next Phase of the Class Environmental Assessment.

c) Provision of an O’Connor Drive Reservoir and Pumping Station

The provision of an O’Connor Drive Reservoir and Pumping Station would be required to provide the current required fire and equalization storage, as well as providing the maximum day demands in Pressure Zone 2.

The required storage capacity for the short-term and mid-term study years 2011 and 2016 would be 6.0 ML and 6.5 ML, respectively.

Due to the incremental storage capacity requirements, phasing of the reservoir should not be considered an option; accordingly, the new storage capacity of **8.8 ML** required for the study year 2026 should be provided for the study year 2011.

The infrastructure size and the required piping and future pumping requirements of the Pumping Station for the long-term study year 2026 should be provided for the study year 2011, in order to allow ready installation of future pumps and associated mechanical, electrical and control equipment, to accommodate the 2026 demands, or greater.

d) Expansion of the Third Avenue Reservoir and Pumping Station

The required expansion (based on incorporating the required additional storage capacity into the existing reservoir) of the Third Avenue Reservoir for the long-term study year 2026 would be 7.1 ML.

The expansion in the storage capacity of **7.1 ML** should be provided for the study year 2011.

Simulation, using the water model, indicated that the existing *theoretical* firm pumping capacity was 31.6 ML/day.

As provided on page 15 and 16, **Appendix A**, Tab 10, the required pumping capacity for a maximum day plus fire flow demand condition would be 33.7 ML/d for the study years 2011 and 2016. The required pumping capacity for a maximum day plus fire flow demand condition would be 35 ML/d for the study year 2026.

The existing pumps to be replaced to provide a firm pumping capacity of **35 ML/d**.

The required pumping capacities should be reviewed during the next Phase of the Class Environmental Assessment.

e) A Kingston Highway 15 Reservoir and Pumping Station

The provision of a Kingston Highway 15 Reservoir would be required to satisfy the current required fire storage and the Pumping Station required to supply the fire flow as well as the peak hour demands in the northern portion of Kingston East.

The new storage capacity required for the long-term study year 2026 of **7 ML** should be provided for the study year 2011.

The infrastructure size and the required piping and future pumping requirements of the Pumping Station for the long-term study year 2026 should be provided for the study year 2011 in order to allow ready installation of future pumps and associated mechanical, electrical and control equipment, to accommodate the 2026 demands (required firm pumping capacity of **19 ML/d**).

f) Watermains

1) Interconnecting watermains

To initiate the interconnection of Kingston West with Kingston Central (including Kingston East), the Bath Road valve (normally closed) would need to be opened and the 400 mm interconnecting watermains on Princess Street and on John Counter Boulevard installed. These would be required for the short-term study year 2011.

Based on modelling, the two-kilometre long 1050 mm watermain interconnection on Front Road/King Street West would not be required until following the mid-term study year 2016.

The complete installation of the 1050 mm trunk watermain from the discharge locations from the Kingston West WTP on Front Road to the discharge locations from the Kingston Central WPP on King Street west *should* be considered for the long-term study year 2026, or sooner, based on the status of the Kingston Central WPP, as determined by Utilities Kingston.

2) Other watermains

i) The provision of the 900 mm discharge watermain from the Kingston West WTP to Front Road *should* be considered, prior to the short-term study year 2011. Utilities Kingston Operations have indicated that this second plant discharge watermain should be considered as a *high priority* work activity (for redundancy of the single discharge watermain).

ii) The 600 mm discharge watermain from an O'Connor Drive Reservoir Pumping Station to Gardiners Road to be provided for the study year 2011.

iii) Based on modeling, a new 600 mm watermain on Front Road, from Days Road, connecting to the existing 600 mm watermain on Bayridge Drive (from Front Road to Taylor Kidd Boulevard would be required for the short-term year 2011. Modelling indicated that without the provision of this watermain, the pressures in the vicinity of Bayridge Drive and Taylor Kidd Boulevard and on Hudson Drive in the area of Downing Street, both in Pressure Zone 1, would be *less than the minimum* required water pressure of 275 kPa (40 psi). In addition, this watermain would provide a much desired, second Bath Road watermain crossing in Kingston West, allowing for significantly improved distribution of the system pressures in Kingston West.

iv) Third Avenue 500 mm watermain

Based on modeling, this watermain *should* be provided for the short-term study year 2011 in order to satisfy the *minimum* required water pressure of 275 kPa (40 psi).

v) Based on modeling, a 400 mm watermain to replace the existing 250 mm watermain on Avenue Road (parallel to Sir John A. MacDonald Boulevard, immediately north of Princess Street), connecting the existing 400 mm watermains at both ends, should be provided for the short-term study year 2011. Increasing the diameter of this small section of watermain would *significantly* improve water pressures in areas to the north for all demand conditions, but most importantly, the available residual water pressure during a fire would be substantially increased.

g) Gardiners Road BS and Sydenham Road BS retirement

The Gardiners Road BS could not be retired until an O'Connor Drive Reservoir and Pumping Station and the 600 mm discharge watermain, connecting to the existing 500 mm watermain on Gardiners Road, were provided. Once provided, the Gardiners Road BS could be retired and a direct flow through the existing water booster station site would be provided, allowing discharge directly to an O'Connor Drive Reservoir, to be pumped into Zone 2 to continue filling the Creekford Road Elevated Tank to the top water level.

The Sydenham Road BS could be retired following the installation of an O'Connor Drive Reservoir and Pumping Station *plus* the 400 mm watermain on Cataraqui Woods Drive, from Centennial Drive to Sydenham Road.

h) Old Colony Road BS and Collins Bay Road BS retirement

The Old Colony Road BS and the Collins Bay BS could be retired (once an O'Connor Drive Reservoir and Pumping Station was constructed) based on the priority established by Utilities Kingston for their retirement.

In order to retire the Old Colony Road BS and the Collins Bay Road BS for the short-term study year 2011, the existing 200 mm watermain on Bayridge Drive (from Cedarwood Drive to Woodbine Road) would need to be upgraded to 400 mm. Based on modelling, without this 400 mm watermain in place, the pressures at the highest location in Pressure Zone 2 would *not* be sufficient during peak hour demand periods, due to high pipe friction losses in the existing, reduced diameter, 200 mm watermain on Bayridge Drive.

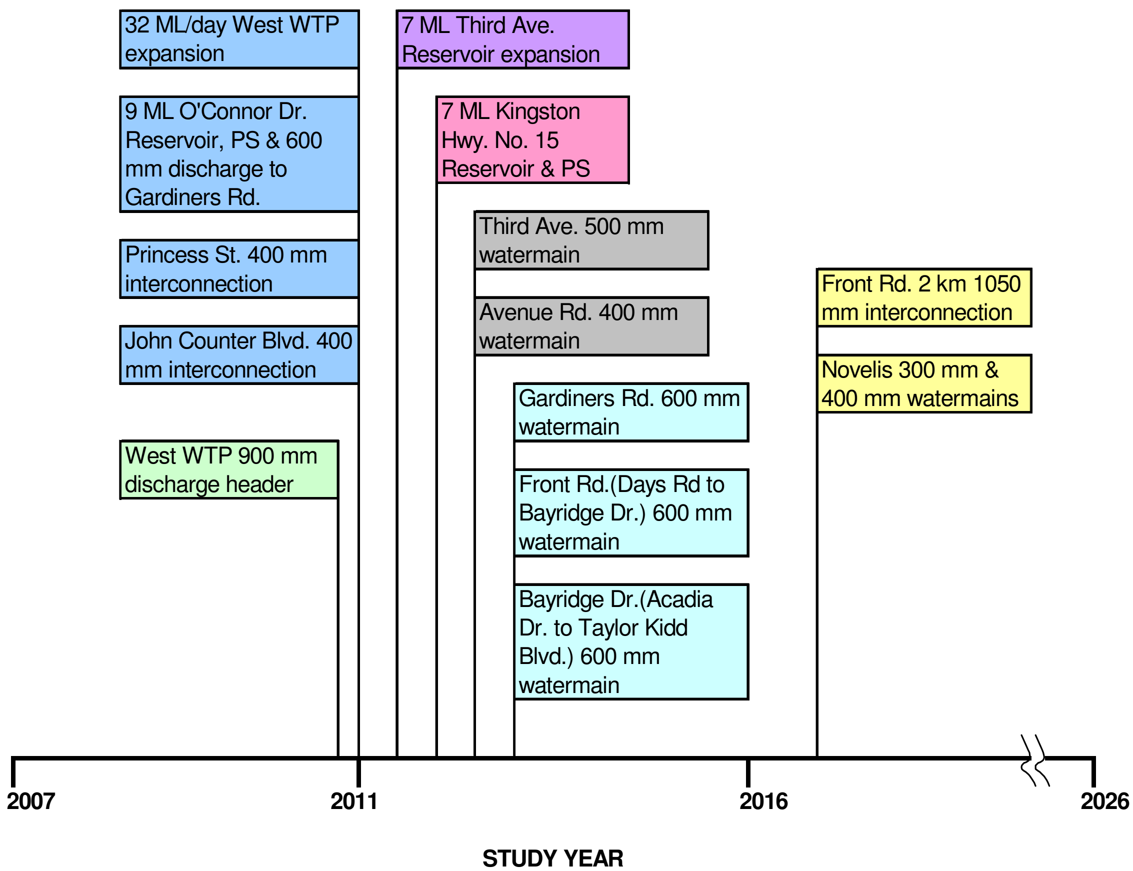
A 400 mm watermain on Bayridge Drive (from Creekford Road to Cedarwood Drive) is planned for construction in the short-term (by the study year 2011) as part of private development in the area of GA2 West. In order to retire *both* water booster pumping stations in the shot-term study year 2011, the replacement of the existing 200 mm watermain with a 400 mm watermain on Bayridge Drive, from Cedarwood Drive to Woodbine Road (420 metres in length) would be required (at an estimated cost of $245,000).

Potentially, this might not be considered a significant budget issue as opposed to the required continued use of the Old Colony Road BS and the Collins Bay Road BS (a Utilities Kingston decision).

8.6.3 Suggested sequence for the provision of required infrastructure for the short-term study year 2011 and following

The suggested sequence for the provision of required infrastructure for the short-term study year 2011 and following has been presented in a visual format in **Figure 8.1**, on the next page. It is understood that due to the *many* infrastructure requirements required on an as soon as possible basis, Utilities Kingston would need to consider budget issues and the suggested sequence that has been provided would be subject to further review by Utilities Kingston.

Figure 8.1 – Suggested Sequence to Provide the Required Infrastructure for the Study Year 2026



Comments: The timeframe for the retirement of water booster pumping stations has not been indicated, as the retirement would be dependent on the priority for retirement, as established by Utilities Kingston.

An O'Connor Drive Reservoir and Pumping Station to be provided and the 400 mm watermain provided on Cataraqui Woods Dr. (from Centennial Dr. to Sydenham Rd.) to retire the Gardiners Road and Sydenham Road BS.

The retirement of the Old Colony Road BS and the Collins Bay BS would require an O'Connor Drive Reservoir and Pumping Station to be provided and a 400 mm watermain provided from Creekford Road to Woodbine Road.

8.7 Comments regarding the implementation of the preferred solution

i) Budget issues would be significant in order to provide the required infrastructure for the study year 2011.

ii) The expansion of the Kingston West WTP remains the "highest" priority.

iii) The second 900 mm discharge watermain from the Kingston West WTP to Front Road should be constructed as soon as possible. This should be considered as "high" priority.

iv) Since an interconnected Kingston West and Kingston Central (including Kingston Central) water distribution system is the basis of Alternative 2, the *actual* interconnection should be provided as soon as possible. This would require the provision of the 400 mm interconnecting watermains on Princess Street and on John Counter Boulevard and the opening of the Bath Road valve (normally closed).

   The 1050 mm interconnection watermain on Front Road and King Street West should be provided following the mid-term study year 2016 The provision of the complete five-kilometre long 1050 mm trunk watermain should be considered prior to the study year 2026 (Alternative 3 and, potentially, Alternative 4, would then be available for implementation following the long-term study year 2026, or earlier).

v) An O'Connor Drive Reservoir and Pumping Station (including the 600 mm discharge watermain from the Pumping Station to Gardiners Road) would be required for the study year 2011 to provide the required maximum day and fire flow for Pressure Zone 2.

vi) The Gardiners Road BS and the Sydenham Road BS could both be retired once an O'Connor Drive Reservoir and Pumping Station were provided, including the 400 mm watermain on Cataraqui Woods Dr., (Centennial Dr. to Sydenham Rd.).

vii) The Third Avenue Reservoir expansion should be provided as soon as possible following the short-term study year 2011.

viii) A Kingston Highway 15 Reservoir and Pumping Station should be provided as soon as possible following the short-term study year 2011.

ix) The Old Colony Road BS and the Collins Bay BS could be retired, as determined by Utilities Kingston, once an O'Connor Drive Reservoir and Pumping Station and a 400 mm watermain provided on Bayridge Drive from Creekford Road to Cedarwood Drive and from Cedarwood Drive to Woodbine Road.

8.8 Class Environmental Assessment undertakings for the additional required infrastructure for the preferred solution for the study year 2026

8.8.1 General

The Class Environmental Assessment undertakings for the additional required infrastructure for the study year 2026 have been provided in **Table 8.3**.

Table 8.3 - Class Environmental Assessment Undertakings for the Required Infrastructure for the Study Year 2026

Class Environmental Assessment Undertaking	Schedule
Expansion of the existing Kingston West WTP	C
New O'Connor Drive Reservoir and Pumping Station and 600 mm discharge watermain to Gardiners Rd.	B
New O'Connor Dr. 600 mm watermain (O'Connor Drive Pumping Station to Gardiners Rd.)	B
Expansion of existing Third Ave. Reservoir	B
Replace pumps at Third Avenue Reservoir Pumping Station	B
New Kingston Highway 15 Reservoir and Pumping Station	B
Decommissioning existing water booster pumping stations	B
New Princess St. interconnecting 400 mm watermain	B[1]
New John Counter Blvd. interconnecting 400 mm watermain	A[2]
New Front Rd./King St. W. interconnecting 1050 mm wm.	B[1]
New Kingston West WTP 900 mm discharge watermain	A[2]
A new O'Connor Drive 600 mm watermain from an O'Connor Drive Reservoir Pumping Station to Gardiners Road	A[2]
A new Gardiners Road 600 mm watermain (from O'Connor Drive to Cataraqui Woods Drive)	A[2]
New Front Rd./Bayridge Dr. 600 mm watermain	A[3]
New Avenue Rd. 400 mm watermain	A[3]
New Novelis 300 mm and 400 mm watermains	A[3]
New Third Ave. 500 mm watermain	A[3]
New Gardiners Rd. 600 mm watermain (O'Connor Dr. to Cataraqui Woods Dr.	A[2]

Notes:

1. Would be a Schedule B undertaking due to the Little Cataraqui Creek crossing (Cataraqui Region Conservation Authority would require input).
2. If constructed within the existing road allowance (most probable)
3. Would generally be considered as Schedule A undertakings, unless, under special mitigating circumstances, the provision of the watermain could be considered as a Schedule B undertaking.

END

IMPACT OF AN EXPANDED STUDY AREA FOR THE PREFERRED SOLUTION FOR THE STUDY YEAR 2026 (2026A)

9 Impact of an "Expanded Study Area" for the Preferred Solution for the Study Year 2026 (2026A)

9.1 Introduction

Utilities Kingston wished to know the potential impacts on the preferred solution (Alternative 2) for an "expanded study area" (previously presented in **Section 3**).

The support information to provide the impact on the preferred solution for an "expanded study area" for the study year 2026 (2026A) was considerable. In order to provide the impact in a concise manner, for ease of presentation, **Section 9** of this Report has been provided in a summary format.

The detailed Section 'Impact of an "Expanded Study Area" for the Preferred Solution for the Study year 2026 (2026A)' has been provided in **Appendix B,** Tab 10 (following Technically Feasible Alternatives, Including Technical Considerations, to Address the "Problem Statement"), for reference.

The "expanded study area" has been based on the City of Kingston's comprehensive secondary planning areas, including the expanded development areas GA3, GA4 and GA5, as presented in the Urban Growth Strategy, Final Report 2004, and additional expanded development areas A, B, C and D. A plan (**Figure 3.1**) indicating the City of Kingston's comprehensive secondary planning area has been provided in **Section 3**, following page 24.

As should be expected, with an increased population; hence, an increased water demand, the water supply, water storage, pumping station and watermain infrastructure, required to accommodate the increased drinking water demand, would increase.

The "expanded study area" water demands and the required increase in the water supply and certain distribution system infrastructure, for the preferred solution, have been provided for the study year 2026 and referred to as the study year **2026A**.

The location of the *significant* potential development areas would be as follows: north of Highway 401 - **GA5**, west of service area GA2 (West) - **GA3** and in the most eastern portion of Kingston East - **GA4**.

Potential development areas A, B, C and D were also included in the "expanded study area" to be reviewed. These potential development areas are considerably small and would have no significant impact, as opposed to GA3, GA4 and GA5.

All impacts on the water supply and the water distribution system facilities and watermains have been provided for both the study year 2026 and the study year 2026A, for comparison purposes.

The additional water supply required, the impact on the required infrastructure in the water distribution system and the potential impact on the water distribution system pressures, as determined by modelling, and the associated costs, as indicated in this Section for the "expanded study area" for the study year 2026A, have been prepared to allow Utilities Kingston to assess the impact of the required additional infrastructure, as compared to the study year 2026.

9.2 Projected maximum day demands versus water treatment plant capacities

The projected maximum day demands for the preferred solution for the study year 2026A and 2026 (for comparison purposes), as compared to the "functional" capacity of the two, water treatment plants, combined, have been indicated in **Table 9.1**.

Table 9.1: Maximum Day Demand Versus Existing Plants Capacities

Study year	Maximum Day Demand (ML/d)	Plants "Functional" Capacity (ML/d)	Deficit in Plants "Functional" Capacity (ML/d)
2026			
Kingston West	65.5	41.0	24.5
Kingston Central (including Kingston East)	101.2	95.0	6.2
Kingston Central	80.9	--	**--**
Kingston East	20.3	--	**--**
Total	**167**	**136.0**	**31**
2026A			
Kingston West	92.5	41.0	51.5
Kingston Central (including Kingston East)	123.5	95	28.5
Kingston Central	91.6	--	**--**
Kingston East	31.8	--	**--**
Total	**216**	**136.0**	**80**

The maximum day demand, for the "expanded study area" for the study year 2026A, for the City of Kingston would be **216 ML/d**.

The maximum day demand, for the study year 2026, for the City of Kingston would be **136 ML/d**.

The **additional** required water supply from the Kingston West WTP to the City of Kingston water distribution system would be 80 ML/d (216 ML/d – 136

ML/d). This would require a Kingston West WTP "rated" capacity expansion of **85 ML/d**.

9.3 Water storage requirements

The water storage requirements for the "expanded study area" for the study year 2026A would increase substantially.

9.4 "Expanded study area" for the study year 2026A

The locations of all required infrastructure (including replacement and proposed new development watermains) to accommodate the water demands for an "expanded study area" for the study year 2026A have been indicated in **Figure 9.1**, on the following page (also included, full size, in the envelope in **Appendix G**, Tab 15).

9.5 Summary of the "rated" water supply, the "functional" water storage, pumping stations, watermains requirements for the preferred solution for the study years 2026 and 2026A

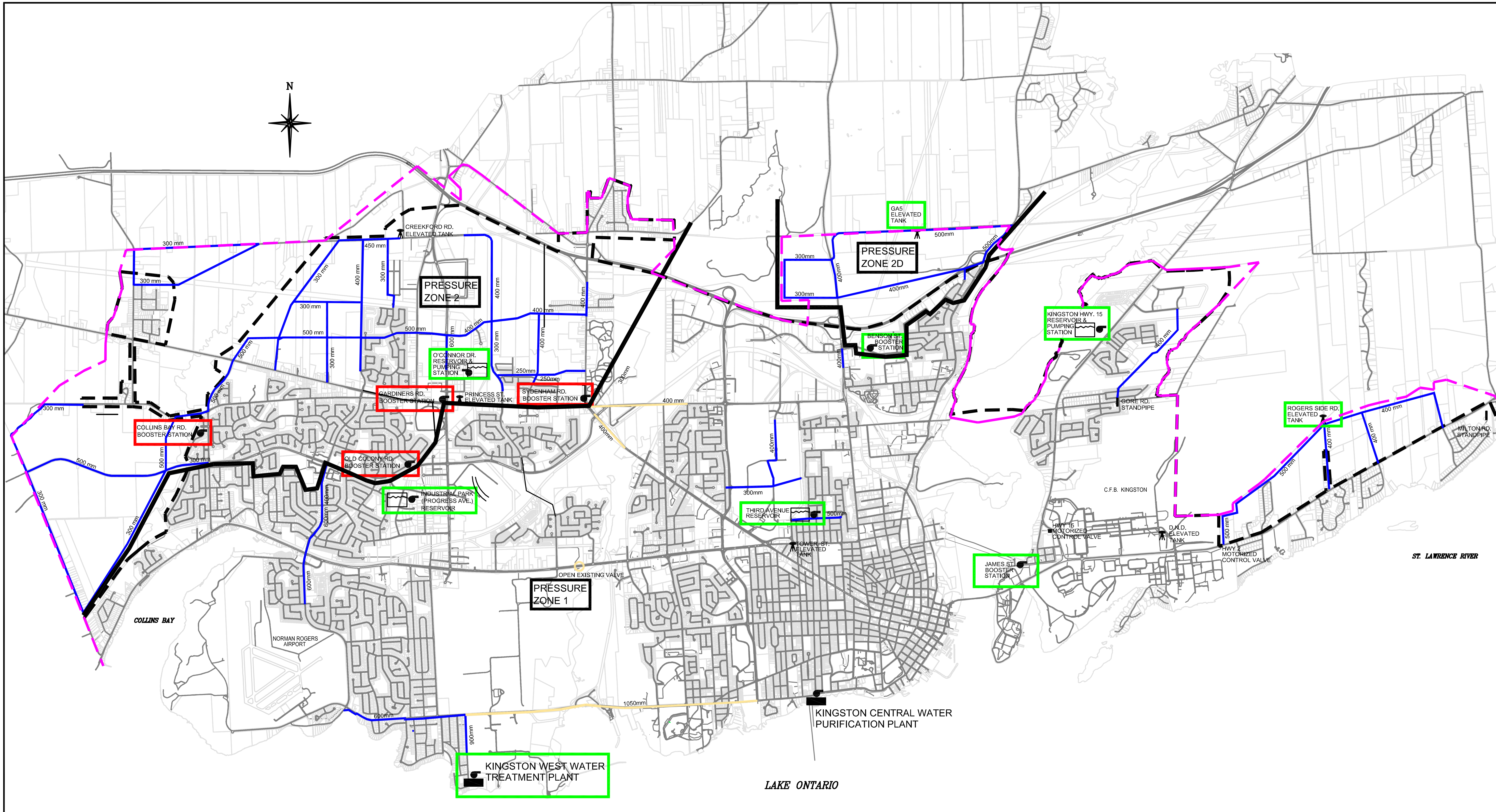
i) <u>Water treatment plants</u>

The **"functional"** water supply is the water available to be pumped into the City of Kingston water distribution system for use.

The **"rated"** capacity of the required **expansions** of the Kingston West WTP (existing "rated" capacity of 45.5 ML/d and an existing "functional" water supply capacity of 41 ML/d) has been estimated by increasing the required "functional" water supply capacity of the plant by a historical percentage (water treatment plants, in general) of six per cent (6%), to account for in-plant water uses (such as filter back washing and other). It has been assumed that the "functional" water supply capacity of the Kingston Central WPP would remain as current (95 ML/d).

ii) <u>Water storage reservoirs</u>

The **"modelled"** required storage capacity of proposed new water storage reservoirs and expansions to existing water storage reservoirs would be *increased* to provide the **"calculated"** storage capacity required to provide the "modelled" proposed new water storage reservoirs and expansions to existing water storage reservoirs. The "calculated" proposed new water storage reservoirs capacities or expansions to existing water storage reservoirs capacities would be *greater* in order to account for unusable storage (based on the existing reservoirs "functional" water storage capacity and the practical issues associated with the operation of reservoirs and also the site conditions).



NOTES:

1. DATA SOURCES: FIGURE W1, CITY OF KINGSTON URBAN GROWTH STRATEGY, JULY, 2004; UTILITIES KINGSTON FILE INFORMATION

LEGEND

URBAN BOUNDARY	NEW/UPGRADED FACILITY
EXPANDED STUDY AREA BOUNDARY	RETIRED
EXISTING WATERMAINS	
NEW WATERMAINS	
INTERCONNECTING WATERMAINS	
PRESSURE ZONE BOUNDARY	

utilities kingston
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UTILITIES KINGSTON
MASTER PLAN FOR WATER SUPPLY

FIGURE 9.1: CITY OF KINGSTON WATER SUPPLY AND DISTRIBUTION SYSTEM – STUDY YEAR 2026A

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A summary of the required “rated” water supply expansion of the Kingston West WTP, the increase in the “calculated” water storage requirements (expansions to existing water storage reservoir capacities or the provision of new water storage reservoirs), the required pumping capacity in the water booster and reservoir pumping stations and the additional watermain requirements, for the study years 2026 and 2026A, has been provided in **Table 9.2**, on the following three pages.

The water supply expansions to the existing capacity of the Kingston West WTP and the proposed new and expansions to water storage reservoirs capacities have been indicated as the “rated” and “calculated” expansions and capacities, respectively.

9.6 Estimated cost of required infrastructure to accommodate the water demands for the preferred solution for the study years 2026 and 2026A

The estimated cost for the required infrastructure for the preferred solution for the study year 2026 (for comparison purposes) and the “expanded study area” for the year 2026A has been indicated in **Table 9.3**, on page 121. Again, the required “rated” water supply expansions of the Kingston West WTP and the required “calculated” water storage capacities of new and expansions to existing reservoirs have been indicated in **Table 9.3**.

Table 9.2 Required Infrastructure for the Preferred Solution (Alternative 2) for the Study Years 2026 and 2026A

Infrastructure Requirements	Study Year 2026	Study Year 2026A
Kingston West		
Water Treatment Plants (ML/day)		
Expansion of the existing Kingston West WTP “rated” capacity	33	85
Reservoirs (ML)		
Expansion of the existing Industrial Park Reservoir	N/A	4.3
New O'Connor Dr. Reservoir	8.8	13
Booster and Pumping Stations (ML/day)		
Industrial Park Reservoir P.S.	19.9	20.7 (review pumps)
Replace pumps at Third Avenue Reservoir Pumping Station	35	35
New O'Connor Dr. Pumping Station	35 (minimum)	88.4
Retire existing Booster Stations	4	4
Watermains (metres)		
New 900 mm discharge watermain from the Kingston West WTP	1,085	1,085
New 600 mm watermain on Front Rd. (Days Rd. to Bayridge Dr.)	1,370	1,370
New 600 mm watermain on Bayridge Dr. (Acadia Dr. to Taylor Kidd Blvd.)	2,083	2,083
New 600 mm watermain on O’Connor Dr. (from O’Connor Drive PS to Gardiners Rd.)	230	230
New 600 mm watermain on Gardiners Rd. (O'Connor Dr. to Cataraqui Woods Dr.)	631	631
New 1050 mm interconnecting watermain on Front Rd.	2,000	4,100
New 400 mm interconnecting watermain on Princess St.	1,000	1,000
New 400 mm interconnecting watermain on John Counter Blvd	1,300	1,300
New 500 mm wm. on Cataraqui Woods Dr. (Gardiners Rd. to Bayridge Dr.)	N/A	1,250
New 400 mm wm. on Cataraqui Woods Dr. (Gardiners Rd. to Centennial Dr.)	N/A	775
New 400 mm watermain on Bayridge Dr. (Cedarwood Dr. to Woodbine Rd.)	N/A	450
New 500 mm watermain on Collins Bay Rd. (Princess St. to Woodbine Rd.)	N/A	860
Kingston Central		
Water Treatment Plants (ML/day)		
Kingston Central WPP	95	95
Reservoirs (ML)		
Expansion of the existing Third Avenue Reservoir	7.1	7.2

Infrastructure Requirements	Study Year	
	2026	**2026A**
New GA5 Elevated Tank	N/A	6
Booster and Pumping Stations (ML/day)		
Third Avenue Reservoir P.S.	35 (replace pumps)	35 (replace pumps)
New Benson Street BS	N/A	12.1
Watermains (metres)		
New 400 mm watermain on Avenue Rd. (Princess St. to McMahon Ave.)	398	398
New 500 mm watermain on Third Ave. (MacDonnell St. to Alfred St.)	645	645
New 300 mm watermain across the Novelis property (east-west)	1,119	1,119
New 400 mm watermain on the Novelis property (north)	765	765
New 400 mm watermain on Division St. (Weller Ave. to Benson St.)	N/A	550
Kingston East		
Reservoirs (ML)		
New Kingston Highway 15 Reservoir	7	7
New Rogers Side Road Elevated Tank	N/A	6.8
Booster and Pumping Stations (ML/day)		
New Kingston Highway 15 Reservoir Pumping Station	19	19
James Street BS	20.3	32.8 (upgrade pumps)

Table 9.3 - Estimated Costs for the Preferred Solution for the Study Years 2026 and 2026A

Infrastructure Description	Unit	Unit Cost	2026		2026A	
			Size	Cost	Size	Cost
Expansion of West WTP "rated" capacity	ML/day	$780,000	33	$25,740,000	85	$66,300,000
Expansion of Industrial Park Reservoir	ML	$435,000	N/A	N/A	4.3	$1,870,500
New O'Connor Dr. Reservoir	ML	$435,000	8.8	$3,828,000	13.0	$5,650,500
New O'Connor Dr. Pumping Station		N/A	N/A	$1,900,000	N/A	$2,700,000
Expansion of Third Avenue Reservoir	ML	$435,000	7.1	$3,088,500	7.2	$3,132,000
New Kingston Highway 15 Reservoir	ML	$435,000	7	$3,045,000	7	$3,045,000
Upgrade Pumps at Third Avenue PS		N/A	N/A	$250,000	N/A	$250,000
New Kingston Highway 15 Pumping Station		N/A	N/A	$1,600,000	N/A	$1,600,000
Retire four existing Booster Stations		N/A	N/A	$200,000	N/A	$200,000
New Benson Street BS		N/A	N/A	-	N/A	$1,750,000
New GA5 Elevated Tank	ML	$800,000	N/A	-	6	$4,800,000
New Rogers Side Road Elevated Tank	ML	$800,000	N/A	-	6.8	$5,440,000
Upgrade pumps at the James Street BS			N/A	-	N/A	$700,000
New 900 mm watermain from West WTP	metres	$1,550	1,085	$1,681,750	1,085	$1,681,750
New 600 mm watermain on Front Rd. (Days Rd. to Bayridge Dr.)	metres	$1,300	1,370	$1,781,000	1,370	$1,781,000
New 600 mm watermain on Bayridge Dr. (Acadia Dr. to Taylor Kidd Blvd.)	metres	$1,300	2,083	$2,707,900	2,083	$2,707,900
New 600 mm watermain on O'Connor Dr. (from O'Connor Drive PS to Gardiners Rd.)	metres	$1,300	230	$299,000	230	$299,000
New 600 mm watermain on Gardiners Rd. (O'Connor Dr. to Cataraqui Woods Dr.)	metres	$1,300	631	$820,300	631	$820,300
New 400 mm watermain on Avenue Rd. (Princess St. to McMahon Ave.)	metres	$950	398	$378,100	398	$378,100
New 500 mm watermain on Third Ave. (MacDonnell St. to Alfred St.)	metres	$1,150	645	$741,750	645	$741,750
New 300 mm watermain on Novelis	metres	$750	1,119	$839,250	1,119	$839,250
New 400 mm watermain on Novelis	metres	$950	765	$726,750	765	$726,750
New 1050 mm interconnecting watermain on Front Rd.	metres	$1,750	2,000	$3,500,000	4,100	$7,175,000
New 400 mm interconnecting watermain on Princess St.	metres	$1,200	1,000	$1,200,000	1,000	$1,200,000
New 400 mm interconnecting watermain on John Counter Blvd.	metres	$1,150	1,300	$1,495,000	1,300	$1,495,000
New 500 mm wm. on Cataraqui Woods Dr. (Gardiners Rd. to Bayridge Dr.) * **	metres	$1,150	N/A	-	1,250	$1,437,500
New 400 mm wm. on Cataraqui Woods Dr. (Gardiners Rd. to Centennial Dr.)	metres	$950	N/A	-	775	$736,250
New 400 mm watermain on Bayridge Dr. (Cedarwood Dr. to Woodbine Rd.)	metres	$950	N/A	-	450	$427,500
New 500 mm watermain on Collins Bay Rd. (Princess St. to Woodbine Rd.)	metres	$1,150	N/A	-	860	$989,000
New 400 mm watermain on Division St. (Weller Ave. to Benson St.)	metres	$950	N/A	-	550	$522,500
New 500 mm watermain to GA5 ET	metres	$1,150	N/A	-	2,400	$2,760,000
New 400 mm wm. to Rogers Side Rd. ET	metres	$950	N/A	-	1,000	$950,000
Total				**$55,850,000**		**$125,010,000**

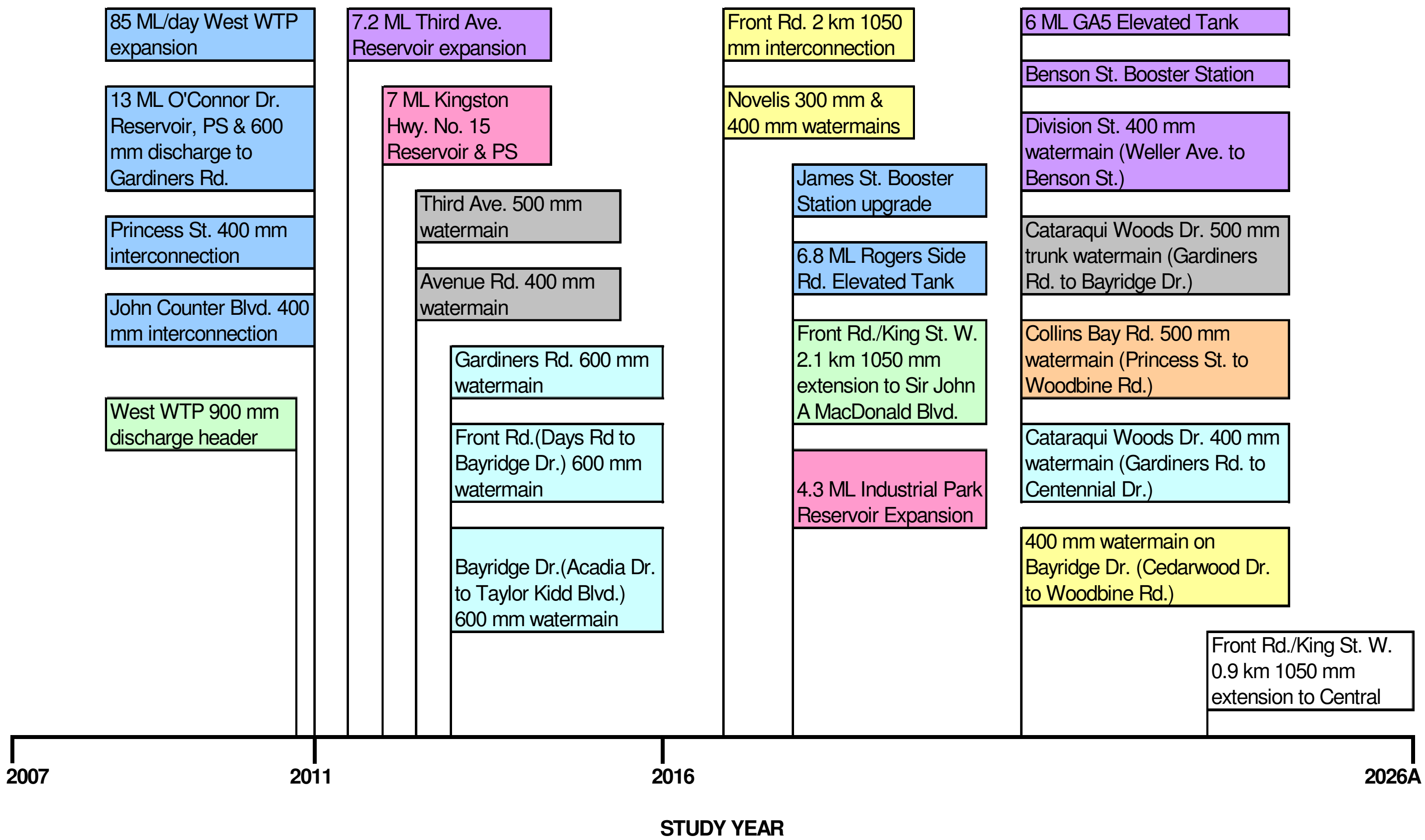
*** The provision of this watermain would be a "very" significant undertaking.

Notes: **1.** The costs indicated in Table 9.2 are 2007 $ costs. The costs will increase over time based on the rate of inflation and the Toronto ENR Index. **2.** All costs include 16% engineering.

9.7 Suggested sequence for the provision of infrastructure required for the "expanded study area" for the study year 2026A

The suggested sequence for the provision of the required infrastructure required for the "expanded study area" for the study year 2026A has been indicated in a visual format in **Figure 9.2**, on the following page. This would require the knowledgeable input from Utilities Kingston regarding the priority to be assigned for the provision of the required additional infrastructure.

Figure 9.2 – Suggested Sequence to Provide the Required Infrastructure for the Study Year 2026A



Notes:
1. The timeframe for the retirement of the water booster pumping stations has not been suggested in **Figure 9.2**.
2. The additional infrastructure to accommodate "expanded development areas" A, B, C and D would not be significant and have not been identified.
3. A 500 mm watermain on Cataraqui Woods Dr. (from Gardiners Road to Taylor Kidd Boulevard) would be required prior to development of GA3 (a major infrastructure requirement).

9. 8 Class Environmental Assessment undertakings for required infrastructure for the preferred solution for the "expanded study area" for the study year 2026A

The Class Environmental Assessment undertakings for the required infrastructure have been indicated in **Table 9.4**.

Table 9.4 - Class Environmental Assessment Undertakings for the Required Infrastructure for the Study Year 2026A

Undertaking	**Schedule**
Expansion of the Kingston West WTP	C
O'Connor Drive Reservoir and Pumping Station	B
Expansion of Third Avenue Reservoir	B
Expansion of Industrial Park Reservoir	B
Kingston Highway 15 Reservoir and Pumping Station	B
GA5 Elevated Water Storage Tank	B
Rogers Side Road Elevated Water Storage Tank	B
Replace pumps at Third Avenue Reservoir Pumping Station	B
Upgrades to James Street Booster Pumping Station	B
Decommissioning water booster pumping stations	B
Princess St. interconnecting 400 mm watermain	B[1]
John Counter Boulevard interconnecting 400 mm watermain	A[2]
Front Rd./King St. West interconnecting 1050 mm watermain	B[1]
Kingston West WTP 900 mm discharge watermain	A[2]
O'Connor Dr. 600 mm watermain (an O'Connor Drive Pumping Station to Gardiners Road)	A[2]
Gardiners Road 600 MM watermain (O'Connor Dr. to Cataraqui Woods Dr.)	A[2]
Front Rd./Bayridge Dr. 600 mm/400 mm watermains	A[3]
Avenue Rd. 400 mm watermain	A[3]
Novelis 300 mm and 400 mm watermains	A[3]
Third Ave. 500 mm watermain	A[3]

Notes:

1. Would be a Schedule B undertaking due to the Little Cataraqui Creek crossing (Cataraqui Region Conservation Authority would require input).
2. If constructed within the existing road allowance (most probable)
3. Would generally be considered as Schedule A undertakings, unless, under special mitigating circumstances, the provision of the watermain could be considered as a Schedule B undertaking.

END

APPENDIX A

TECHNICALLY FEASIBLE ALTERNATIVES, INCLUDING TECHNICAL CONSIDERATIONS, TO ADDRESS THE “PROBLEM STATEMENT

1 Technically Feasible Alternatives, Including Technical Considerations, to Address the “Problem Statement”

1.1 General

The various scenarios to address the “Problem Statement” have been presented in **Section 4** of the main Report.

The criteria and assumptions, on which the scenarios were based, were also presented in **Section 4** of the main Report.

Scenarios were presented for the study years 2026, 2016 and 2011.

Modelling was provided for the year 2006 to determine the status of the water supply and distribution system, as current.

Four technically feasible alternatives have been determined:

i) An independent Kingston West and an independent Kingston Central (including Kingston East) water supply and distribution system

ii) An interconnected City of Kingston water supply and distribution system (with water supplied from both the Kingston West WTP and the Kingston Central WPP)

iii) An interconnected City of Kingston water supply and distribution system (with water supplied from an expanded Kingston West WTP, with the Kingston Central WPP no longer in service)

iv) An interconnected City of Kingston water supply and distribution system (with water supplied from a new water treatment plant, with the Kingston West WTP and the Kingston Central WPP no longer in service)

The locations for potential ‘high-risk’ fires have been based on knowledge of the City of Kingston and discussions with the City of Kingston Fire Department. The Fire Underwriters Survey and the MOE Guidelines indicates that fighting only one fire for a single water supply and distribution system (similar in size to the future population for the City of Kingston) is generally the accepted practice; accordingly, *one* fire occurrence only has been modelled for each independent water supply and distribution system and for an interconnected City of Kingston water supply and distribution system.

Modelling has been completed for all scenarios (independent and interconnected) for the study years 2011, 2016 and 2026.

Modelling has also been completed for a City of Kingston "expanded study area" for the preferred alternative, *only,* for the study year 2026 (referred to as "2026A").

The accepted approach for determining the progressive water supply and water distribution system watermains and facilities requirements in future study years was to model for the most future study year (2026) and then model progressively backwards (i.e., the long-term study year 2026, the mid-term study year 2016 and then the short-term study year 2011). This modelling approach would provide additional watermains and infrastructure to be provided in the earlier study years, based on knowledge of the most future design requirements (i.e., avoids the potential need to replace watermains, if sized only to accommodate the more current study year being modelled and would allow potential phasing of water supply and water storage and the associated pumping stations and booster pumping stations).

For additional in-ground storage at distributed high lift pumping and storage facilities, such as the Third Avenue Reservoir and the Industrial Park Reservoir (Progress Avenue Reservoir), it has been assumed that additional expansions would be constructed at elevations generally identical to those of the existing cells. The old and new cells would be hydraulically connected to operate together with the identical overflow levels, top water levels, and low water levels (for pump protection or other constraints). It has been assumed that the cells would act together to "turn over" the water in both the old and new cells (a required operational procedure). The normal operating range would be adjusted to reflect the new total fire and emergency storage volumes below, and the new total equalization storage above the fire storage volume.

Based on modelling, in many cases the additional equalization storage required is small; accordingly, with the increased, expanded reservoir footprint, the equalization storage would be a smaller fraction of the total than is currently the case and a new normal low operating level would be correspondingly higher than has currently been established.

1.2 Alternatives

1.2.1 General

Modelling of the independent and an interconnected water supply and distribution system scenarios for the study year 2006 identified certain existing water supply and distribution system deficiencies that need to be addressed in the near term. The modelling for the study year 2026 scenarios allowed the identified deficiencies to be addressed such that the more immediate, required watermains and water supply and distribution systems facilities could be provided to accommodate the future study year's requirements.

Modelling has also allowed the technically feasible alternatives to be established.

As indicated in **Section 1.1**, above, the alternatives and the modelling for the study years 2011, 2016 and 2026 have been indicated from the most future study year to the more current study year.

Reference should be made to **Section 3** of the main Report for all values used in **Appendix A**.

1.2.2 Alternative 1 - Independent Kingston West and Kingston Central (including Kingston East) water supplies and distribution systems

a) Kingston West water supply and distribution system

1) Study year 2026

i) General

The maximum day demand for the study year 2026 would be provided by an expansion to the existing Kingston West WTP to provide the required additional water supply while maintaining the Kingston Central WPP at its "functional" water supply capacity of 95 ML/d.

ii) Water supply requirement

The required maximum day discharge from the Kingston West WTP into the Kingston West water distribution system would be 77.3 ML/d.

The 2006 "functional" water supply capacity of the Kingston West WTP has been established as 41 ML/d; accordingly, a minimum **36 ML/d** (36.3 ML/d) or, (77.3 ML/d – 41 ML/d) water supply expansion would be required to supply all Pressure Zones in Kingston West. The required 36 ML/d water supply expansion would be provided based on a suggested timeframe as presented for the study year 2011, following.

Invista owns the land adjacent to the existing Kingston West WTP; accordingly, negotiations with Invista would be required to potentially obtain any additional land required to accommodate a minimum water supply expansion of 36 ML/d at the Kingston West WTP or to the minimum required water supply expansion, based on the preferred solution selected.

The Kingston West WTP intake pipe (1200 mm) would have sufficient capacity for a water supply expansion of 36 ML/d and greater; however, the existing intake structure is an intake crib and the intake crib would require additional hydraulic review (potentially, a new intake structure would be required).

iii) Water storage requirements

<u>Pressure Zone 1</u>

Based on the MOE Guidelines, an additional 6.5 ML of water “storage” would be required in Pressure Zone 1.

The on-site water storage at the Kingston West WTP would be required for in-plant use (e.g., providing a portion of the required chlorine contact time (CT) for an expansion of the plant, filters back washing and other); accordingly, the required additional water storage would need to be provided in the water distribution system at the Industrial Park Reservoir (Progress Avenue Reservoir) and Pumping Station or at some other location.

In addition, it would be more prudent to provide the required additional fire storage and pumped supply at a location upstream from the Kingston West WTP (further upstream in the water distribution system); such that, only the maximum day demand would need to be accommodated in the watermains emanating from the Kingston West WTP. The Industrial Park Reservoir would appear to be the most logical location to provide the required additional storage.

Modelling, assuming the water storage reservoir at the Kingston West Plant was reserved for in-plant uses (i.e., has not been included in the Kingston West water storage requirements), indicated that the required additional storage at the Industrial Park Reservoir site would be **10.1 ML** (5.4 ML for fire and 4.7 ML for equalization).

Based on a review of the city-owned land available for potential expansion, the Industrial Park Reservoir site could readily accommodate a reservoir expansion of 10.1 ML.

<u>Pressure Zone 2b</u>

Based on the MOE Guidelines, an additional 11.3 ML of water storage would be required for Pressure Zone 2 (to be located in existing Pressure Zone 2b and drawing water from Pressure Zone 1).

Modelling indicated that the *required* storage capacity would be **9.6 ML/d** (6.3 ML/d for fire storage and 3.3 ML/d for equalization storage).

This required additional water storage could be provided by a new in-ground reservoir and the associated pumping station located at the northeast end of O'Connor Drive (on property owned by the City of Kingston and of more than sufficient size to accommodate a new in-ground reservoir and the associated pumping station). If an O'Connor Drive Reservoir and Pumping Station were located at this location, the Gardiner's Road BS would be retired. An examination and modelling of other potential reservoir and pumping station locations has indicated that the O'Connor Drive site is a well-suited location. Based on previous Reports, it appeared that this location had been the "location of choice" for many years and the Municipality acquired the property as a result.

Since this reservoir would draw water from Pressure Zone 1 and since the Princess Street Elevated Tank must not be allowed to drain into the reservoir, a pressure control valve on the watermain discharge into the reservoir would need to be provided such that the valve would sustain a pressure in Pressure Zone 1 at the inlet to the reservoir of 300 kPa (43.5 psi). Flow into the reservoir would only occur when the pressure was greater than 300 kPa.

Modelling has indicated that during average day conditions, the water level in the Princess Street Elevated Tank and an O'Connor Drive Reservoir would not be decreasing.

The starting and stopping of the pumps at an O'Connor Drive Reservoir and Pumping Station would be controlled by the established high and low water levels in the Creekford Elevated Tank (i.e., once the water level in the Creekford Elevated Tank reached the top water level, the pumps at an O'Connor Drive Pumping Station would stop). A second actuated butterfly valve on the inlet watermain to an O'Connor Drive Reservoir would be required, downstream of the pressure control valve, to stop the flow into the reservoir once the water level in the reservoir increased to the top water level.

This would be addressed during the next Phase of the Class Environmental Assessment.

Pressure Zone 2c

No additional water storage would be required to service Pressure Zone 2c. All required water storage for Pressure Zone 2c would be provided in Pressure Zone 2b. As indicated below, Pressure Zone 2c would no longer exist and Pressure Zone 2b and 2c would become a single pressure zone (Pressure Zone 2b).

Pressure Zone 2a

No additional water storage would be required to service Pressure Zone 2a. All required water storage for Pressure Zone 2a would be provided in Pressure Zone 2b. Potentially, Pressure Zone 2a could be eliminated. This has been further presented for the study year 2011, following.

iv) Water storage pumping stations and booster stations

Pressure Zone 1

The required flow from the Industrial Park Reservoir Pumping Station would be 230 L/s (**19.9 ML/d**) to satisfy the peak hour and maximum day plus fire flow demand conditions. The capacity of the existing pumps is adequate to satisfy this flow with two pumps operating in parallel, based on the pump curves on file. It is likely that the two electrically driven pumps have never been stressed to pump at a rate of approximately 115 L/s (9.95 ML/d) each. The revised design operating points on the pumps curves would be reviewed during the next Phase of the Class Environmental Assessment.

Pressure Zone 2b

For a pumping station at an O’Connor Drive Reservoir, the total dynamic head of the pumps would need to be sufficient to pump, at the required maximum day flow rate, to the top water level of the Creekford Road Elevated Tank (159.8 m). The required maximum day flow would be approximately **35 ML/d** (400 L/s) to supply the entire Pressure Zone 2 (assuming that Pressure Zones 2a and 2c were to be eliminated, as discussed in **Section 7** of the main Report).

During a maximum day plus fire flow condition, the Creekford Road Elevated Tank has *insufficient* fire storage to accommodate a fire flow of 378 L/s for six hours. Accordingly, for a fire flow condition, the pumps at an O’Connor Drive Pumping Station would be required to supply the maximum day demand plus supplement the fire flow demand (i.e., the fire flow would be supplied by both the Creekford Road Elevated Tank and an O’Connor Drive Reservoir and Pumping Station).

Pressure Zone 2c

All required water storage and water supply would be provided from the Creekford Road Elevated Tank and an O'Connor Drive Reservoir and Pumping Station (Pressure Zone 2b).

Only one additional watermain would be required to accommodate a maximum day plus fire flow demand condition, a 400 mm watermain on Cataraqui Woods Drive, from Centennial Drive to Sydenham Road (part of the development in Cataraqui North Subdivision). The provision of this watermain would allow the Sydenham BS to be retired with no upstream impact and Pressure Zone 2b and Pressure Zone 2c would become one pressure zone (Pressure Zone 2b). Retiring the Sydenham Road BS and eliminating Pressure Zone 2c would be desirable.

With the installation of the 400 mm watermain, a suitable fire flow would be available at the Petro Canada fuel storage tanks.

It should be noted that with the retirement of the Sydenham Road BS, this southerly section of Sydenham road would become a dead-end watermain. A suitable method to provide a loop for this section of watermain should be considered.

Pressure Zone 2a

Currently, all required water storage and water supply would be provided from Zone 1.

Pressure Zone 2a is currently serviced by the Old Colony Road BS [maintaining a pressure differential between the suction (from Pressure Zone 1) and the discharge of the booster pumps of 140 kPa (20 psi), a boost in the pressure to Zone 2a of 140 kPa] and the Collins Bay Road Booster Station [discharge pressure maintained at 640 kPa (93 psi)].

Modelling with the provision of the Creekford Road Elevated Tank in service and the provision of an O'Connor Drive Reservoir and Pumping Station to supply water to the Creekford Road Elevated Tank [presented in **Item iii),** above], with the appropriate opening and closing of the existing valve(s) allowing the flow of water to the Old Colony Road BS to be drawn from Pressure Zone 2 rather than from Pressure Zone 1, the Old Colony Road Booster Station would not be required and could be retired. This would be desirable.

Based on modelling, the Collins Bay Road Booster Station would also *not* be required and could be retired. This would also be desirable.

Based on modelling, the pressure, at the peak hour demand condition, in the most northerly and easterly end of Kingston West (Westbrook), for the study years 2026, 2016 and 2011, would be significantly greater than the minimum required pressure of 275 kPa. Based on modelling, the pressures, at the peak hour demand condition in the Westbrook area, for the years 2026, 2016 and 2011, would only be 12 kPa less than the pressures that would be provided with the two existing water booster stations still in operation.

Pressure Zone 2a and Pressure Zone 2b were modelled, with the valves open between the two pressure zones, for a fire flow of 378 L/s on Gardiners Road. During the fire flow modelling, the observed pressure at the most northwesterly location in Pressure Zone 2a (Westbrook) was 444 kPa (64.4 psi). The observed pressure at the highest location in Pressure Zone 2a was 380 kPa (55 psi).

It should be noted that the capacity of the pumps at an O'Connor Drive Reservoir and Pumping Station would need to be increased as the pumps would be supplying water, at the maximum day demand rate (and supplementing the fire flow demand), to an increased size service area (i.e., the water would be supplied from an O'Connor Drive Reservoir in Zone 2 rather than drawing water from Pressure Zone 1 at the Old Colony Road BS location). This would not be an issue, as increased capacity pumps at one location versus pumps at three separate locations would be a *definite* benefit.

With the above implemented, there would only be two Pressure Zones; namely, Pressure Zone 1 and Pressure Zone 2.

v) Watermain requirements

The required additional/increased size watermains would be as follows:

i) A second 900 mm discharge watermain from the Kingston West WTP

ii) A new 600 mm watermain from the existing watermain at the corner of Front Road and Days Road to the existing watermain at the corner for Front Road and Bayridge Drive (replacing the existing 200 mm watermain on Front Road)

iii) A new 600 mm watermain on Bayridge Drive, from Acadia Drive to Taylor Kidd Blvd.

iv) New watermains in GA2 West and in the Cataraqui North development areas

v) A new 600 mm watermain from the discharge of an O'Connor Dr. Reservoir Pumping Station to the intersection of Gardiners Road and Cataraqui Woods Drive

vi) A 400 mm watermain on Cataraqui Woods Drive from Centennial Drive to Sydenham Road

2) Study year 2016

i) General

The water distribution system requirements for the study year 2016 have taken into account the requirements for the study year 2026. If possible, water storage and the associated pumping stations and watermains would be provided based on the study year 2026 requirements and staging of required additional works for the study year 2016 would be provided based on a pre-determined timeframe to ensure that infrastructure was in place, when required.

ii) Water supply requirement

The required maximum day discharge from the Kingston West WTP into the Kingston West water distribution system would be 64.7 ML/d.

The 2006 "functional" capacity of the Kingston West WTP has been established as 41.0 ML/d; accordingly, a minimum water supply expansion of **24 ML/d** (64.7 ML/d – 41 ML/d)) would be required to supply all Pressure Zones in Kingston West. The suggested timing to provide the additional water supply capacity of 24 ML/d has been indicated for the study year 2011, following.

iii) Water storage requirements

<u>Pressure Zone 1</u>

Based on modelling, assuming the existing water storage at the Kingston West WTP was reserved for in-plant use, an additional **8.2 ML** (5.4 ML for fire and 2.8 ML of equalization storage) of water storage would be required.

As presented for the study year 2026, the location to provide this required additional storage would be as an expansion of the existing Industrial Park Reservoir.

Further discussion regarding the size of the reservoir expansion has been indicated for the study year 2011, following.

Pressure Zone 2b

Based on the MOE Guidelines, an additional 8.3 ML of water storage would be required for Pressure Zone 2b.

Based on modelling and the fact that the equalization storage in the Creekford Elevated Tank would be available, an additional **7.4 ML** of water storage (5.4 ML of fire storage and 2.0 ML of equalization storage) would be required.

As indicated for the study year 2026, the water storage reservoir could be provided at an O'Connor Drive, city-owned site.

The provision of this storage (taking into account the number of cells to be provided over time) has taken into account the additional 4.0 ML of additional storage required for the study year 2026 and the required storage indicated for the study year 2011, following.

Pressure Zone 2c

No additional water storage would be required to service Pressure Zone 2c. All required water storage would be provided in Pressure Zone 2b.

As indicated for the study year 2026, above, Pressure Zone 2c and Pressure Zone 2b would become a single pressure zone (Pressure Zone 2b).

Pressure Zone 2a

As indicated for the study year 2026 (the most demanding), Pressure Zone 2a would become part of a single Pressure Zone 2. All system storage for Pressure Zone 2 would be provided in the Creekford Road Elevated Tank and an O'Connor Drive Reservoir.

iv) Water storage pumping stations and booster stations

As indicated for the study year 2026, the Gardiners Road BS, the Sydenham Road BS, the Old Colony Road BS and the Collins Bay BS could all be retired.

An O'Connor Drive Reservoir and Pumping Station would be required to supply the maximum day demand to the Creekford Road Elevated Tank and to supplement the fire flow demand to Kingston West, Pressure Zone 2.

v) Watermain requirements

The watermains required would be the same as for the study year 2026.

3) Study year 2011

i) General

The water distribution system requirements for the study year 2011 have taken into account the future requirements for the study year 2016 and the study year 2026. If possible, water storage and the associated pumping stations and watermains would be provided based on the study year 2016 and the study year 2026 requirements and staging of required additional works for the study year 2011 would be provided on an as required basis, when possible.

ii) Water supply requirements

The required maximum day discharge from the Kingston West WTP into the Kingston West water distribution system would be 59 ML/d.

The 2006 functional capacity of the Kingston West WTP has been established as 41.0 ML/d; accordingly, a minimum **18 ML/d** (59 ML/d – 41 ML/d) water supply expansion would be required to supply all Pressure Zones in Kingston West.

Since the required water supply expansion of the Kingston West WTP for the study year 2016 is **24 ML/d** (a study year 2011 water supply expansion difference of **6 ML/D** (24 ML/d – 18 ML/d), potentially, expanding the Kingston West WTP in the study year 2011 to provide the water supply capacity required for the study year 2016 could be an option [a 24 ML/d expansion followed by a 12 ML/d expansion for the year 2026].

Two Kingston West WTP expansions within five years to increase the water supply capacity by an additional 6 ML/d to accommodate the water demands for the study year 2016 would suggest that, depending on available funding, only one water supply expansion of 24 ML/d should be provided. Another consideration would be to provide the water supply expansion of **36 ML/d** to accommodate the water demands for the study year 2026. Water treatment plant expansions to accommodate the water demands for a 20-year period are common.

iii) Water storage requirements

Pressure Zone 1

Based on the MOE Guidelines, an additional 7.0 ML (assuming the existing water storage at the Kingston West WTP would be reserved at the plant for in-plant use) of water storage would be required in Pressure Zone 1.

Based on modelling, and assuming the existing water storage at the Kingston West WTP would be reserved at the plant, an additional **8.2 ML** (5.4 ML for fire and 2.8 ML for equalization) of distribution system water storage would be required.

As indicated for the study years 2026 and 2016, the most suitable location to provide this required storage would be as an expansion of the existing Industrial Park Reservoir. Since the new reservoir cell would be interconnected with the existing reservoir, the current operating range in the reservoir would need to be revised to suit, once interconnected.

Pressure Zone 2b

Based on the MOE Guidelines, an additional 4.9 ML of water storage would be required for Pressure Zone 2b.

Based on modelling and the fact that the equalization storage in the Creekford Elevated Tank would be available, an additional 6.0 ML of water storage (4.6 ML of fire storage and 1.4 ML of equalization storage) would be required.

As indicated for the study years 2026 and 2016, the water storage could be provided at an O'Connor Drive, city-owned site.

A storage capacity of 6.5 ML should be provided for the study year 2011. Since the required expansion to **9.6 ML** (an increase of 3.1 ML) would be required for the study year 2016, potentially, the reservoir storage capacity of **9.6 ML** should be provided for the study year 2011.

<u>Pressure Zone 2c</u>

No additional water storage would be required to service Pressure Zone 2c. All required water storage would be provided in Pressure Zone 2b.

As indicated below, Pressure Zone 2c and Pressure Zone 2b would become a single pressure zone (pressure Zone 2).

<u>Pressure Zone 2a</u>

The same comments as provided for the study year 2016.

iv) Water storage pumping stations and booster stations

The same scenario as indicated for the study year 2016 would apply.

v) Watermain requirements

The watermains required would be the same as for study year 2016.

b) Kingston Central water supply and distribution system

1) Study year 2026

i) General

The existing Kingston Central WPP could supply the maximum day demand for the study year 2026.

ii) Water supply requirement

Kingston Central is a single pressure zone with the maximum day water supply from the Kingston Central WPP being controlled by the water level in the Tower Street Elevated Tank.

The Kingston Central WPP supplies all water to Kingston Central and Kingston East. Since Kingston East is currently supplied by the two (a 500 mm and a 450 mm) Great Cataraqui River watermain crossings (in parallel) to the James Street Booster Pumping Station (the flow is also measured). At the James Street BS the pressures are increased to service Kingston East (basically a new pressure zone) accordingly, Kingston Central and Kingston East have been addressed independently.

The required maximum day water supply from the Kingston Central WPP to the Kingston Central (including Kingston East) water distribution system would be **94 ML/d** (93.8 ML/d). The 2006 "functional" capacity of the Kingston Central WPP has been established as 95.0 ML/d; accordingly, if the "functional" water supply capacity remains as 95.0 ML/d, no expansion of the Kingston Central WPP would be required. The only consideration would be the age of the plant.

The Kingston Central WPP has two intake pipes (the longer intake pipe is used). The existing long intake pipe (1200 mm) would remain to have sufficient capacity and the existing ductile iron intake pipe is provided with corrosion protection and the intake structure (three flared intake structures) would be satisfactory to supply the required 2026 Kingston Central WPP water supply requirement.

iii) Water storage requirements

Based on the MOE Guidelines an additional 7.0 ML of water storage would be required.

Based on modelling, **6.2 ML** would be required (fire storage requirement, *only*).

The 6.2 ML of additional storage would be provided at the Third Avenue Reservoir (current storage capacity of 23.2 ML), well upstream from the Kingston Central WPP. The property originally acquired for the existing Third Avenue Reservoir allowed for a future reservoir expansion and the required 6.2 ML of additional storage could readily be accommodated adjacent to the existing reservoir and pumping station.

The new 6.2 ML expansion reservoir cell would be interconnected with the existing Third Avenue Reservoir.

For a maximum day plus fire flow condition in Kingston West, a portion of the storage in the Third Avenue Reservoir would be available and could be used.

In order to maintain the required fire storage, the current operating range would need to be reduced to suit, once interconnected. This would be addressed during the next Phase of the Class Environmental Assessment.

iv) Water storage pumping station

The required flow from the Third Avenue Pumping Station, for the worst condition of a maximum day plus fire flow (in Kingston Central) would be **35 ML/d** (410 L/s).

The existing pumps, operating in parallel, as would be required, would *not* be capable of providing this flow except if the pumps were in a *new* condition (not the case). There does not appear to be space available for additional pumps; accordingly, the existing pumps should be replaced to ensure the required performance of the pumps.

v) Watermain requirements

The required additional/increased size watermains would be as follows:

i) A 400 mm watermain on Avenue Road (on the west side and parallel to Sir John A. MacDonald Boulevard, immediately north of Princess Street to McMahon Ave.)

ii) A 500 mm watermain on Third Avenue to replace the existing 150 mm watermain from the Third Avenue Reservoir, east to the intersection of Alfred and Carlton Streets

iii) A 300 mm, east/west watermain from Avenue Road at McMahon Avenue across the Novelis property connecting to the 450 mm watermain on the eastern side of the Novelis property and a 400 mm watermain, connected to the mid-point of the east/west watermain, northerly and connected to Hyperion Court, would be required.

2) Study year 2016

i) Water supply requirement

The required maximum day water supply from the Kingston Central WPP into the Kingston Central (including Kingston East) water distribution systems would be **84 ML/d** (83.7 ML/d).

The 2006 functional capacity of the Kingston Central WPP has been established as 95.0 ML/d; accordingly, if the “functional” capacity remains as 95.0 ML/d, no expansion of the Kingston Central WPP would be required. The only consideration would be the age of the plant and the condition of the reinforced concrete at the lowest level of the plant.

ii) Water storage requirements

Based on the MOE Guidelines an additional 5.4 ML of water storage would be required at the Third Avenue Reservoir.

Based on modelling, **5.8 ML** would be required for fire storage, *only* (no equalization storage would be required). As indicated for the study year 2026, above, the current reservoir operating range would need to be reduced to suit.

iii) Water storage pumping station

The required flow from the Third Avenue Pumping Station, for the worst condition of a maximum day plus fire flow (in Kingston Central) would be **33.7 ML/d** (390 L/s).

The existing pumps at the Third Avenue Pumping Station would need to be replaced.

iv) Watermain requirements

The additional required watermains would be the same as for the study year 2026; except, the watermains in the Novelis property would *not* be required.

3) Study year 2011

i) Water supply requirement

The required maximum day water supply from the Kingston Central WPP into the Kingston Central (including Kingston East) water distribution systems would be **84.3 ML/d**. It should be noted that, based on **Table 3.10**, **Section 3**, **Item 3.2.3** of the main Report, the "unaccounted for" water in the study year 2016 was decreased from 20% in 2011 to 15% in 2016. This is the reason why the required maximum day water supply required from the Kingston Central WPP would be less in the study year 2016 (83.7 ML/D) as compared to the study year 2011 (84.3 ML/d).

The 2006 "functional" capacity of the Kingston Central WPP has been established as 95.0 ML/d; accordingly, if the "functional" capacity remains as 95.0 ML/d, no expansion of the Kingston Central WPP would be required. The only consideration would be the age of the plant and the condition of the reinforced concrete at the lowest level of the plant.

ii) Water storage requirements

Based on the MOE Guidelines an additional 6.3 ML of storage would be required at the Third Avenue Reservoir.

Based on modelling, 5.8 ML of fire storage *only* (no equalization storage would be required).

The modelled **6.2 ML** reservoir addition, required for the study year 2026, should be provided for the study year 2011.

As indicated for the study years 2026 and 2016, above, the current reservoir operating range would need to be reduced to suit. This would be addressed during the next Phase of the Class Environmental Assessment.

iii) Water storage pumping station

The required flow from the Third Avenue Pumping Station, for the worst condition of a maximum day plus fire flow (in Kingston Central) would be **33.7 ML/d** (390 L/s).

The existing pumps, operating in parallel, as would be required, would not be capable of providing this flow.

The existing pumps at the Third Avenue Pumping Station would need to be replaced. This would be addressed in the next Phase of the Class Environmental Assessment.

iv) Watermain requirements

The additional required watermains would be the same as for the study year 2016.

c) Kingston East

1) Study year 2026

i) General

The Kingston Central WPP supplies all water to Kinston East. The Kingston East water demand is currently supplied by the two (a 400 mm and a 450 mm) Great Cataraqui River watermain crossings (in parallel) to the James Street BS (the flow is also measured), at which point the pressures are increased to service Kingston East (basically, Kingston East is a separate pressure zone).

An existing motorized control valve on the existing 400 mm watermain (on Kingston Highway 15 at Main Street) currently controls the flow of water from the James Street BS to the Gore Road Standpipe. The primary control for the James Street BS is provided by the water level in the DND Elevated Water Storage Tank (TWL of 151.3 M); however, the water level in the Gore Road Standpipe provides a secondary control of the motorized control valve. The TWL of the DND Elevated Water Storage Tank and the Gore Road Standpipe are the same.

It is understood that Utilities Kingston wish to provide the necessary controls to control the water supplied to Kingston East, independent of CFB Kingston (the DND Elevated Tank). Since the primary control for the starting and stopping of the James Street BS is currently the water level in the DND Elevated Tank (a secondary control is currently in place to control the two motorized control valves from the Gore Road Standpipe and the Milton Road Standpipe, both having the same top water level as the DND Elevated Tank) it would be difficult to revise this current and well-functioning control.

A pressure transmitter installed on the inlet to the DND Elevated Tank (external from the DND Elevated Tank) with the pressure transmitter display at the Kingston Central WPP) to control the starting and stopping of the James Street BS would appear to be one choice. Since CFB Kingston have and will remain to have a significant water demand, it would be difficult to completely remove the primary control of the James Street BS from the DND Elevated Tank.

This pressure transmitter method is currently very successfully employed by The City of Toronto for supplying water to The Regional Municipality of York-owned and operated water storage reservoirs (with the water level being transmitted to The City of Toronto, Central Control).

This would be addressed in the next Phase of the Class Environmental Assessment.

ii) Water supply requirement

The maximum day demand for Kingston East would be **20.3 ML/d**.

Modelling has confirmed that for the study year 2026, the maximum day demand, upstream of the motorized control valve, can be provided, complete, by the existing James Street BS. In order to supply the additional water flows to satisfy the required peak hour and the maximum day plus fire flow demands, an in-ground reservoir and pumping station (pumping into the existing water distribution system) would be required.

For the portion of Kingston East south of the motorized control valve on Kingston Highway 15 at Main Street, as indicated in **Table A.1**, below, the population increase in the southern portion has remained relatively low since the year 2006.

Table A.1 - Kingston East Population, Northern Portion and Southern Portion (CFB Kingston)

Study year	Northern portion	Southern portion	Total
2026	12,081	4,852*	16,933
2016	8,395	4,804*	13,199
2011	6,567	4,759*	11,326
2006	5,610	4,637*	10,247

* It should be noted that the population between the years 2006 to the projected growth for the study year 2026 is relatively small (215 or, a 4.6% increase in population)

Modelling has confirmed that for the study year 2026, the maximum day plus fire flow could be provided for the portion of Kingston East, south of the motorized control valve that controls the flow of water from the James Street BS to the portion of Kingston East, north of the motorized control valve on Kingston Highway 15 at Main Street (includes the existing DND Elevated Tank and the Milton Road Standpipe).

iii) Water storage requirements

A suitable location to provide the required in-ground reservoir and pumping station would be in the northern portion of Kingston East adjacent to Kingston Highway 15. For modelling purposes, the reservoir and pumping station were assumed to be located on the west side of Kingston Highway 15.

A fire flow of 378 L/s for a duration of six hours would require fire storage, only, volume of 8.2 ML. This volume would be excessive and would certainly cause difficulties in the turnover of the water being retained in a Kingston Highway 15 Reservoir and the Gore Road Standpipe.

Since the portion of Kingston East, north of the motorized control valve could essentially be considered as a separate pressure zone, the fire and equalization storage has been based on the population actually being serviced for the study years 2026, 2016 and 2011 and in accordance with the MOE Guidelines.

The populations that would be serviced for the study years 2026, 2016 and 2011, north of the motorized control valve, have been indicated in **Table A.2**, below, including the MOE Guideline requirements for fire flows for the actual populations being serviced for the study years 2026, 2016 and 2011.

Table A.2

Storage Requirement for Kingston East - based on MOE Guidelines for actual population being serviced (Area north of Kingston Highway 15 motorized control valve)			
Study year	**2026**	**2016**	**2011**
Population	12,081	8,395	6,567
Maximum day demand (ML/day)	10.98	6.81	5.00
Fire flow rate (L/s)	**220**	**189**	**189**
Fire flow duration (hrs)	**3**	**3**	**3**
A = Fire Storage (m^3)	2,376	2,041	2,041
B = Equalization Storage (m^3)	2,745	1,703	1,251
C = Emergency Storage (m^3)	1,280	936	823
Total storage requirement (m3)	**6,401**	**4,680**	**4,115**

Since the James Street BS is capable of providing a portion of the maximum day demand for the Kingston East water distribution system, north of the motorized control valve, the secondary control (the primary control is the DND elevated tank) of the motorized control valve from the Gore Road Standpipe should remain as current. In order to provide control of a Kingston Highway 15 Reservoir and Pumping Station from the Gore Road Standpipe, an "additional" control to start the pumps [based on a water level, lower than currently established to open the motorized control valve (in order to allow the James Street BS to continue providing a water flow)] would be required.

iv) Water storage pumping station

The starting of the pumps in a Kingston Highway 15 Pumping Station would be controlled by the water level in the Gore Road Standpipe, as established by Utilities Kingston. The top water level of the Gore Road Standpipe is 151.3 m. The current operational level, as controlled by the existing motorized control valve, is 4 metres (145.7 m to 149.7 m).

Currently, when the level in the Gore Road Standpipe drops to elevation 145.7 m, the motorized control valve would open and once the Gore Road Standpipe has been filled to elevation 149.7 m, the motorized control valve would close.

The suggested “lower” water level elevation in the Gore Road Standpipe, at which the pumps in a Kingston Highway 15 Pumping Station would start, would be 143.7 m (2.0 m lower than the existing low operational water level).

The top of pipe elevation of the discharge pipe from a Kingston Highway 15 Pumping Station would be 92 m.

Accordingly, the required, discharge pipe pressure from a Kingston Highway 15 Pumping Station (in order to *fill* the Gore Road Standpipe) would be (151.3 m – 92 m) or, 59.3 m or, 84 psi (579 kPa).

In order to fill the Gore Road Standpipe to the established top water level of 149.7 m, the discharge pressure from a Kingston Highway 15 Pumping Station would be (149.7 m – 92 m) or, 57.7 m or, 82 psi (565.4 kPa).

In order to supply the largest fire flow of 220 L/s (**19 ML/d**) at 150 kPa at the highest elevation in Kingston East, the discharge pressure from a Kingston Highway 15 Pumping Station would need to be 45.8 m or, 69.3 psi or, 478 kPa. This required pressure (to satisfy the requirement of 150 kPa or, 21.75 psi at the fire location) is not greater than the maximum allowable discharge pressure of 82 psi (565.4 kPa).

It should be noted that during a maximum day plus fire flow demand condition, *no* flow from a Kingston Highway 15 Pumping Station would flow south towards the motorized control valve (this condition is desirable).

The motorized control valve, under average day and maximum day demand periods, would be controlled by the water level in the Gore Road Standpipe. However, during peak hour and maximum day plus fire flow demand conditions (the pumps at a Kingston Highway 15 Pumping Station would have started), the motorized control valve would be controlled by the water level in a Kingston Highway 15 Reservoir in addition to the Gore Road Standpipe (both water levels controlling the motorized control valve). The motorized control valve would *remain* open until the water level in the Gore Road Standpipe (likely already filled to the TWL by the water flow from a Kingston Highway 15 Pumping Station after the pumps had been called to start by the lower control water level in the Gore Road Standpipe) and in a Kingston Highway 15 Reservoir *both* rose to the pre-determined standpipe and reservoir TWL, at which point, the motorized control valve would close. The water distribution system would then return to normal operation, based on the water level in the Gore Road Standpipe.

It was important to confirm that during average day conditions, for the portion of Kingston East [including GA2 (East)], north of the motorized control valve, that the existing system, operating based on the water levels in the Gore Road Standpipe, would be able to provide the required flows and pressures to the most northerly portion of Kingston East. This would confirm whether or not, with a Kingston Highway 15 Reservoir and Pumping Station, to provide the peak hour and maximum day plus fire flow demands, an elevated water storage tank, at the most northerly location in Kingston East, should be considered.

The highest ground elevation in the most northerly portion of GA2 (East) is 108 m.

For the average day demand condition and not taking into account the pipe friction losses between the Gore Road Standpipe and the most northerly location in GA2 (East), the pressure at the most northerly location in GA2 (East), would be (147.7 m – 108 m) or, 39.7 m or, 56.4 psi or, 388.9 kPa.

Modelling for the average day demand, based on the same information as above, indicated a pressure of 54.8 psi or 378 kPa, at the same location. This calculated versus modelled comparison confirms the modelling results that for the average day demand, for the area north of the motorized control valve, the available pressure at the most northerly location in GA2 (East), would be satisfactory based solely on the water distribution system pressure as provided by the Gore Road Standpipe.

Based on the above, a Kingston Highway 15 Reservoir and Pumping Station would *not* require the provision an elevated water storage tank at the most northerly location in Kingston East [within the GA2 (East) boundary]. In addition, for maximum day demands, the existing water distribution system, north of the motorized control valve, could continue to operate, as current.

The water level in the Gore Road Standpipe would control the stopping and starting of the pumps at a Kingston Highway 15 Pumping Station.

A Kingston Highway 15 Reservoir, with a storage capacity of **6.4 ML**, and Pumping Station (a firm pumping capacity of 19 ML/d) for the study year 2026 should be provided for the study year 2011.

The provision of a continuous free chlorine residual analyzer and a free chlorine residual adjustment system for the water being discharged from a Kingston Highway 15 Reservoir and Pumping Station should be provided (the required free chlorine residual could dissipate to concentrations less than desired in the reservoir over extended periods of storage time). Potentially, this could also apply to the Gore Road Standpipe.

v) Watermain requirements

The water supply to a Kingston Highway 15 Reservoir and Pumping Station would be supplied from the James Street BS, *without* the requirement to increase the size of the existing watermains from the James Street BS to a Kingston Highway 15 Reservoir and Pumping Station.

The Kingston Highway 15 Reservoir and Pumping Station scenario would *not* require the third Great Cataraqui River watermain crossing to supply water demands to Kingston East; although, this third watermain crossing would provide an emergency water supply (in the potential event of issues at the James Street BS). If the third watermain were installed, a connection to a Kingston Highway 15 Reservoir would be provided with a similar motorized control valve that would open and close based on the equalization storage water levels, only, in a Kingston Highway 15 Reservoir, as selected by Utilities Kingston.

If the third watermain were installed and flow from Kingston East to Kingston Central was desired, this could potentially be accommodated through the use of two-way pressure reducing valves (set at slightly different pressures).

2) Study year 2016

i) Water supply requirement

The total maximum day demand for Kingston East would be **15 ML/d**.

ii) Water storage requirements

Based on the MOE Guidelines (as presented in **Table A.2**, above), the storage required at a Kingston Highway 15 Reservoir would be 4.7 ML.

Since phasing of a Kingston Highway 15 Reservoir would not be practical, the required study year 2026 storage capacity of **6.4 ML** should be provided for the year 2016.

iii) Water storage pumping station

The phasing of the required pumps would not have significant cost implications; accordingly, installation of the pumps to service the study year 2026 should be provided.

iv) Watermain requirements

The watermain requirements would be the same as for the study year 2026.

3) Study year 2011

i) Water supply requirement

The total maximum day demand for Kingston East would be **12.5 ML/d**.

ii) Water storage requirements

Based on the MOE Guidelines (as presented in **Table A.2**, above), the storage required would be 4.1 ML.

Since phasing of a Kingston Highway 15 Reservoir would not be practical, the required study year 2026 storage capacity of **6.4 ML** should be provided for the year 2011.

iii) Water storage pumping station

The same scenario as presented for the study year 2016 would apply; accordingly, installation of the pumps to service the study year 2026 should be provided.

iv) Watermain requirements

The watermain requirements would be the same as for the study years 2026 and 2016.

1.2.3 <u>Alternative 2</u> - Interconnected water supplies (expand the Kingston West WTP and maintain the Kingston Central WPP in operation) and distribution systems servicing the City of Kingston

1) Study year 2026

i) General

Alternative 2 is based on increasing the water supply capacity of the Kingston West WTP, maintaining the “functional” capacity of the Kingston Central WPP at 95 ML/d and providing interconnecting watermains at appropriate locations in a City of Kingston water distribution system.

ii) Water supply requirement

The maximum day demand for the City of Kingston would be **167 ML/d** (166.7 ML/d).

It should be noted that the maximum day demand is *less* than the total of the two independent systems maximum day demands due to the reduced maximum day peaking factor of 1.5, applicable due to the *interconnected* system.

The maximum day water supply from the Kingston Central WPP into the City of Kingston (including Kingston East) water distribution system would be 95.0 ML/d. The difference in the required maximum day demand 72 ML/d (167 ML/d – 95 ML/d) would be supplied from the Kingston West WTP. This would require the water supply from the Kingston West WTP to be expanded by **31 ML/d** (72 ML/d – 41 ML/d).

The maximum day demand for Kingston West would be 65.5 ML/d. The maximum day demand for Kingston Central (including Kingston East) would be 101.2 ML/d (a total of 167 ML/d).

To satisfy the maximum day demand condition for Kingston Central (including Kingston East), 6.2 ML/d (101.2 ML/d – 95 ML/d) would need to be supplied to Kingston Central (including Kingston East) from the Kingston West WTP.

iii) Water storage requirements

For an interconnected system for Pressure Zone 1, the Industrial Park Reservoir does *not* need to be expanded.

The water storage requirements in Kingston West, Pressure Zone 2, would be provided in the Creekford Road Elevated Tank and in a new O'Connor Drive Reservoir.

Based on modelling, an O'Connor Drive Reservoir would require 6.3 ML of fire storage and approximately 1.7 ML of equalization storage or, a total new storage capacity of **8.0 ML**.

Based on modelling, the Third Avenue Reservoir would need to be expanded to provide an additional storage capacity of **4.7 ML**, which would be fire storage *only* (6.2 ML would be required as for an independent Kingston Central water distribution system). As presented for independent Kingston Central in **Item 1.2.2**, above, a 4.7 ML reservoir expansion could readily be accommodated on the existing City-owned site.

The Third Avenue Reservoir expansion of 4.7 ML would be required for an interconnected system for the maximum day plus fire flow condition in Kingston Central. The required additional storage capacity has been *confirmed* by modelling a maximum day plus fire flow condition in Kingston Central.

The water storage requirements in Kingston East would remain the same as for Alternative 1 for the independent Kingston East condition (i.e., a Kingston Highway 15 Reservoir and Pumping Station with a reservoir capacity of **6.4 ML**).

iv) Water storage pumping stations and booster stations

The required flow from the Industrial Park Reservoir Pumping Station would remain the same as for Alternative 1.

The required flow from an O'Connor Drive Reservoir Pumping Station would remain the same as for Alternative 1.

The required flow from the Third Avenue Pumping Station, for the worst condition of a maximum day plus fire flow (in Kingston Central) would be **29.1 ML/d** (337 L/s).

The existing pumps, operating in parallel, as would be required, would be capable of providing this flow.

The Sydenham Road BS, the Old Colony Road BS and the Collins Bay BS could all be retired.

v) Watermain requirements

The additional watermains required for the independent Kingston West and Kingston Central (including Kingston East) would remain as indicated for the two independent water distribution systems.

Interconnection of the two water distribution systems would require opening the Bath Road valve, the installation of a 400 mm interconnection watermain on Princess Street and on John Counter Boulevard and a 1050 mm interconnection watermain on Front Road/King Street West.

The 1050 mm watermain should be provided, *offset* from the direct alignment from the ends of the watermains in Kingston West and Kingston Central. This would allow the extension of the 1050 mm watermain to the east and to the west, to the water treatment plant discharge locations on King Street West and on Front Road, without interrupting the two existing watermains.

The existing 300 mm watermain on Front Road would be replaced with the 1050 mm watermain to the Kingston West WTP discharge pipes location on Front Road. A 450 mm tee would be provided on the 1050 mm watermain to allow connection to the existing 450 mm watermain, at the westerly end of the existing watermain on King Street West. A temporary plug would be provided at the easterly end of the 1050 mm watermain to allow further extension without disrupting the existing 450 mm watermain. The connection to the two discharge watermains from the Kingston West WTP should be provided as part of the interconnection of Kingston West to Kingston East.

Modelling of the interconnected water distribution systems, as presented in **Table A.3** and **Table A.4**, on the following page, indicated that an interconnection on John Counter Boulevard was not specifically required (only slight differences in the flows through Bath Road, Princess Street and Front Road/King Street West were observed).

Table A.3 – Study year 2026 Interconnection Locations and Flows

Flow Condition	Average day (L/s)	Maximum day (L/s)	Peak hour (L/s)
1) John Counter Blvd.	-3	1	-14
2) Princess St.	-21	-9	-28
3) Bath Rd.	-27	-47	-77
4) Front Rd.	98	94	82
Total	**47**	**39**	**37**
Note: Positive flows indicate flows from Kingston West to Central.			

Table A.4 – Year 2026 Interconnection Locations and Flows

Flow Condition	Average day (L/s)	Maximum day (L/s)	Peak hour (L/s)
1) John Counter Blvd.	**--**	**--**	**--**
2) Princess St.	-21	-9	-31
3) Bath Rd.	-27	-47	-79
4) Front Rd.	98	94	79
Total	**50**	**28**	**31**
Note: Positive flows indicate flows from Kingston West to Central.			

As indicated in **Item b),** above, to satisfy the maximum day demand condition, 6.2 ML/d (71.8 L/s) would need to be supplied to Kingston Central from the Kingston West WTP. For the maximum day condition, modelling indicated that 8.1 ML/d (94 L/s) would flow to Kingston Central from Kingston West as a result of the 1050 mm interconnection on Front Road.

Modelling indicated that a significant portion of the easterly flow of 94 L/s, from the Kingston West WTP, generally moved north at the intersection of King Street West and Portsmouth Avenue to Bath Road and then moved west on Bath Road. Flow moving north on Portsmouth Avenue would generally service the area south and west of the intersection of Bath Road and Portsmouth Avenue, currently serviced from the Kingston Central WPP for the independent systems. This indicated that more than the required flow from the Kingston West WTP moved easterly on Front Road and a significant portion of the flow supplied the demand south and west of the intersection of Bath Road and Portsmouth Avenue. The remainder of the flow continued easterly past Portsmouth Avenue. This was considered an expected path for the demand flow (path of least resistance).

Modelling indicated that the available water pressures at the discharge locations from *both* water treatment plants to the water distribution systems remained *unchanged*. In the northern areas of Kingston West and Kingston central, the pressures during average day, maximum day and peak hour demand conditions remained the *same* as for the independent systems.

This confirmed that the interconnection of the two independent systems, with the same other watermain installations required for the independent systems, would have *no* impact on the system pressures throughout an interconnected City of Kingston water supply and distribution system.

It is understood that John Counter Boulevard will be re-constructed in the near future. Although it has been indicated in **Table A.3** and **Table A.4** that a John Counter interconnection would not necessarily be required to interconnect the Kingston Central and the Kingston West water distribution systems, the installation of this interconnecting 400 mm watermain (from Indian Road to Princess Street), as a component of the re-construction of John Counter Boulevard, should be provided.

Increased numbers of interconnections, between Kingston Central and Kingston West, should be provided for the purposes of redundancy (security of supply) and to provide alternate avenues of flow (providing re-circulation of the water), particularly for more-future study years (beyond the study year 2026) as the water demands would increase.

Modelling indicated that the provision of two-way booster pumping stations at the four interconnection locations were *not* required (i.e., flows would move freely to the west and to the east at the four interconnection locations, based on the demands from Kingston West and Kingston Central).

2) Study year 2016

i) General

The water supply and distribution system requirements for the study year 2016 have taken into account the water supply and distribution system requirements for the study year 2026. For example, in-ground water storage and pumping facilities could be provided in the study year 2016 to accommodate the requirements for the study year 2026. This would be a method to ensure that the study year 2026 requirements could be readily accommodated. Potentially, the decision to provide the study year 2026 requirements in the study year 2016 could prove to be justifiable (this would be avoided, if possible, in order to allow costs to be expended on an "as required basis").

ii) Water supply requirement

The maximum day demand for the City of Kingston would be **145 ML/d**.

The maximum day water supply from the Kingston Central WPP into the City of Kingston (including Kingston East) water distribution system would be 95.0 ML/d. The difference in the required maximum day demand (145 ML/d – 95 ML/d) or, **50 ML/d** would be supplied from the Kingston West WTP. This would require the water supply from the Kingston West WTP to be expanded by **9 ML/d** (50 ML/d – 41 ML/d).

The maximum day demand for Kingston West would be 54.8 ML/d.

The maximum day demand for Kingston Central (including Kingston East) would be 90.3 ML/d (a total of 145 ML/d).

Since the Kingston Central maximum day demand of 90.3 ML/d would be less than the maximum day discharge from the Kingston Central WPP of 95 ML/d (a difference of 4.7 ML/d), *no* water supply would be required to Kingston Central from the Kingston West WTP.

iii) Water storage requirements

i) Based on modelling, an expansion of the Industrial Park Reservoir is *not* required.

ii) Based on modelling, the storage capacity required at an O'Connor Drive Reservoir would be **6.5 ML** (5.1 ML for fire storage and 1.4 ML for equalization storage).

iii) Based on modelling, the water storage requirements for the Third Avenue Reservoir would remain the same (**4.7 ML**) as for the study year 2026, indicated in preceding **Item 1), iii)**, above.

iv) The water storage requirements in Kingston East would remain the same as for the study year 2026 (i.e., a Kingston Highway 15 Reservoir and Pumping Station with a reservoir capacity of **6.4 ML**).

iv) Water storage pumping stations and booster stations

The reservoir pumping stations and the water booster stations would remain as indicated for the study year 2026.

v) Watermain requirements

i) The same watermains, as required for the study year 2026, would be required (including the watermains on Novelis).

ii) For comparison purposes, **Table A.5** and **Table A.6**, on the following page, have been provided to determine the impact the installation of the Front Road/King Street west interconnection would have on the movement of water with only three of the four interconnection locations (excluding the John Counter Boulevard interconnection; although, this fourth interconnection would be provided).

There would be no significant change in the flow pattern with the Front Road/King Street West interconnection in place. The *total* flow of water from Kingston Central to Kingston West would decrease; however, the flow of water from Kingston Central to Kingston West would increase for Princess St. and Bath Rd.

For the study year 2016, for an interconnected system, the maximum day demand for Kingston Central (including Kingston East) is 90.9 ML/day, which is less than the functional capacity of the Kingston Central WPP (95 ML/d). For the study year 2016, it is desirable that this “excess” water supply capacity in Kingston Central be transferred to Kingston West. **Tables A.5** and **Table A.6**, following, indicate that the total flow from Kingston Central to Kingston West would be greater *without* the Front Road interconnecting watermain in place; accordingly, the 1050 mm interconnection watermain on Front Road/King Street West would *not* be required for the study year 2016.

Table A.5 – Study year 2016 Interconnection Locations and Flows

Flow Condition	Average day (L/s)	Maximum day (L/s)	Peak hour (L/s)
1) John Counter Blvd.	**--**	**--**	**--**
2) Princess St.	-26	-19	-30
3) Bath Rd.	-41 (540 gpm)	-45 (600 gpm)	-74 (975 gpm)
4) Front Rd.	**--**	**--**	**--**
Total	**-67**	**-64**	**-104**
Note: Positive flows indicate flows from Kingston West to Central.			

Table A.6 – Study year 2016 Interconnection Locations and Flows

Flow Condition	Average day (L/s)	Maximum day (L/s)	Peak hour (L/s)
1) John Counter Blvd.	**--**	**--**	**--**
2) Princess St.	-27	-16	-33
3) Bath Rd.	-49 (650 gpm)	-57 (750 gpm)	-79 (1044 gpm)
4) Front Rd.	46	41	25
Total	**-30**	**-32**	**-87**
Note: Positive flows indicate flows from Kingston West to Central.			

Again, due to the near-future re-construction of John Counter Boulevard, the 400 mm interconnection watermain on John Counter Boulevard should be provided as a component of the current road re-construction project.

3) Study year 2011

i) General

The water supply and distribution system requirements for the study year 2011 will take into account the water supply and distribution system requirements for the study years 2016 and 2026. For example, in-ground water storage and pumping facilities could be provided in the study year 2011 to accommodate the requirements for the study years 2016 and 2026. This method would ensure that the study years 2016 and 2026 requirements could be readily accommodated. Potentially, the study years 2016 and 2026 requirements could indicate that the provision of the 2016 and 2026 requirements should be provided in the study year 2011.

ii) Water supply requirement

The maximum day demand for the City of Kingston would be **141 ML/d** (140.8 ML/d).

The maximum day discharge from the Kingston Central WPP into the City of Kingston (including Kingston East) water distribution system would 95.0 ML/d. The difference in the required maximum day demand of **46 ML/d** (140.8 ML/d – 95 ML/d) would be supplied from the Kingston West WTP. This would require the Kingston West WTP to be expanded by **5 ML/d** (46 ML/d – 41 ML/d).

By the time the expansion of the Kingston West WTP was completed for the study year 2011, the plant would already be at the required water supply capacity. With this in mind, the capacity required for the study year 2016, as a minimum should be provided in the study year 2011. This would mean that the water supply from the Kingston West WTP should be increased by **9 ML/d,** for the study year 2011 (based on the required expansion for the study year 2016).

The required expansion for the study year 2026 would be **22 ML/d** (30.7 ML/d – 9.1 ML/d). In order to ensure that sufficient capacity at the Kingston West WTP is provided immediately following the study year 2016, as a potential option, 50% of the required water supply capacity required for the study year 2026 or, **11 ML/d** could be provided for the study year **2016**. The next water supply expansion of **11 ML/d** could be provided by the study year **2021** (providing the required total water supply capacity of **167 ML/d**).

The maximum day demand for Kingston West would be 49.9 ML/d.

The maximum day demand for Kingston Central (including Kingston East) would be 90.9 ML/d.

The total maximum day demand for the City of Kingston would be **141 ML/d**.

Since the Kingston Central maximum day demand of 90.9 ML/d would be less than the maximum day discharge from the Kingston Central WPP (95 ML/d), *no* water would need to be supplied to Kingston Central from the Kingston West WTP.

iii) Water storage requirements

i) Based on modelling, an expansion of the Industrial Park Reservoir is *not* required.

ii) Based on modelling, the storage capacity required at an O'Connor Drive Reservoir would be **6.0 ML** (4.6 ML for fire storage and 1.4 ML for equalization).

iii) Based on modelling, the Third Avenue Reservoir would need to be expanded to provide an additional storage capacity of 4.0 ML, for fire storage *only*. Based on modelling, no equalization storage would be required.

The additional Third Avenue Reservoir storage capacity of 4.0 ML is required for a maximum day plus fire flow condition in *Kingston Central*. The required additional fire storage capacity was *confirmed* by modelling a maximum day plus fire flow condition in Kingston Central.

Assuming that Alternative 2 was selected as the preferred solution, and since an additional storage capacity of 4.7 ML would be required for both the study years 2016 and 2026, an additional storage capacity of **4.7 ML** should be provided for the study year 2011.

iv) The water storage requirements in Kingston East would remain the same as for the study year 2026 (i.e., a Kingston Highway 15 Reservoir and Pumping Station with a reservoir capacity of **6.4 ML**).

iv) Water storage pumping stations and booster stations

The reservoir pumping stations and the water booster stations would remain as indicated for the study years 2026 and 2016.

v) Watermain requirements

The same watermains as identified for the study year 2026 and 2016 would be required (including the watermains on the Novelis property).

i) The 400 mm watermain on Cataraqui Woods Drive, connecting Gardiners Road to Sydenham Road would be required for the study year 2011 in order to allow the Sydenham Road BS to be retired (desirable). Without this 400 mm watermain in place, with the Sydenham Road BS retired, the water pressures at the most northerly end of Sydenham Road would be less than the 275 kPa required during peak hour demand conditions.

ii) For comparison purposes, **Table A.7** and **Table A.8**, on the following page, have been presented to determine the impact of the installation of the Front Road/King Street west interconnection would have on the movement of water with three interconnection locations (excluding the John Counter Boulevard interconnection; although this fourth interconnection would be provided).

By comparing the flows in **Table A.7** with the flows in **Table A.8**, there would be no significant change in the flow from Kingston Central to Kingston West on Bath Road and Princess Street for the average day, maximum day and the peak hour conditions with the Front Road/King Street West interconnection provided.

By providing the Front Road/King Street interconnection, the ”Total” flow from Kingston Central to Kingston West would actually *decrease* (for the average day condition, the “Total” flow to Kingston West from Kingston Central would be 35 L/s versus 66 L/s); however, the flow from Kingston Central to Kingston West would *increase* on Princess Street and Bath Road.

The flow from the Kingston West WTP, with the Front Road/King Street interconnection provided, generally moved north at the intersection of King Street West and Portsmouth Avenue to Bath Road and then moved west on Bath Road. Flow moving north on Portsmouth Avenue would supply some of the water demands in the area south and west of the intersection of Bath Road and Portsmouth Avenue, currently supplied from the Kingston Central WPP. By not providing the Front Rd./King St. interconnect, more flow would be forced to flow from the Kingston Central WPP to serve the demands in Kingston West (desirable as the Kingston CPP currently has excess capacity to be used in Kingston West)

Based on the above, the 1050 mm interconnection watermain on Front Road/King Street West would *not* be required for the study year 2011.

Table A.7 – Study year 2011 Interconnection Locations and Flows

Flow Condition	Average day (L/s)	Maximum day (L/s)	Peak hour (L/s)
1) John Counter Blvd.	**--**	**--**	**--**
2) Princess St.	-40	-49	-76
3) Bath Rd.	-26	-16	-30
4) Front Rd./King St.	**--**	**--**	**--**
Total	**-66**	**-65**	**-106**
Note: Positive flows indicate flows from Kingston West to Central.			

Table A.8 – Study year 2011 Interconnection Locations and Flows

Flow Condition	Average day (L/s)	Maximum day (L/s)	Peak hour (L/s)
1) John Counter Blvd.	**--**	**--**	**--**
2) Princess St.	-48	-55	-78
3) Bath Rd.	-28	-19	-31
4) Front Rd./King St.	41	36	12
Total	**-35**	**-38**	**-97**
Note: Positive flows indicate flows from Kingston West to Central.			

Again, due to the near-future re-construction of John Counter Boulevard, the 400 mm interconnection watermain on John Counter Boulevard should be provided as a component of the current road re-construction project.

1.2.4 <u>Alternative 3</u> - Interconnected water supply (retire the Kingston Central WPP and provide the total water supply from the Kingston West WTP) and distribution systems servicing the City of Kingston

1) Study year 2026

i) General

Alternative 3 is based on increasing the water supply capacity of the Kingston West WTP to supply the water demands for the City of Kingston (Kingston Central WPP would be retired) and providing interconnecting watermains at appropriate locations in the City of Kingston water distribution system.

Since the water distribution requirements could vary only *slightly* from Alternative 2 for the study years 2016 and 2011 (the required water supply would remain the same), the requirements for the study year 2026, only, have been presented. If Alternative 3 were selected as the preferred solution, the potential slight variations in the water distribution system requirements would be provided.

ii) Water supply requirement

The maximum day demand for the City of Kingston would be **167 ML/d** (166.7 ML/d). The Kingston West WTP would be expanded to supply, as a minimum, 167 ML/d.

iii) Water storage requirements

The water storage requirements would be the same as for Alternative 2.

The water supply to the most upstream end of the water distribution systems for Kingston West and Kingston Central (including Kingston East) would remain the same as for Alternative 2; accordingly, the storage requirements would remain the same as for Alternative 2.

iv) Water storage pumping stations and booster stations

The required flow from the Industrial Park Reservoir Pumping Station would remain the same as for Alternatives 1 and 2.

The required flow from an O'Connor Drive Reservoir Pumping Station would remain the same as for Alternatives 1 and 2.

The required flow from the Third Avenue Pumping Station, for the worst condition of a maximum day plus fire flow (in Kingston Central) would be **29.1 ML/d** (337 L/s). The existing pumps, operating in parallel, as would be required, would be capable of providing this flow.

The Gardiners Road BS, the Sydenham Road BS, the Old Colony Road BS and the Collins Bay BS could all be retired.

v) Watermain requirements

The additional water distribution system watermains as required for the independent Kingston West and Kingston Central (including Kingston East) would remain as indicated for the two independent systems.

Table A.9 and **Table A.10**, on the next page, have been provided to determine whether or not the John Counter Boulevard interconnection would be required. An initial assessment indicated that the John Counter Boulevard interconnection would not be required; however, as indicated in **Item 1.2.3**, the provision of this interconnection should be installed as part of the reconstruction of John Counter Boulevard to provide a fourth interconnection. Modelling has been based on the provision of three interconnections only (John Counter Boulevard interconnection not included).

The interconnection of the two independent water distribution systems would require opening the Bath Road valve, the installation of a 400 mm interconnection watermain on Princess Street, a 400 mm interconnection watermain on John Counter Boulevard and a 1050 mm interconnection watermain from the Kingston West WTP and the retired Kingston Central WPP at the plant discharge connections to the existing water distribution systems at Front Road and at King Street West.

Table A.9 – Study year 2026 Interconnection Locations and Flows

Flow Condition	Average Day (L/s)	Maximum Day (L/s)	Peak Hour (L/s)
1) John Counter Blvd.	-12	-6	-21
2) Princess St.	-23	-18	-26
3) Bath Rd.	-39	-45	-71
4) Front Rd.	1152	1172	1174
Total	**1078**	**1103**	**1056**
Note: Positive flows indicate flows from Kingston West to Central.			

Table A.10 – Study year 2026 Interconnection Locations and Flows

Flow Condition	Average Day (L/s)	Maximum Day (L/s)	Peak Hour (L/s)
1) John Counter Blvd.	**--**	**--**	**--**
2) Princess St.	-27	-18	-28
3) Bath Rd.	-40	-44	-71
4) Front Rd.	1150	1175	1175
Total	**1083**	**1113**	**1076**
Note: Positive flows indicate flows from Kingston West to Central.			

Again, due to the near-future re-construction of John Counter Boulevard, the 400 mm interconnection watermain on John Counter Boulevard should be provided as a component of the current road re-construction project.

1.2.5 <u>Alternative 4</u> - Interconnected water supplies (retire the Kingston Central WPP and retire the Kingston West WTP and provide a new, "green-field" water treatment plant) and distribution systems servicing the City of Kingston

1) Study year 2026

i) General

Alternative 4 is based on the provision of a new water treatment plant, to be located in a suitable location, to supply the water demands for the City of Kingston and providing interconnecting watermains at the appropriate locations in the City of Kingston water distribution system.

Based on modelling, assuming a new water treatment plant located between the Kingston West WTP and the Kingston Central WPP, the plant discharge flows on Front Road/King Street West would be distributed westerly and easterly, as required. A 1050 mm trunk watermain, from the connection location on Front Road from a retired Kingston West WTP and from the connection location on King Street

West from a retired Kingston Central WPP has been used in the modelling for this alternative.

With the provision of the 1050 mm trunk watermain, connecting the discharge locations from the retired Kingston West WTP and the retired Kingston Central WPP, the water supply to Kingston West and to Kingston Central (including Kingston East) would remain the same as for Alternatives 1, 2 and 3.

By modelling with a 1050 mm trunk watermain (as required and modelled for Alternative 3), if it was determined that a new water treatment plant was not the preferred alternative, at a more future time (following the study year 2026), a new water treatment plant could still be considered and could be located at a suitable location between the Kingston West WTP and the Kingston Central WPP and connect to the 1050 mm trunk watermain (as for Alternative 2 and 3).

The water supply and distribution system requirements for Alternative 4 all remain as the indicated requirements for Alternative 2.

ii) Water supply requirement

The maximum day demand for the City of Kingston would be **167 ML/d** (166.7 ML/d).

iii) Water storage requirements

The water storage requirements would be the same as for Alternative 2.

The water supply to the most upstream end of the water distribution systems for Kingston West and Kingston Central (including Kingston East) would remain the same as for Alternative 2; accordingly, the storage requirements would remain the same as for Alternative 2.

iv) Water storage pumping stations and booster stations

The required flow from the Industrial Park Reservoir Pumping Station would remain the same as for Alternatives 1, 2 and 3.

The required flow from an O'Connor Drive Reservoir Pumping Station would remain the same as for Alternatives 1, 2 and 3.

The required flow from the Third Avenue Pumping Station would remain the same as for Alternative 2 and Alternative 3.

The Gardiners Road BS, the Sydenham Road BS, the Old Colony Road BS and the Collins Bay BS could all be retired.

v) Watermain requirements

The watermains, as indicated for Alternatives 1, 2 and 3, would be required.

The maximum day flow from a new water treatment plant would supply more water to Kingston Central (106.1 ML/d) than to Kingston West (56.9 ML/d). The reason the total maximum day flow of 163 ML/d (106.1 ML/d + 56.9 ML/d) indicated varies slightly from the calculated flow of **167 ML/d** (166.7 ML/d) is due to the fact that modelling indicated that a small portion of the maximum day demand for the Kingston Central was being supplied by the Industrial Park Reservoir Pumping Station and the Third Avenue Reservoir Pumping Station. Regardless, the new water treatment plant would supply a maximum day flow of **167 ML/d** to the City of Kingston water distribution system.

The required interconnection watermains and the flows have been indicated in **Table A.11**, below.

Table A.11 – Study year 2026 Interconnection Locations and Flows

Flow Condition	Average day (L/s)	Maximum day (L/s)	Peak hour (L/s)	MD+FF** (L/s)
1) John Counter Blvd.	**--**	**--**	**--**	**--**
2) Princess St.	-28	-19	-28	-86
3) Bath Rd.	-43	-46	-73	-51
4) King St. (flow to Kingston Central)	1200	1228	1174	1180
5) Front Rd. (flow to Kingston West)	-647	-659	-730	-770
Total flow to Kingston Central	**1129**	**1163**	**1073**	**1043**
Total flow to Kingston West	**-718**	**-724**	**-831**	**-907**
Note: Positive flows indicate flows from Kingston West to Central.				
** The fire is located in Kingston West				

Again, due to the near-future re-construction of John Counter Boulevard, the 400 mm interconnection watermain on John Counter Boulevard should be provided as a component of the road re-construction project.

1.3 Identified Alternative Solutions

1.3.1 General

It is common practice to provide water treatment plants with a 20-year design water supply capacity. If this were to be the design requirements, assuming the "functional" capacity of the Kingston Central WPP remained at 95 ML/d, the Kingston West WTP would be expanded to provide the required design water supply for the study year 2026 as a single Kingston West WTP expansion.

Funding availability would be the major issue regarding the expansion of the Kingston West WTP to supply water based on the study year 2026 requirements. The major advantage would be not requiring construction activities more than once from the initial water supply expansion until the water supply, for the years beyond the study year 2026, were required (assumed to be made available in the study year 2026).

The required water supply for the study year 2026, indicating the water supply requirement and associated expansion of the required water supply from the Kingston West WTP (the determined present "functional" capacity of the Kingston Central WPP remains constant at 95 ML/d), has been presented for the alternative of an independent Kingston West water supply and distribution system, for the alternative of an independent Kingston Central (including Kingston East) water supply and distribution system and for the alternative of an interconnected Kingston West and Kingston Central (including Kingston East), following. The required water supply for each of the three alternatives has also been indicated for the study years 2011 and 2016.

The design water supply capacity could be provided for less than the 20-year design capacity. This would be a design consideration based on the preferred solution selected in the next Phase of the Class Environmental Assessment.

The alternative of a new water treatment plant to supply water for the City of Kingston, interconnected water distribution systems has also been provided.

1.3.2 <u>Alternative 1</u> – Independent systems

It should be noted that in **Section 3** of the main Report, the maximum day demand for an *independent* Kingston West water supply was calculated to be (**1.77** x average day demand), the maximum day demand for an independent Kingston Central (including Kingston East) water supply was calculated to be (**1.39** x average day demand). For an *interconnected* Kingston West and Kingston Central (including Kingston East) water supply, the maximum day demand was calculated to be (**1.5** x average day demand). For example, for the study year 2026 for an independent Kingston West, the required water supply from the Kingston West WTP would be **77 ML/d** (1.77 x 43.7 ML/d); however, for an interconnected system, the required water supply from the Kingston West WTP would be **72 ML/d** (167 ML/d – 95 ML/d) or, [(1.5 x 111.15 ML/d) – 95 ML/d] or, an increase in the water supply from the Kingston West WTP of **31 ML/d** (72 ML/d – 41 ML/d), as indicated in **Figure A.2** on page 46.

The required water supply and storage requirements for Alternative 1 have been provided in **Table A.12.**

Table A.12 Summary of Requirements for Alternative 1

Alternative 1	Water Supply	Required Additional Water Storage
Study Year 2026		
West	Increase supply from the Kingston West WTP from a "functional" capacity of 41 ML/d to 77 ML/day (an increase in the water supply of **36 ML/d)**	A new O'Connor Drive in-ground Reservoir and Pumping Station with a total storage capacity of **9.6 ML**
		Expand the existing Industrial Park Reservoir from a total storage capacity of 6.6 ML to 16.7 ML (an increase of **10.1 ML**)
Central	Maintain "functional" capacity of Kingston Central WPP, **95 ML/day**	Expand the existing Third Avenue Reservoir from a total storage capacity of 23.2 ML to 29.4 ML (an increase of **6.2 ML**)
East	Supplied by James Street BS from Kingston Central, **20.3 ML/day**	A new Kingston Highway 15 in-ground Reservoir and Pumping Station with a total storage capacity of **6.4 ML**
Study Year 2016		
West	Increase supply from the Kingston West WTP from a "functional capacity of 41 ML/d to 65 ML/day (an increase in the water supply of **24 ML/d**)	A new O'Connor Drive in-ground Reservoir and Pumping Station with a total storage capacity of **7.4 ML**
		Expand the existing Industrial Park Reservoir from a total storage capacity of 6.6 ML to 14.8 ML (an increase of **8.2 ML**)
Central	Maintain "functional" capacity of Kingston Central WPP, 95 ML/day	Expand the existing Third Avenue Reservoir from a total storage capacity of 23.2 ML to 29.0 ML (an increase of **5.8 ML**)
East	Supplied by James Street BS from Kingston Central, **15 ML/day**	A new Kingston Highway 15 in-ground Reservoir and Pumping Station with a total storage capacity of **6.4 ML**

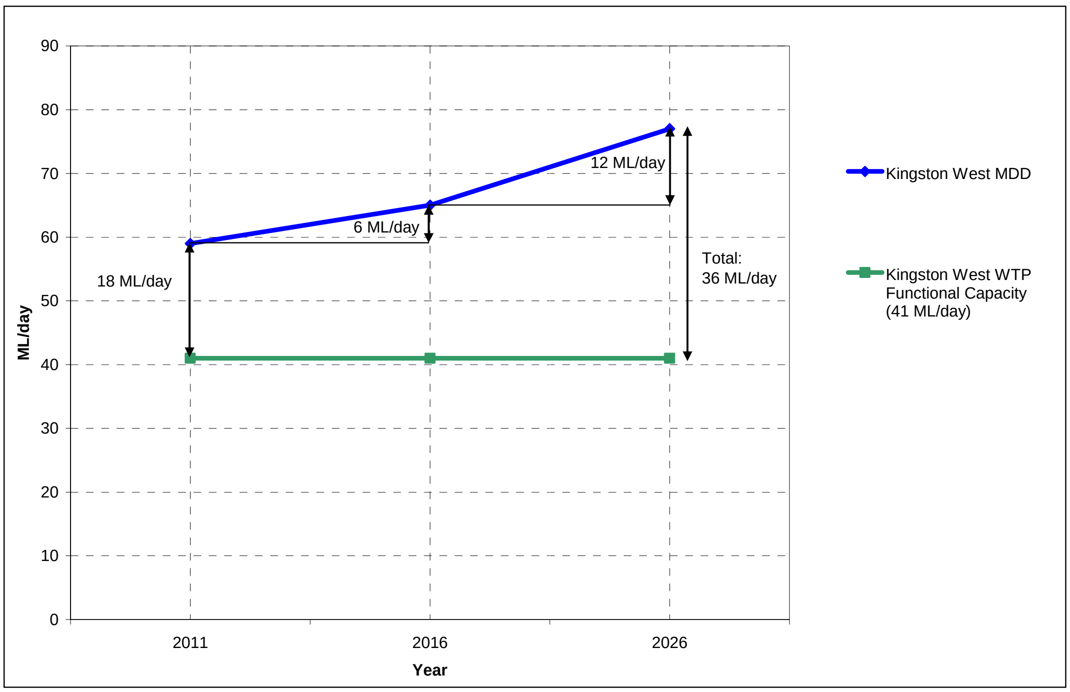
Alternative 1	**Water Supply**	**Required Additional Water Storage**
Study Year 2011		
West	Increase supply from the Kingston West WTP from a "functional capacity of 41 ML/d to 59 ML/day (an increase in the water supply of **18 ML/d**)	A new O'Connor Drive in-ground Reservoir and Pumping Station with a total storage capacity of **6.0 ML**
		Expand the existing Industrial Park Reservoir from a total storage capacity of 6.6 ML to 14.8 ML (an increase of **8.2 ML**)
Central	Maintain "functional" capacity of Kingston Central WPP, **95 ML/day**	Expand the existing Third Avenue Reservoir from a total storage capacity of 23.2 ML to 29.0 ML (an increase of **5.8 ML**)
East	Supplied by James Street BS from Kingston Central, **12 ML/day**	A new Kingston Highway 15 in-ground Reservoir and Pumping Station with a total storage capacity of **6.4 ML**

i) As indicated in **Table A.12**, the required storage capacities for the Industrial Park Reservoir for each study year are very similar; accordingly, the existing reservoir should be expanded from an existing storage capacity of 6.6 ML to 16.7 ML (an expansion of **10.1 ML**) for the study year 2011.

ii) Based on **Table A.12**, a new O'Connor Drive Reservoir, with a total storage capacity of 6.5 ML is required for the study year 2011. Since the required expansion to 9.6 ML (an increase of 3.1 ML) would be required for the study year 2016, potentially, the reservoir storage capacity of **9.6 ML** should be provided for the study year 2011.

The required water supply expansions of the Kingston West WTP for the study years 2011, 2016 and 2026 have been provided in graphical form in **Figure A.1**, on the following page.

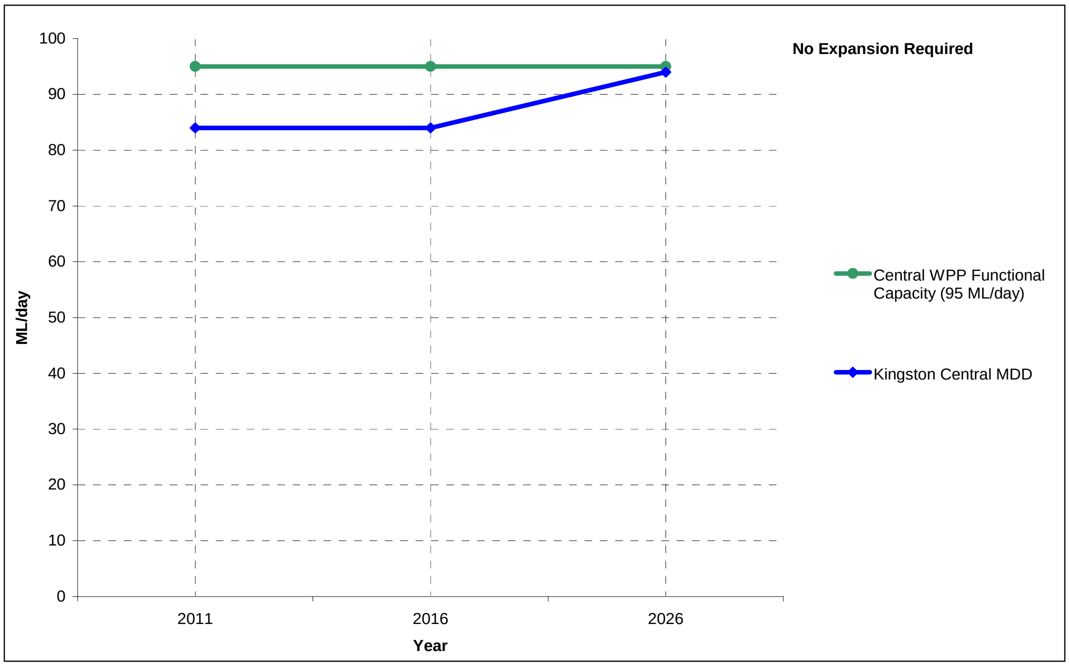
Figure A.1 - Alternative 1 – Independent Kingston West Maximum Day vs. Existing Plant Functional Capacity



As indicated in **Figure A.1**, a *minimum* expansion of the Kingston West WTP of **24 ML/d** would be required for the study year 2011 (to accommodate the increased demand immediately following the study year 2011 to the study year 2016). An additional expansion of the Kingston West WTP of **12 ML/d** would be required for the study year 2016 (to accommodate the increased demand immediately following the study year 2016 to the study year 2026).

The required water supply from the Kingston Central WPP for the study years 2011, 2016 and 2026 has been provided in graphical form in **Figure A.2**, on the following page. It should be noted that the determined "functional" capacity of the Kingston Central WPP of 95 ML/d would not be exceeded in the study year 2026.

Figure A.2 - Alternative 1 – Independent Kingston Central Maximum Day vs. Existing Plant "Functional" Capacity



1.3.3 Alternative 2 – Interconnected Systems (maintain Kingston Central WPP operational and provide all required additional water supply by increasing the capacity of the Kingston West WTP)

The required water supply and storage requirements for Alternative 2 have been provided in **Table A.13**, following.

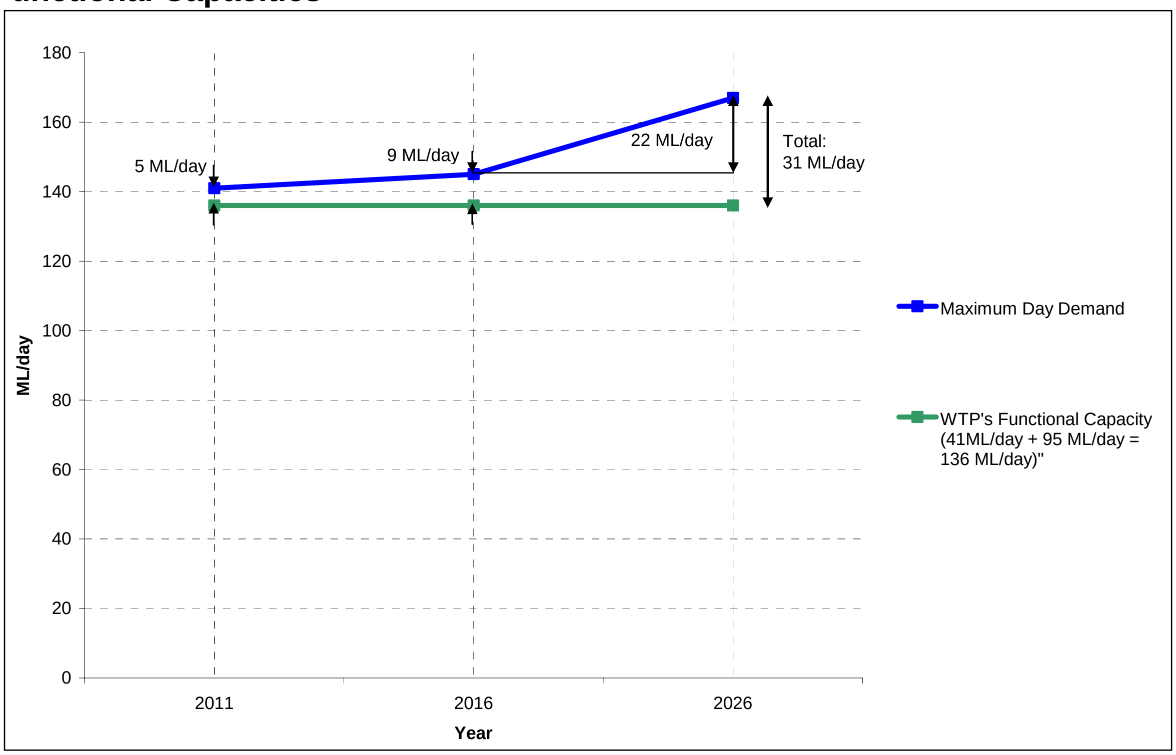
Table A.13 - Summary of the Water Supply and Storage Requirements for Alternative 2

Alternative 2	Water Supply	Required Additional Water Storage
Study Year 2026		
West	Increase the existing “functional” water supply capacity of the Kingston West WTP from 41 ML/d to a total water supply capacity of 72 ML/d (an increase in the water supply capacity of **31 ML/d**)	A new O'Connor Drive in-ground Reservoir and Pumping Station with a total storage capacity of **8.0 ML**
Central	Maintain the existing "functional" water supply capacity of the Kingston Central WPP as **95 ML/day**	Expand the existing storage capacity of the Third Avenue Reservoir from 23.2 ML to 27.9 ML (an increase of **4.7 ML**)
East	Supplied by James Street BS from the Kingston Central, **20.3 ML/day**	A new Kingston Highway 15 in-ground Reservoir and Pumping Station with a total storage capacity of **6.4 ML**
Interconnection Locations **Open** Bath Road valve New **400 mm** watermains on Princess Street and on John Counter Boulevard A new **1050 mm** watermain connecting the existing Kingston West WTP discharge pipes on Front Road to the end of the existing 450 mm watermain on King Street.		
Alternative 2	**Water Supply**	**Required Additional Water Storage**
Study Year 2016		
West	Increase the water supply capacity of the Kingston West WTP from 41 ML/d to 50 ML/day (an increase in the water supply of **9 ML/d**)	A new O'Connor Drive in-ground Reservoir and Pumping Station with a total storage capacity of **6.5 ML**
Central	Maintain the existing "functional" water supply capacity of the Kingston Central WPP, **95 ML/day**	Expand the existing storage capacity of the Third Avenue Reservoir from 23.2 ML to 27.9 ML (an increase of **4.7 ML**)
East	Supplied by the James Street BS from the Kingston Central WPP, **15 ML/day**	A new Kingston Highway 15 in-ground Reservoir and Pumping Station with a total storage capacity of **6.4 ML**
Interconnection Locations **Open** Bath Road valve New **400 mm** watermains on Princess Street and on John Counter Boulevard		

Alternative 2	Water Supply	Required Additional Water Storage
Study Year 2011		
West	Increase the water supply capacity of the Kingston West WTP from 41 ML/d to 50 ML/day (an increase in the water supply of **5 ML/d**)	A new O'Connor Drive in-ground Reservoir and Pumping Station with a total storage capacity of **6.0 ML**
Central	Maintain the "functional" water supply capacity of the Kingston Central WPP, **95 ML/day**	Expand the existing storage capacity of the Third Avenue Reservoir from 23.2 ML to 27.2 ML (an increase of **4.0 ML**)
East	Supplied by the James Street BS from the Kingston Central WPP, **12 ML/day**	A new Kingston Highway 15 in-ground Reservoir and Pumping Station with a total storage capacity of **6.4 ML**
Interconnection Locations **Open** Bath Road valve New **400 mm** watermains on Princess Street and on John Counter Boulevard		

The required water supply for Alternative 2 for the study years 2011, 2016 and 2026 have been provided in graphical form in **Figure A.3**, on the following page.

Figure A.3 - Alternative 2 – City of Kingston Maximum Day vs. Existing Plants Functional Capacities



As indicated in **Figure A.3**, a *minimum* water supply expansion of **9 ML/d** would be required at the Kingston West WTP for the study year 2011 (to accommodate the increased demand immediately following the study year 2011 to the study year 2016). An additional water supply expansion of **22 ML/d** would be required at the Kingston West WTP for the study year 2016 (to accommodate the increased demand immediately following the study year 2016 to the study year 2026).

Since Alternative 2 is based on the "functional" water supply capacity of the Kingston West WTP and on the "functional" water supply capacity of the Kingston Central WPP, potentially, upgrades to the existing plants could be provided to increase the "functional" water supply capacity of one or both plants (Kingston Central WPP most likely) to increase the combined water supply by the required **5 ML/d** for the study year **2011** and, potentially, increase the combined water supply by the required **9 ML/d** for the study year 2016.

An increase in the "functional" water supply capacity of the Kingston Central WPP appears to be unlikely; accordingly, it would appear that for Alternative 2, an increase in the water supply capacity at the Kingston West WTP should be provided for the study year 2026 for the study year 2011 (i.e., provide an increase in capacity of **31 ML/d** for the study year 2026).

1.3.4 Alternative 3 – Interconnected systems (retire the Kingston Central WPP and supply all water from the Kingston West WTP)

The required water supply and storage requirements for Alternative 3 have been provided in **Table A.14**.

Table A.14 - Summary of the Water Supply and Storage Requirements for Alternative 3

Alternative 3	Water Supply	Required Additional Water Storage
Study Year 2026		
West	Increase the water supply from the Kingston West WTP from a "functional" water supply capacity of 41 ML/d to **167 ML/day** (an increase in the water supply of **126 ML/d**)	A new O'Connor Drive in-ground Reservoir and Pumping Station with a total storage capacity of **8.0 ML**
Central	**Retire** the Kingston Central WPP	Expand the existing storage capacity of the Third Avenue Reservoir from 23.2 ML to 27.9 ML (an increase of **4.7 ML**)

East	Supplied by the James Street BS from the Kingston Central WPP, **20.3 ML/day**	A new Kingston Highway 15 in-ground Reservoir and Pumping Station with a total storage capacity of **6.4 ML**
Interconnection Locations **Open** Bath Road valve New **400 mm** watermains on Princess Street and on John Counter Boulevard A new **1050 mm** watermain connecting the existing discharge watermains from the Kingston West WTP and the Kingston Central WPP.		

1.3.5 <u>Alternative 4</u> – Interconnected systems (provide a new WTP and retire the Kingston Central WPP and the Kingston West WTP)

The required water supply and storage requirements for Alternative 4 have been provided in **Table A.15**, following.

Table A.15 Summary of the Water Supply and Storage Requirements for Alternative 4

Alternative 4	Water Supply	Required Additional Water Storage
Study Year 2026		
	A new WTP with a water supply of **167 ML/day**	
West	**Retire** the Kingston West WTP	A new O'Connor Drive in-ground Reservoir and Pumping Station with a total storage capacity of **8.0 ML**
Central	**Retire** the Kingston Central WPP	Expand the existing storage capacity of the Third Avenue Reservoir from 23.2 ML to 27.9 ML (an increase of **4.7 ML**)
East	Supplied by the James Street BS from the Kingston Central WPP, **20.3 ML/day**	A new Kingston Highway 15 in-ground Reservoir and Pumping Station with a total storage capacity of **6.4 ML**
Interconnection Locations **Open** Bath Road Valve New **400 mm** watermains on Princess Street and on John Counter Boulevard A **1050 mm** watermain connecting the existing discharge watermains from the Kingston West WTP and the Kingston Central WPP.		

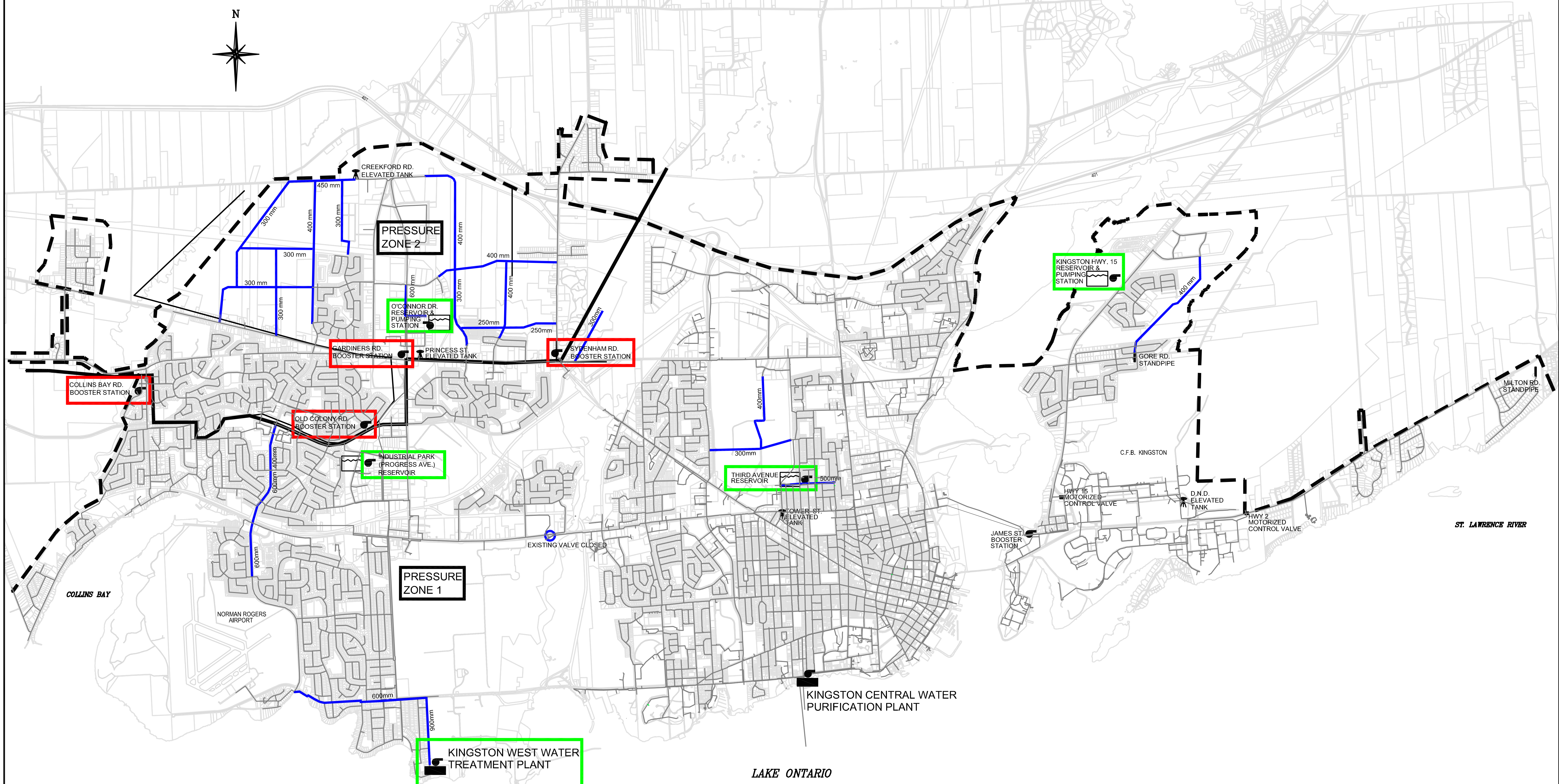
Alternatives 1, 2, 3, and 4 have been illustrated in **Figures A.4, A.5, A.6 and A.7**, on the following pages.

1.4 Items identified to provide timely expansions of water supply and distribution system facilities for the City of Kingston

1.4.1 General

As expected, modelling for Kingston West, Kingston Central and Kingston East, for the study years 2026, 2016 and 2011 has identified certain items that need to be addressed on as soon as possible basis. The items are generally based on observations of the distribution system watermains and facilities (e.g., reservoirs not filling as expected, minimal flows in watermains for an

ALTERNATIVE 1



NOTES:

1. DATA SOURCES: FIGURE W1, CITY OF KINGSTON URBAN GROWTH STRATEGY, JULY, 2004; UTILITIES KINGSTON FILE INFORMATION

LEGEND

URBAN BOUNDARY	NEW/UPGRADED FACILITY
EXISTING WATERMAINS	RETIRED
NEW WATERMAINS	
PRESSURE ZONE BOUNDARY	

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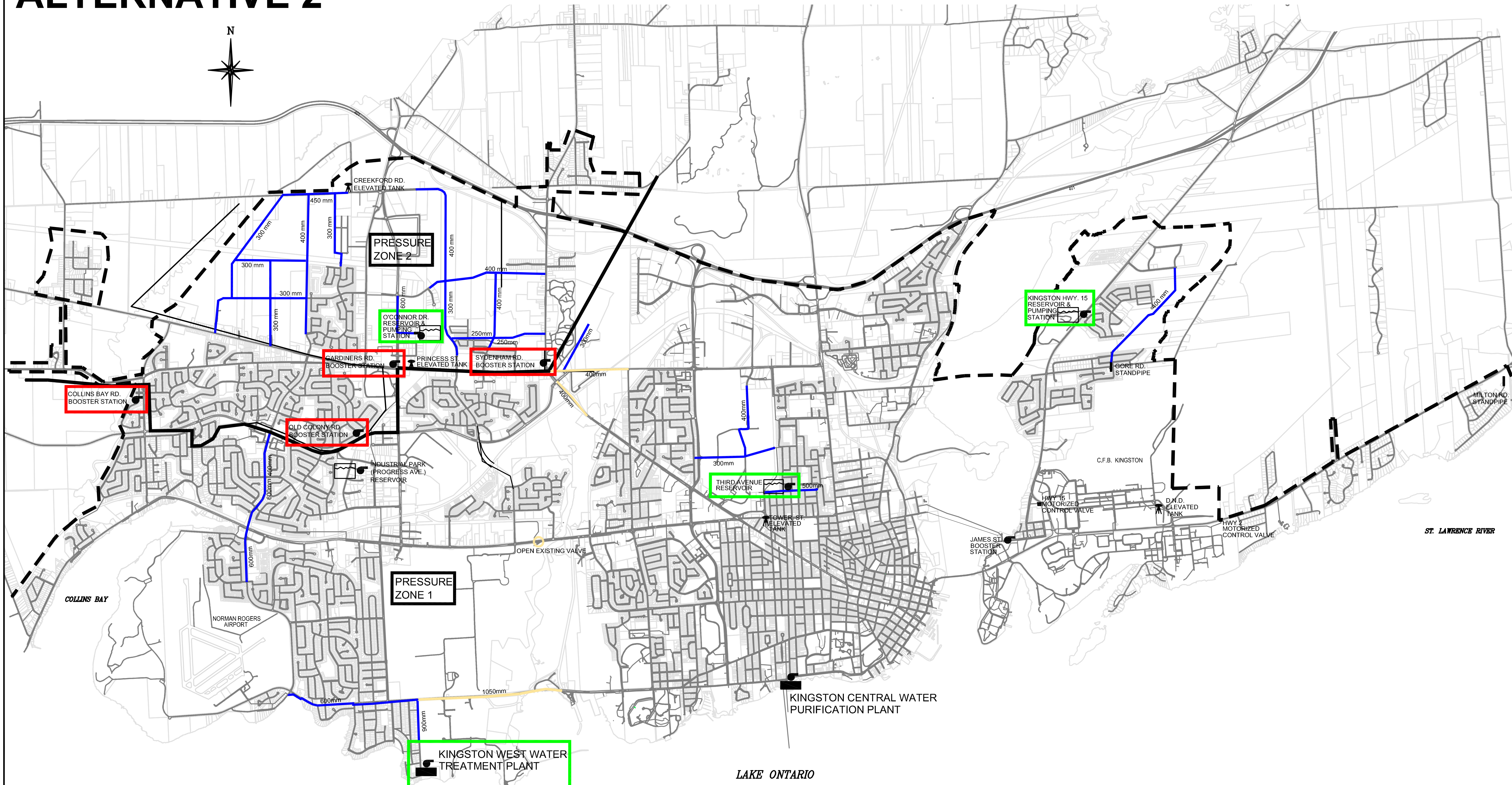
FIGURE A.4: CITY OF KINGSTON
WATER DISTRIBUTION SYSTEM
ALTERNATIVE 1 – YEAR 2026

ALTERNATIVE 2



NOTES:

1. DATA SOURCES: FIGURE W1, CITY OF KINGSTON URBAN GROWTH STRATEGY, JULY, 2004; UTILITIES KINGSTON FILE INFORMATION

LEGEND

URBAN BOUNDARY	NEW/UPGRADED FACILITY
EXISTING WATERMAINS	RETIRED
NEW WATERMAINS	
INTERCONNECTING WATERMAINS	
PRESSURE ZONE BOUNDARY	

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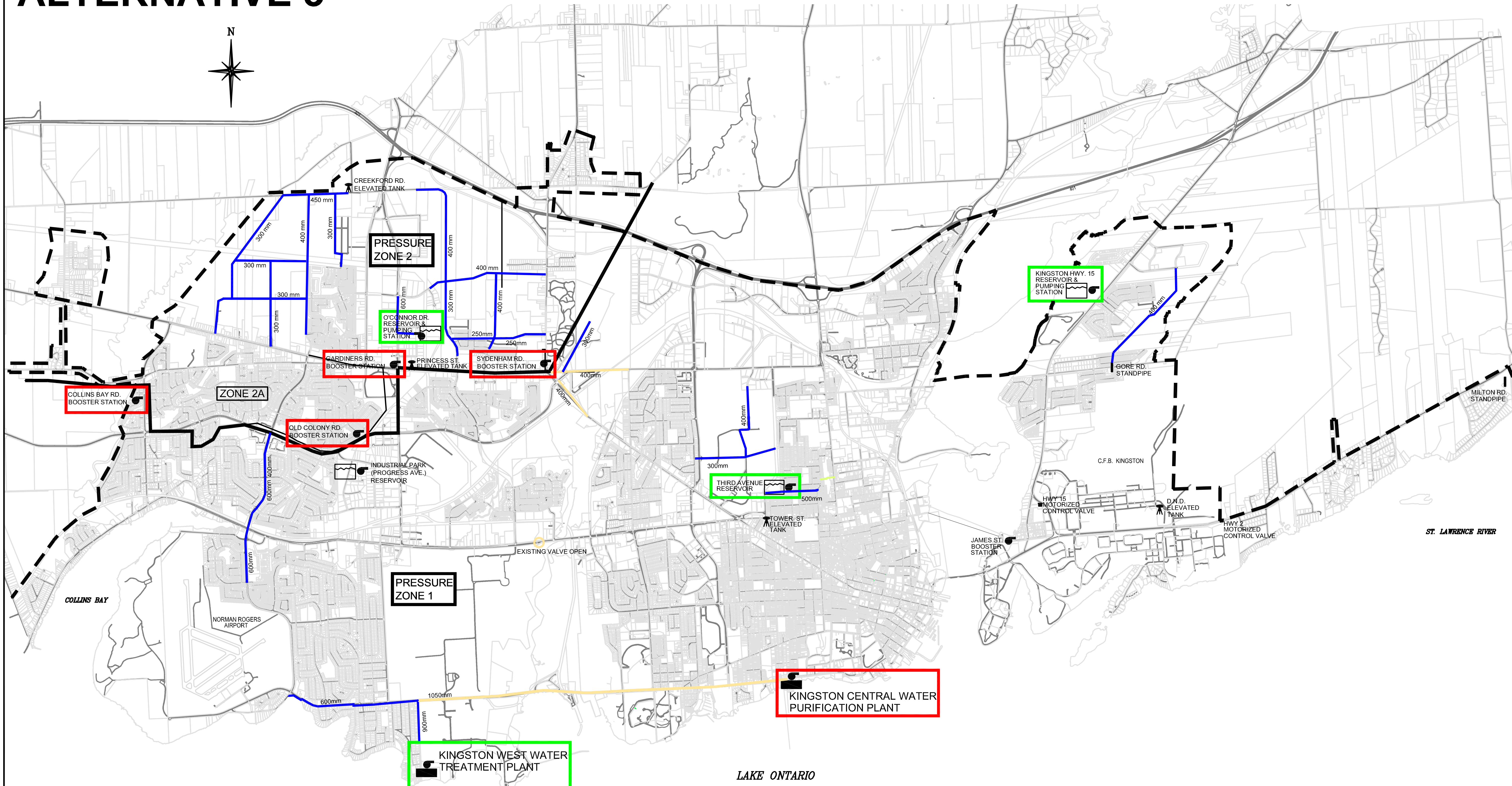
FIGURE A.5: CITY OF KINGSTON WATER DISTRIBUTION SYSTEM ALTERNATIVE 2 – YEAR 2026

ALTERNATIVE 3



NOTES:

1. DATA SOURCES: FIGURE W1, CITY OF KINGSTON URBAN GROWTH STRATEGY, JULY, 2004; UTILITIES KINGSTON FILE INFORMATION

LEGEND

- URBAN BOUNDARY
- EXISTING WATERMAINS
- NEW WATERMAINS
- INTERCONNECTING WATERMAINS
- PRESSURE ZONE BOUNDARY
- NEW/UPGRADED FACILITY
- RETIRED

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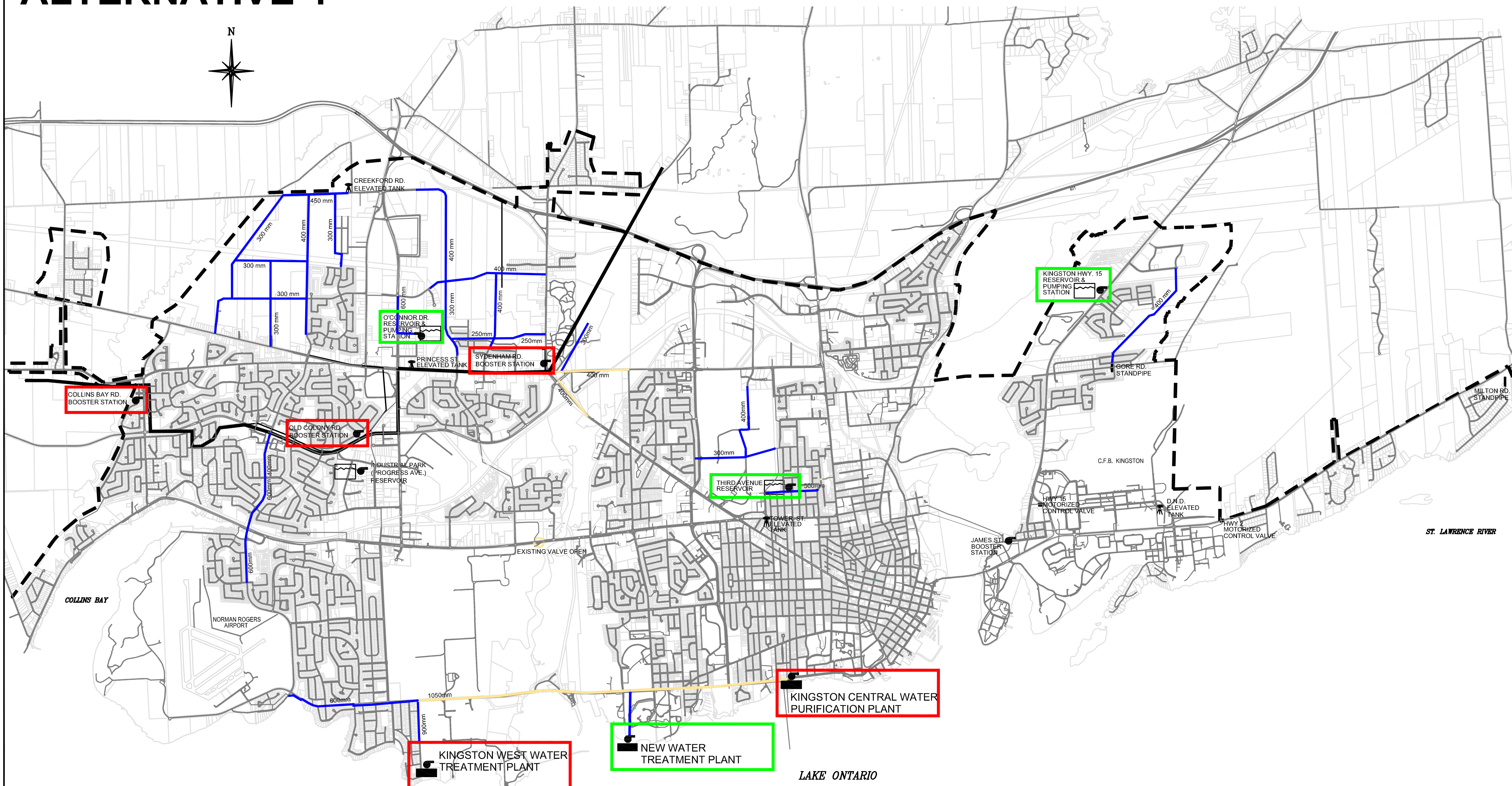
FIGURE A.6: CITY OF KINGSTON WATER DISTRIBUTION SYSTEM ALTERNATIVE 3 – YEAR 2026

ALTERNATIVE 4



NOTES:

1. DATA SOURCES: FIGURE W1, CITY OF KINGSTON URBAN GROWTH STRATEGY, JULY, 2004; UTILITIES KINGSTON FILE INFORMATION

LEGEND

- URBAN BOUNDARY
- EXISTING WATERMAINS
- NEW WATERMAINS
- INTERCONNECTING WATERMAINS
- PRESSURE ZONE BOUNDARY
- NEW/UPGRADED FACILITY
- RETIRED

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FIGURE A.7: CITY OF KINGSTON WATER DISTRIBUTION SYSTEM ALTERNATIVE 4 – YEAR 2026

interconnected system and other). The items identified have been presented below. Additional modelling has been carried out to identify and present the selected methods to address these items.

1.4.2 Items identified

i) For an *interconnected* Kingston West and Kingston East water supply and water distribution system (Alternative 2), the required additional water supply from the Kingston West WTP, to accommodate the Kingston West water demands for the study year 2011, would be **5 ML/d**. For the study year 2016, the water supply from the Kingston West WTP would need to be increased to supply 9 ML/d.

For an *independent* Kingston West water supply and distribution system, the water supply from the Kingston West WTP would need to be increased to supply **17.9 ML/d** for the study year 2011. For the study year 2016, the water supply from the Kingston West WTP would need to be increased to supply 24 ML/d.

If the Bath Road valve was opened and the Princess Street and the John Counter Boulevard interconnection watermains were provided, the required water supply expansion of the Kingston West WTP, to satisfy the Kingston West water demands for the study year 2011, would be *reduced* by **12.9 ML/d** (17.9 ML/d - 5 ML/d).

The expected *minimum* water supply expansion of the Kingston West WTP would be provided to supply water for the study year 2016. For an interconnected City of Kingston versus an independent Kingston West water supply and distribution system, the required water supply from the Kingston West WTP would be reduced from 23.7 ML/d to 9 ML/d.

The above is based on the “functional” water supply capacity of the Kingston West WTP and the Kingston Central WPP. Upgrades to the existing plants could provide an increase the “functional” water supply capacity of one or both plants. It has been determined that increasing the existing “functional” water supply capacity of either plant should not be considered as an option.

Since an increase in the “functional” water supply capacity of the Kingston Central WPP should not be considered, it would appear that for Alternative 2, an increase in water supply capacity at the Kingston West WTP should be provided for the study year 2026 for the study year 2011 (i.e., provide an increase in the water supply of **31 ML/d** for the study year 2011). An intermediate expansion would remain as an option, as presented in **Item 1.2.3**, above.

ii) Regardless of the alternative selected as the preferred solution, based on modelling, the Old Colony Road BS and the Collins Bay Road BS could both be retired. Both water booster stations were constructed prior to the provision of the Creekford Elevated Tank and a proposed O'Connor Drive Reservoir and Pumping Station. The Creekford Road Elevated Tank and an O'Connor Drive Pumping Station would provide increased static water pressure to the most northwestern location (Westbrook) in Kingston West. An O'Connor Drive Reservoir and Pumping Station would supply water from Pressure Zone 2, as opposed to Pressure Zone 1.

Adjustment in the existing open and closed valves would be required such that Pressure Zone 2a would be connected directly to Pressure Zone 2 and not Pressure Zone 1.

With the Old Colony Road BS retired and the appropriate open and closed valves adjusted, there would only be two pressure Zones in Kingston West, Pressure Zone 1 and Pressure Zone 2.

iii) Regardless of the alternative selected as the preferred solution, a new reservoir and pumping station would be required for Kingston West, Pressure Zone 2. The most logical location to install this required reservoir and pumping station would be on O'Connor Drive, on City-owned land and of sufficient size. The actual location would be determined during the next Phase of the Class Environmental Assessment.

iv) Regardless of the alternative selected as the preferred solution, the Gardiners Road BS and the Sydenham Road BS could be retired [existing Pressure Zone 2b and 2c would become one pressure zone (Pressure Zone 2)].

Retiring the Gardiners Road BS and the Sydenham Road BS would be desirable.

Both booster stations could be retired once an O'Connor Drive Reservoir and Pumping Station and a 600 mm watermain on O'Connor Drive (from an O'Connor Drive Reservoir and Pumping Station to Gardiners Road) and a 400 mm watermain on Cataraqui Woods Drive (from just east of Gardiners Road to Sydenham Road) were installed.

The Sydenham Road BS could be retired while still providing sufficient pressure at the north end of Sydenham Road for the peak hour condition. Once the 400 mm watermain on Cataraqui Woods Drive between Gardiners Road and Sydenham Road is completed, a suitable fire flow would be provided with the Sydenham Road BS retired.

v) Regardless of the alternative selected as the preferred solution, a new reservoir and pumping station would be required for fire and equalization storage in the northern portion of Kingston East. A proposed suitable location to install this required reservoir and pumping station would be in the northern portion of Kingston East adjacent to Kingston Highway 15 (the location was established on the west side, for modelling purposes). The actual location would be determined during the next Phase of the Class Environmental Assessment.

vi) Regardless of the alternative selected as the preferred solution, the southern portion of Kingston East would require *no* upgrades for all study years.

vii) The existing reservoir at the Kingston West WTP would be reserved to provide additional chlorine contact time and for other in-plant requirements, such as back washing filters. The available volume of this on-site reservoir has *not* been included in the required water distribution system storage requirements for any of the alternatives being considered.

viii) At an appropriate time, the Kingston Central WPP should be retired due to the increasing age of the facility and the requirement for on-site water storage for chlorine contact time and other in-plant uses, such as back washing filters. This should be considered during the evaluation of alternatives to determine the preferred solution and the timing for implementation of the preferred solution. The Master Plan for Water Supply has been prepared based on the assumption that the Kingston Central WPP would remain in operation to the study year 2026.

ix) The Third Avenue Reservoir would need to be expanded for Alternative 1 **only**. The existing pumps in the Third Avenue Reservoir and Pumping Station should be reviewed to determine if the existing pumps, operating in parallel at the maximum day plus fire flow rate, could operate within an acceptable range on the pump curves (i.e., not operate at the very end of the pump curves, which would create pump cavitation). This would be addressed during the next Phase of the Class Environmental Assessment.

1.5 Expanded Study Area 2026A for Preferred Solution

Once the preferred solution has been selected, an expanded study area (increased development and population) will be reviewed (**Section 9** of the main Report), based on the selected preferred solution.

END

APPENDIX B

IMPACT OF AN EXPANDED STUDY AREA FOR THE PREFERRED SOLUTION FOR THE STUDY YEAR 2026 (2026A)

1 Impact of an "Expanded Study Area" for the Preferred Solution for the Study year 2026 (2026A)

1.1 Introduction

The preferred solution (Alternative 2) is based on increasing the water supply capacity of the Kingston West WTP, maintaining the "functional" water supply capacity of the Kingston Central WPP, providing watermains to interconnect the two existing independent water supplies and distribution systems (at appropriate locations) and required system infrastructure upgrades to form a unified City of Kingston water supply and distribution system.

Utilities Kingston wished to know the potential impacts on the preferred solution for an "expanded study area", presented in **Sub-Section 3.1** of the main Report.

The "expanded study area" has been based on the City of Kingston's comprehensive secondary planning areas, including the expanded development areas GA3, GA4, GA5, as presented in the Urban Growth Strategy, Final Report 2004, and additional development areas A, B, C and D. A plan indicating the City of Kingston's comprehensive secondary planning area has also been presented in **Sub-Section 3.1** of the main Report.

As should be expected, with an increased population; hence, an increased drinking water demand, the drinking water supply, water storage, booster and pumping stations and watermain infrastructure, required to accommodate the increased drinking water demand, would increase.

In order to determine the impact of an "expanded study area" on the infrastructure requirements for the preferred solution, the additional drinking water demands have been calculated, incorporating the additional development areas associated with this "expanded study area", as indicated in **Table B.3**, on page 4, (also presented at the two Public Information Centres) and the associated modelling has been completed, incorporating the increased drinking water demands.

The "expanded study area" water demands and the required increase in the water supply and certain distribution system infrastructure, for the preferred solution, have been provided for the study year 2026 and referred to as the study year **2026A**.

The significant "expanded study areas" would be located: north of Highway 401 (**GA5**), west of service area GA2 (West) (**GA3**) and in the most eastern portion of Kingston East (**GA4**).

Since the development plans are not known in the “expanded study areas”, looped watermain systems have been provided (in an estimated logical manner), as required, such that the water demands could be appropriately apportioned throughout the “expanded study areas”.

It has been assumed that the *majority* of the cost for all watermains required to service the “expanded study area” would be developments costs and at no cost to Utilities Kingston. Certain costs have been included as Utilities Kingston’s costs to provide increased size watermains, only. Cost sharing to increase the size of currently established watermains, as required for development purposes, would be likely; however, these costs have *not* been included.

Certain information regarding the study year 2026A has been indicated in **Section 3** of the main Report. This information has been presented again in this Section.

Certain relevant information has been provided for both the study year 2026 and the study year 2026A, for ready comparison purposes.

The additional water supply required, the impact on the required infrastructure in the water distribution system and the potential impact on the water distribution system pressures, as determined by modelling, and the associated costs, as indicated in this Section, have been prepared for consideration by Utilities Kingston.

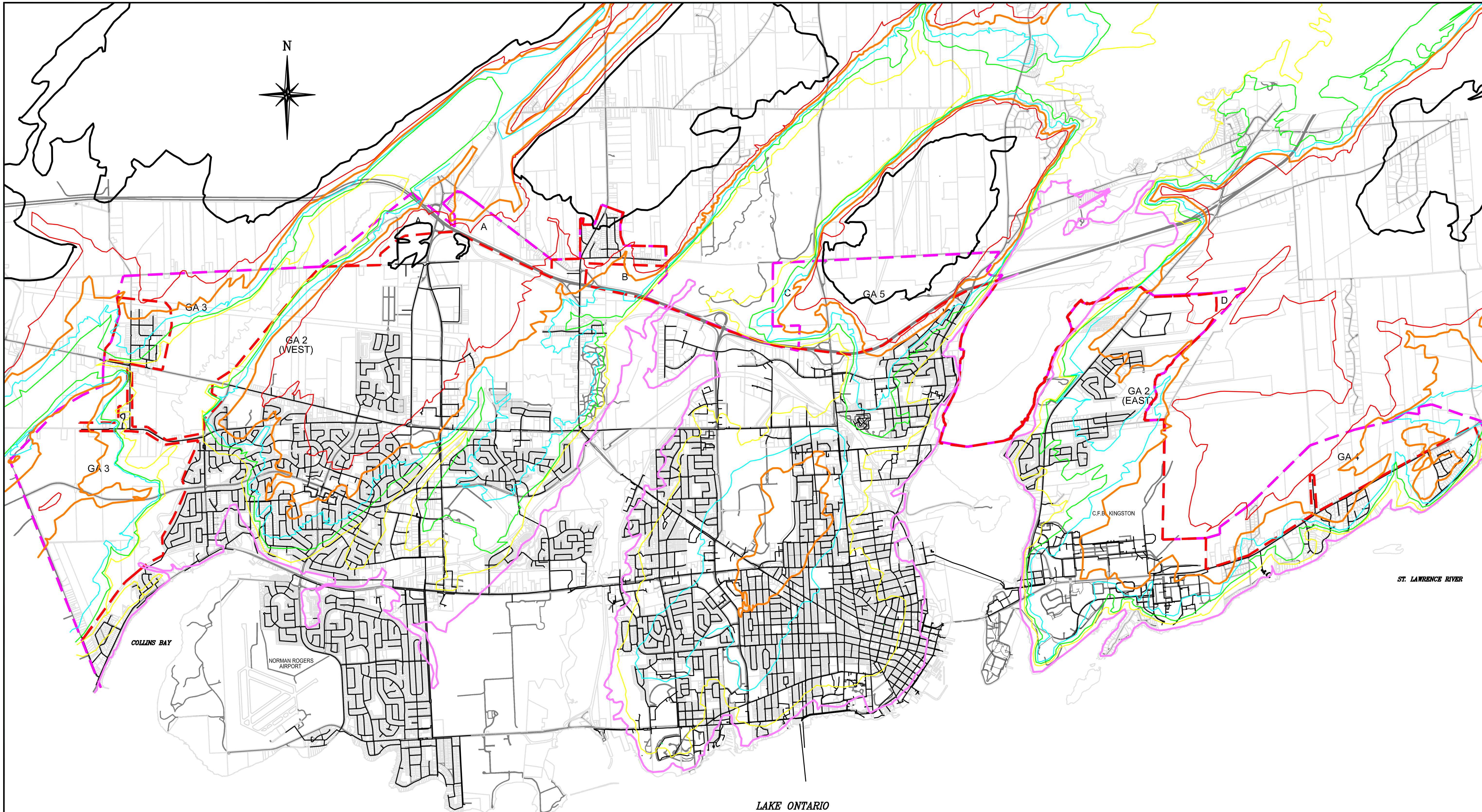
1.2 Anticipated Items of note

i) Based on existing ground contours in GA3, GA4 and GA5, the ground elevations would increase as the potential service areas expand to the north, to the west and to the east. This increase in ground elevations could pose water-servicing impacts. The existing ground contours have been indicated in **Figure B.1**, on the following page.

ii) For the considerably large expanded development area, GA5, a water booster pumping station would likely be required to provide the required water distribution system pressures to this higher ground elevation area.

i) For the expanded development area, GA4, an increase in the capacity of the pumps at the James Street BS would be required.

iv) For the study year 2026, the system pressures, during the peak hour demand periods, were near the minimum required pressure of 275 kPa (40 psi) in the area just south of Highway 401, between Division Street and Montreal Street. With the increased water demands in GA5, these



NOTES:

1. DATA SOURCES: FIGURE W1, CITY OF KINGSTON URBAN GROWTH STRATEGY (UGS), JULY, 2004; UTILITIES KINGSTON FILE INFORMATION

LEGEND

85 m
90 m
95 m
100 m
105 m
110 m
120 m

URBAND BOUNDARY

EXPANDED SERVICE AREA

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MASTER PLAN FOR WATER SUPPLY

FIGURE B.1
CONTOUR MAPPING

P:\.....\10424\Master Plan Figures\Figure B.1.dwg May 2007 water pressures, during the peak hour demand periods, would be expected to decrease *below* the required minimum water pressure. Accordingly, a booster pumping station in the area of Division Street and Benson Street, at an appropriate location, should be considered "as required". There is a considerable difference in the ground elevation between the areas south of Highway 401 to the most northerly location in GA5. A thorough examination of the booster station discharge pressure would be required.

In addition, additional water storage, likely to be provided in an elevated water storage tank, north of Highway 401 (at the most northern and central location in GA5), would also be likely to in order to provide the peak hour and fire flow demands in GA5. Due to the significant difference in elevation, measures, such as pressure reducing valves on certain water service connections, could be required for the serviced portions of GA5 at the lowest existing ground elevations (along the western boundary of GA5).

v) The pressure zone boundaries between Pressure Zone 1 and Pressure Zone 2 would likely require further adjustment, as a result of the "expanded study areas".

vi) With the provision of a new water booster pumping station, to service development in GA5, a new pressure zone would be created downstream of the water booster pumping station.

1.3 Population and water demands for an "expanded study area" for the study year 2026A

1.3.1 Population projections

The future water demands have been based on population growth and the average day, per capita consumption rate. Population growth projections have been calculated based on "The City of Kingston Micro Demographic Model" (updated January 2006). This model was used to identify the population in each Census Tract within the study area for the both study years 2026 and 2026A.

The projected populations for both study years, for Kingston West, Kingston Central and Kingston East, have been indicated in **Table B.1**.

Table B.1: **Population Summary**

Study year	**West**			**Central**	**East**	**Total**
	Zone 1	Zone 2	Total			
2026	34,266	27,862	62,128	61,599	16,933	**140,660**
2026A	34,266	55,888	90,154	72,726	30,405	**193,285**

The projected population for the study year 2026A has been obtained by adding the additional population for the "expanded study area" to the study year 2026 population. The additional population for the study year 2026A has been indicated in **Table B.2**.

Table B.2: Study Year 2026A Additional Population

	GA3	GA4	GA5	A	B	C	D	Total
Land Area (Ha)	515	295	242	139	43	35	9	1,278
Population	20,700	13,110	9,718	5,595	1,731	1,409	362	**52,625**

Notes:
1. Population yields were provided in the Urban Growth Strategy, Final Report 2004.
2. Populations for areas A, B, C, and D have been calculated based on the same average residential densities used to determine the populations for the growth alternatives (UGS, Interim Report No. 2, 2004) i.e., 25 units/gross ha, 2.3 persons per household and 70% residential land use.

1.3.2 Projected maximum day demands versus water treatment plant capacities

The projected maximum day demands for the preferred solution for the study year 2026A and 2026 (for comparison purposes), as compared to the "functional" water supply capacity of the two, water treatment plants, combined, have been indicated in "million litres per day" (**ML/d**) in **Table B.3**.

Table B.3: Maximum Day Demand Versus Existing Plants Capacities

Study year	Maximum Day Demand (ML/d)	Plants "Functional" Capacity (ML/d)	Deficit in Plants "Functional" Capacity (ML/d)
2026			
Kingston West	65.5	41.0	24.5
Kingston Central (including Kingston East)	101.2	95.0	6.2
Kingston Central	80.9	--	**--**
Kingston East	20.3	--	**--**
Total	**167**	**136.0**	**31**
2026A			
Kingston West	92.5	41.0	51.5
Kingston Central (including Kingston East)	123.5	95	28.5
Kingston Central	91.6	--	**--**
Kingston East	31.8	--	**--**
Total	**216**	**136.0**	**80**

1.3.3 Water supply requirement

From **Table B.3**, the maximum day demand, for the study year 2026A, for Kingston West would be 92.5 ML/d, the maximum day demand for Kingston Central would be 91.6 ML/d, the maximum day demand in Kingston East would be 31.8 ML/D (the combined maximum day for Kingston Central, including Kingston East, would be 123.5 ML/d and the maximum day demand for the City of Kingston would be 216 ML/d.

The maximum day discharge from the Kingston Central WPP into the City of Kingston water distribution system would be 95 ML/d. The difference in the required maximum day demand (216 ML/d – 95 ML/d) or, 121 ML/d would be supplied from the Kingston West WTP. This would require an expansion in the water supply capacity of the Kingston West WTP of **80 ML/d** (121 ML/d – 41 ML/d).

To satisfy the maximum day demand condition in Kingston Central (including Kingston East), 28.5 ML/d (123.5 ML/d – 95 ML/d) or, would need to be supplied to Kingston Central (including Kingston East) from the Kingston West WTP.

To satisfy the maximum day demand condition in Kingston West, 51.5 ML/d (92.5 ML/d – 41 ML/d) would need to be supplied to Kingston West from the Kingston West WTP. Again, the total required additional water supply from the Kingston West WTP would be 80 ML/d (28.5 ML/d + 51.5 ML/d).

In order to allow sufficient volume for other non-metered uses, such as additional chlorine contact time, back washing of the filters and other, the required plant water supply capacity has been increased by 6 per cent; accordingly, the required Kingston West WTP “rated” water supply capacity should be **85 ML/d**.

1.4 Water storage requirements

1.4.1 General

The water storage requirements for the “expanded study area” for the study year 2026A would increase significantly.

1.4.2 Water storage requirement summary for the study year 2026A

The deficit in the required water storage for the preferred solution for the “expanded study area” for the study years 2026 and 2026A has been indicated in **Table B.4**, below.

Table B.4: Water Storage Deficit Summary for the Preferred Solution

	Water Storage Deficit (m^3)
	Interconnected Water Distribution System
2026	8,842
2026A	24,199

The water storage deficit has increased approximately *three-fold* for the study year 2026A.

The water storage requirements, pending site conditions/expansion adjustments, have been indicated in **Table B.5**, on the following page.

Table B.5: **Study year 2026A City of Kingston Water Storage Requirements**

		Kingston West			Kingston Central (including Kingston East)			Combined
		Zone 1	Zone 2	Sub-total	Central	East	Sub-total	Total
MOE Fire Flows								
Population		34,266	55,888	90,154	72,726	30,405	103,131	**193,285**
Historical Max Day Factor		1.77	1.77	1.77	1.39	1.39	1.39	1.5
Max. Day Demand	(ML/d)	43.6	65.5	109.1	84.9	29.5	114.4	215.9
Fire Flow rate	(L/s)*	354	378	378	378	325	378	378
Fire Flow Duration	(hr)*	5.0	6.0	6.0	6.0	5.0	6.0	6.0
Storage Requirements								
- Fire	(m^3)	6,372	8,165	8,165	8,165	5,850	8,165	8,165
- Equalization	(m^3)	10,910	16,365	27,276	21,222	7,370	28,592	53,970
- Emergency	(m^3)	4,321	6,133	8,860	7,347	3,305	9,189	15,534
- Total	**(m^3)**	**21,603**	**30,663**	**44,301**	**36,733**	**16,526**	**45,946**	**77,669**
Existing Storage								
- Total	**(m^3)**	**14,700**	**6,800**	**21,500**	**26,600**	**5,370**	**31,970**	**53,470**
- Total Functional	(m^3)	5,870	1,700	7,570	14,700	1,060	15,760	23,330
Storage Surplus								
- Total	**(m^3)**	**-6,903**	**-23,863**	**-22,801**	**-10,133**	**-11,156**	**-13,976**	**-24,199**
- Functional	(m^3)	-5,040	-14,665	-19,706	-6,522	-6,310	-12,832	-30,640

*Based on MOE guidelines App N Table 2

It has been assumed that the Pressure Zone 1 maximum day demand is 40% of the total maximum day demand in Kingston West and that the Pressure Zone 2 maximum day demand is 60% of the total maximum day demand in Kingston West

1.5 "Expanded study area" for the study year 2026A

1.5.1 Expanded development area GA3

The provision of an O'Connor Drive Reservoir and Pumping Station would be required to provide the current required fire and equalization storage, as well as providing the maximum day demands in Pressure Zone 2.

The infrastructure size and the required piping and future pumping requirements of the Pumping Station for the study year 2026A should be provided for in the study year 2011 in order to allow ready installation of future pumps and associated mechanical, electrical and control equipment, to accommodate the 2026A demands, or greater.

The total dynamic head of the pumps would remain as for the study year 2011 (sufficient to fill the Creekford Road Elevated Tank).

1.5.2 Expanded development area GA5

In order to supply water to the most northern (and central) location in GA5, a water booster pumping station would be required, drawing water from Pressure Zone 1.

The existing water pressures during the peak hour demand periods for the study year 2026, for the area just east of Division Street to Montreal Street, just south of Highway 401, were near the minimum required water pressure of 275 kPa (40 psi).

The provision of a water booster pumping station on Division Street and Perth Road was investigated. If a water booster station was located on Division Street, north of Benson Street, the water demands in GA5 would reduce the existing water pressures in the area between just east of Division Street and Montreal Street, just south of Highway 401, to below the required minimum pressure of 275 kPa (40 psi); accordingly, if a water booster pumping station was located on Division Street, it would need to be located *south* of Benson Street.

The ground elevation on Division Street, just south of Benson Street, is 84 metres. North of Benson Street the ground elevation decreases to 83 metres.

The ground elevation at the north (and central) location in GA5 is 130 metres. With the maximum allowable discharge pressure of 690 kPa (100 psi) from a water booster pumping station on Division Street, just south of Benson Street, the residual pressure would be significantly less than the required minimum system water pressure of 275 kPa (40 psi) at the highest ground elevation in GA5 (at the northern and central location in GA5).

This condition would preclude the location of the required water booster pumping station being located on Division Street.

The ground elevation on Benson Street increases from 84 metres to 100 metres just easterly of Division Street. If the water booster pumping station was located on Benson Street at a ground elevation of 100 metres, with a discharge pressure of 690 kPa (100 psi), the required minimum pressure of 275 kPa (40 psi) could readily be provided at the highest ground elevation of 130 metres in GA5.

With a Benson Street BS located at a ground elevation of 100 metres, the existing water pressures in the area between just east of Division Street and Montreal Street would increase to near the maximum water pressure of 690 kPa (100 psi).

There is an existing 400 mm watermain on Benson Street that continues on other streets easterly to Montreal Street; accordingly, the proposed watermain route from a Benson Street BS would follow the existing 400 mm watermains to Montreal Street (at Sheppard Street). A new 500 mm watermain would be required from Montreal Street (commencing at Sheppard Street), northerly, crossing Highway 401, to McAdoo's Lane, then, westerly on McAdoo's Lane to a GA5 elevated water storage tank (located at the highest ground elevation at the approximate mid-point of the northern boundary of GA5).

The elevated water storage tank has been ideally located to service GA5.

The resultant water pressure at a GA5 elevated water storage tank would be above the minimum required system pressure of 275 kPa (40 psi) for the peak hour demand condition.

The route for the 500 mm watermain would likely follow the internal road system in the GA5 development area, westerly and northerly from Montreal Street, south of McAdoo's Lane. This would decrease the length of the 500 mm watermain and would allow this watermain to provide two functions; namely, the water supply to a GA5 elevated water storage tank and a water distribution header, westerly and northerly, through the middle of the expanded development area.

With the provision of a Benson Street BS, a new pressure zone, Pressure Zone 2D, would be created for all areas serviced easterly and northerly (GA5) of the location of a Benson Street BS. The Pressure Zone 2D boundary has been indicated in **Figure B.2**, on the following page.

The water services south of Highway 401 in the new Pressure Zone 2D would benefit through much increased water pressure.

Due to the significant difference in elevation, measures, such as pressure reducing valves (located inside the building being serviced) on certain water service connections, would be required for the serviced portions of GA5 at the lowest existing ground elevations (along the western boundary of GA5).

If development in the expanded development area GA5 were to proceed, the Benson Street BS, the 500 mm watermain and a **6 ML** GA5 Elevated Storage Tank would be required as soon as any significant development was scheduled to proceed.

Unfortunately, the study year 2026A capacity of a GA5 Elevated Tank could not be phased nor, could the installation of the 500 mm watermain supply to the elevated tank.

Potentially, only the booster pumps in a Benson Street BS could be phased. The building for a Benson Street BS and all other associated works would be required as soon as any significant development was scheduled to proceed.

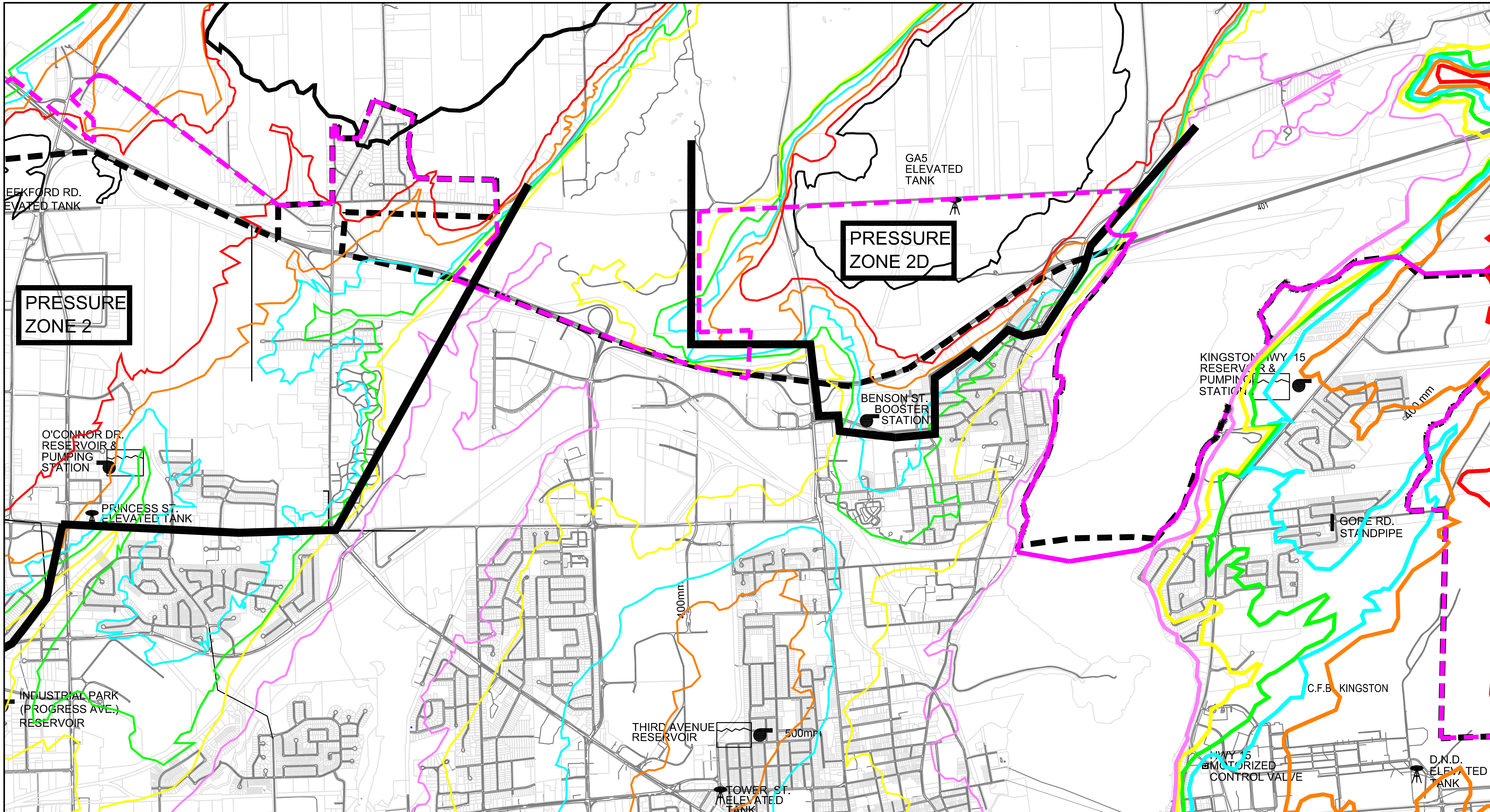
1.5.3 Expanded development area GA4 (south of Kingston Highway 15 motorized valve)

The populations that would be serviced for the study year 2026A have been indicated in **Table B.6**, including the MOE Guideline requirements for fire flows for the actual populations being serviced in the study year 2026A.

Table B.6 - Storage Capacity Required for GA4

Study year	**2026A**
Population	17,962
Maximum day demand (ML/day)	20.5
Fire flow rate (L/s)	257
Fire flow duration (hrs)	4
A = Fire Storage (m^3)	3,700
B = Equalization Storage (m^3)	5,125
C = Emergency Storage (m^3)	2,206
Total storage requirement (m^3)	**11,000**

The total water storage requirement would include the existing water storage in the DND Elevated Tank and the Milton Road Standpipe; accordingly, the



NOTES:

1. DATA SOURCES: FIGURE W1, CITY OF KINGSTON URBAN GROWTH STRATEGY, JULY, 2004; UTILITIES KINGSTON FILE INFORMATION

LEGEND

PRESSURE ZONE BOUNDARY
URBAN BOUNDARY
EXPANDED STUDY AREA BOUNDARY
EXISTING WATERMAINS

CONTOUR ELEVATIONS

85 m
90 m
95 m
100 m
105 m
110 m
120 m

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FIGURE B.2
PRESSURE ZONE 2D BOUNDARY – STUDY YEAR 2026A

P:\.....\10424\Master Plan Figures\Figure 9.2, 9.3, 9.5.dwg May 2007 required *additional* storage capacity required would be 7 ML (11 ML – 2.27 ML – 1.77 ML).

The stopping and starting of the booster pumps at the James Street BS is currently controlled *only* by the water level in the DND Elevated Tank.

A secondary control would be required such that the pumps in the James Street BS would not stop until the DND Elevated Tank, the Milton Road Standpipe and the new water storage facility were all at the high water level.

With regard to the motorized control valve on Highway No. 2, it would still be required to allow the water retained in the Milton Road Standpipe *and* a new water storage facility to be used in order to prevent long detention times in both facilities. Accordingly, the existing control of the motorized control valve would require modification such that the motorized control valve would only close once the water levels in the Milton Road Standpipe and a new water storage facility *both* reached the top water level, at which point, the motorized control valve would close.

To consider the use of an elevated water storage tank, it would be prudent to abandon the Milton Road Standpipe and include the storage capacity of 1.8 ML in a new, elevated water storage tank. Unfortunately, an elevated water storage tank for the *combined* water storage capacity would be too large. For this reason, combining the two water storage facilities has been considered no further.

A **6.8 ML** elevated tank (the identical size of the Creekford Road Elevated Tank) would be sufficient to provide the additional required water storage.

The most suitable location to provide an elevated tank would be at highest ground elevation (119 m) and at the approximate mid-point of GA4 and at the most northerly location. Accordingly, the proposed location would be near the north end of Rogers Side Road.

It would be logical to maintain the top water level in a Rogers Side Road Elevated Tank the same as for the DND Elevated Tank (151.3 m) and the Milton Road Standpipe (151.3 m). With an identical top water level, there would be no change in the system pressures as exist in the current water distribution system in the southern portion of Kingston East.

The system pressure adjacent to a Rogers Side Road Elevated Tank would be 32.3 m (151.3 m – 119 m) or, 316 kPa (46 psi). This would satisfy the minimum water pressure requirement of 275 kPa. The suggested location would be ideal to service development area GA4.

The water supply to the Rogers Side Road Elevated Tank would be provided by a new 400 mm watermain from Highway No. 2. The 400 mm watermain would act as a common inlet and outlet from the tank and would also provide the main distribution system watermain to service a large portion of GA4.

As indicated above, the Milton Road Standpipe and a Rogers Side Road Elevated Tank would require an additional control to ensure that the James Street BS would not stop until the DND Elevated Tank, the Milton Road Standpipe and a Rogers Side Road Elevated Tank were all at the high water level. As also indicated above, the Highway No. 2 motorized control valve would remain as current; except, both the Milton Road Standpipe and a Rogers Side Road Elevated Tank would *both* need to reach the top water level before the motorized control valve would close.

Based on modelling, an altitude valve would be required in the DND Elevated Tank and the Milton Road Standpipe.

If development in the “expanded study area” GA4 was to proceed, the 6.8 ML Rogers Side Road Elevated tank, the 400 mm supply watermain from Highway No. 2 and an increase in the capacity of the pumps at the James Street BS would be required following the study year 2016.

1.6 Water distribution system modelling for development areas GA3, GA4, GA5, A, B, C, and D for a maximum day plus fire flow condition for 2026A

1.6.1 General

The required water supply and distribution facilities, as provided in the Sections above, have been developed through the use of the water distribution model.

Specific modelling for 2026A has been completed for the condition of a maximum day plus fire flow condition in GA3, GA4, GA5, A, B, C and D.

1.6.2 Modelling for the maximum day plus fire flow condition for 2026A in GA3

The water supply to accommodate a maximum day plus fire flow in GA3 would be supplied from an O’Connor Drive Reservoir and Pumping Station and the existing Creekford Road Elevated Tank.

The distance from these two facilities to development area GA3 is extensive; accordingly, in order to supply sufficient flow to GA3, it was necessary to provide an increased diameter watermain from Gardiners Road to GA3 in the model.

In order to provide a suitable maximum day plus fire flow to GA3 in Pressure Zone 2, a 500 mm watermain for the *total* length from Gardiners Road to GA3 was required. Some of the watermains along the selected route were planned 300 mm development watermains; others replaced existing 300 mm watermains and others were watermains assumed as required in GA3 (no development plans).

The proposed general alignment of the 500 mm watermain has been indicated in **Figure B.3**, on the following page.

Based on modelling, with the provision of the 500 mm watermain on Cataraqui Woods Drive (commencing at Gardiners Road) to GA3, a suitable fire flow, at a residual pressure of 150 kPa, would be available in GA5.

1.6.3 Modelling for the maximum day plus fire flow condition for 2026A in GA4

The water supply to accommodate a maximum day plus fire flow in GA4 would be supplied from the DND Elevated Tank, the Gore Road Standpipe and a Rogers Side Road Elevated Tank.

A fire was simulated at a location on Highway No. 2 near the intersection with Glen Lawrence Crescent (east of Rogers Side Road).

Based on modelling, the required fire flow of 257 L/s for a duration of four hours, at a residual pressure of 150 kPa, would be available.

1.6.4 Modelling for the maximum day plus fire flow condition for 2026 in GA5

The water supply to accommodate a maximum day plus fire flow in GA5 would be supplied from a GA5 Elevated Tank.

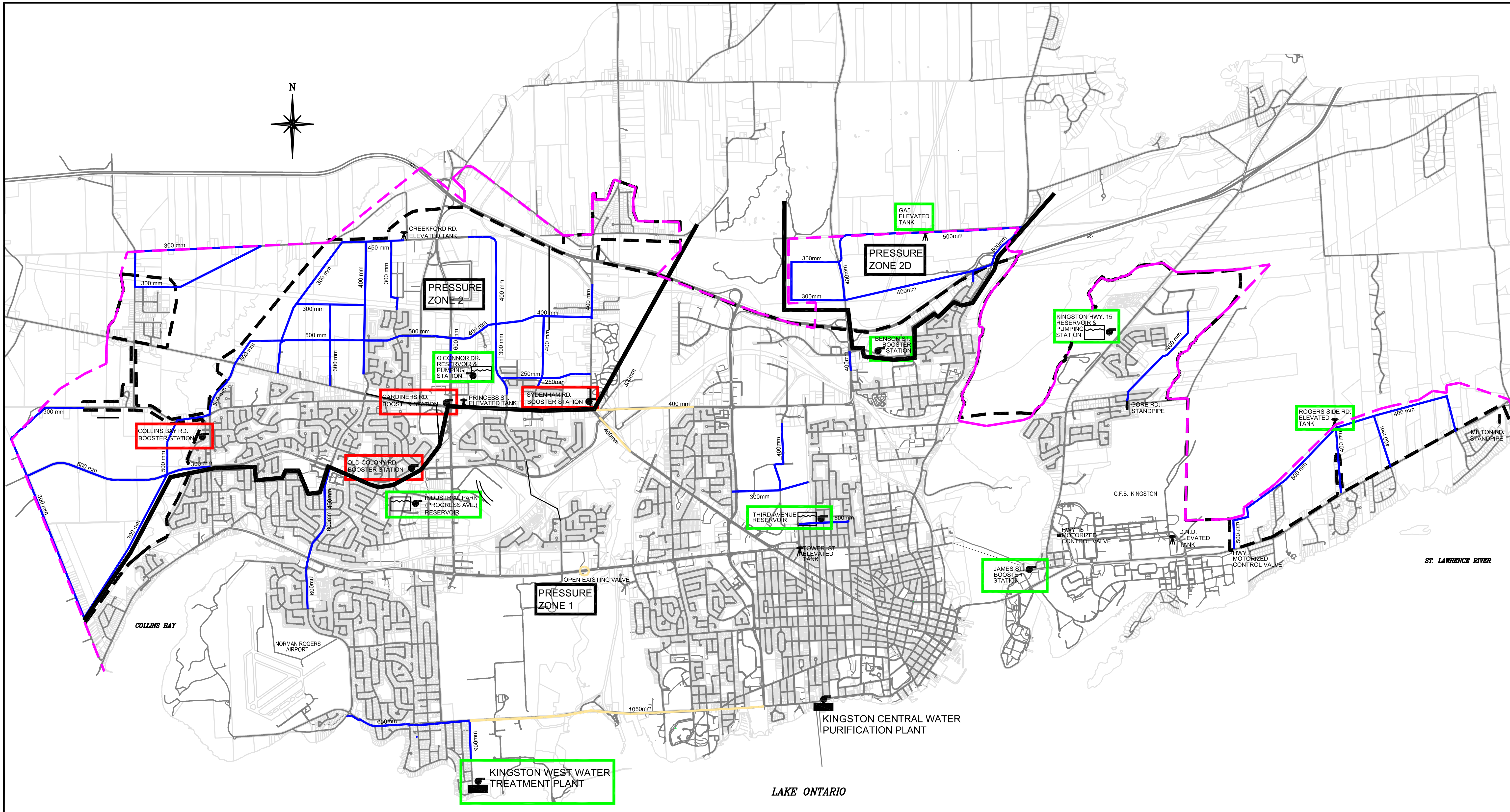
A fire was simulated at a location just east of Perth Road immediately south of McAdoo's Lane.

Based on modelling, the required fire flow of 200 L/s for a duration of three hours, at a residual pressure of 150 kPa, would be available.

1.7 Realignment of the pressure zone boundary between Pressure Zone 1 and Pressure Zone 2 in Kingston West and a potential new pressure zone (Pressure Zone 2D), north of Highway 401, west of Montreal Street

1.7.1 General

The expanded development area in GA3 has required the Pressure Zone Boundary between Pressure Zone 1 and Pressure Zone 2 and a potential new pressure zone, Pressure Zone 2D, in the area north of Highway 401, west of



NOTES:

1. DATA SOURCES: FIGURE W1, CITY OF KINGSTON URBAN GROWTH STRATEGY, JULY, 2004; UTILITIES KINGSTON FILE INFORMATION

LEGEND

- URBAN BOUNDARY
- EXPANDED STUDY AREA BOUNDARY
- EXISTING WATERMAINS
- NEW WATERMAINS
- INTERCONNECTING WATERMAINS
- PRESSURE ZONE BOUNDARY
- NEW/UPGRADED FACILITY
- RETIRED

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FIGURE B.3: CITY OF KINGSTON WATER SUPPLY AND DISTRIBUTION SYSTEM – STUDY YEAR 2026A

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Montreal Street, to be further examined based on the ground elevations and a logical pressure zone boundary.

1.7.2 Peak hour demand, pressure contour plan for the "expanded study area"

A peak hour demand, pressure contour plan (**Figure B.4**) for the "expanded study area" for the study year 2026A has been included on the following page (also enclosed, full size, in the envelope at the end of **Appendix B**).

A review of both **Figure B.1** (ground contour plan) and the modelled available system pressures for the study year 2026A was required in order to determine if the required minimum system pressures were available at *all* locations and to potentially adjust existing pressure zone boundaries to maximize the available system pressures.

Of particular note, was the area north of Highway 401 and west of Montreal Street (GA5) and the current pressure zone boundary, between Pressure Zone 1 and Pressure Zone 2 in the area south of Taylor Kidd Boulevard and on both sides of Bayridge Drive.

1.8 Pressure Zone 1 and Pressure Zone 2 in the area South of Taylor Kidd Boulevard

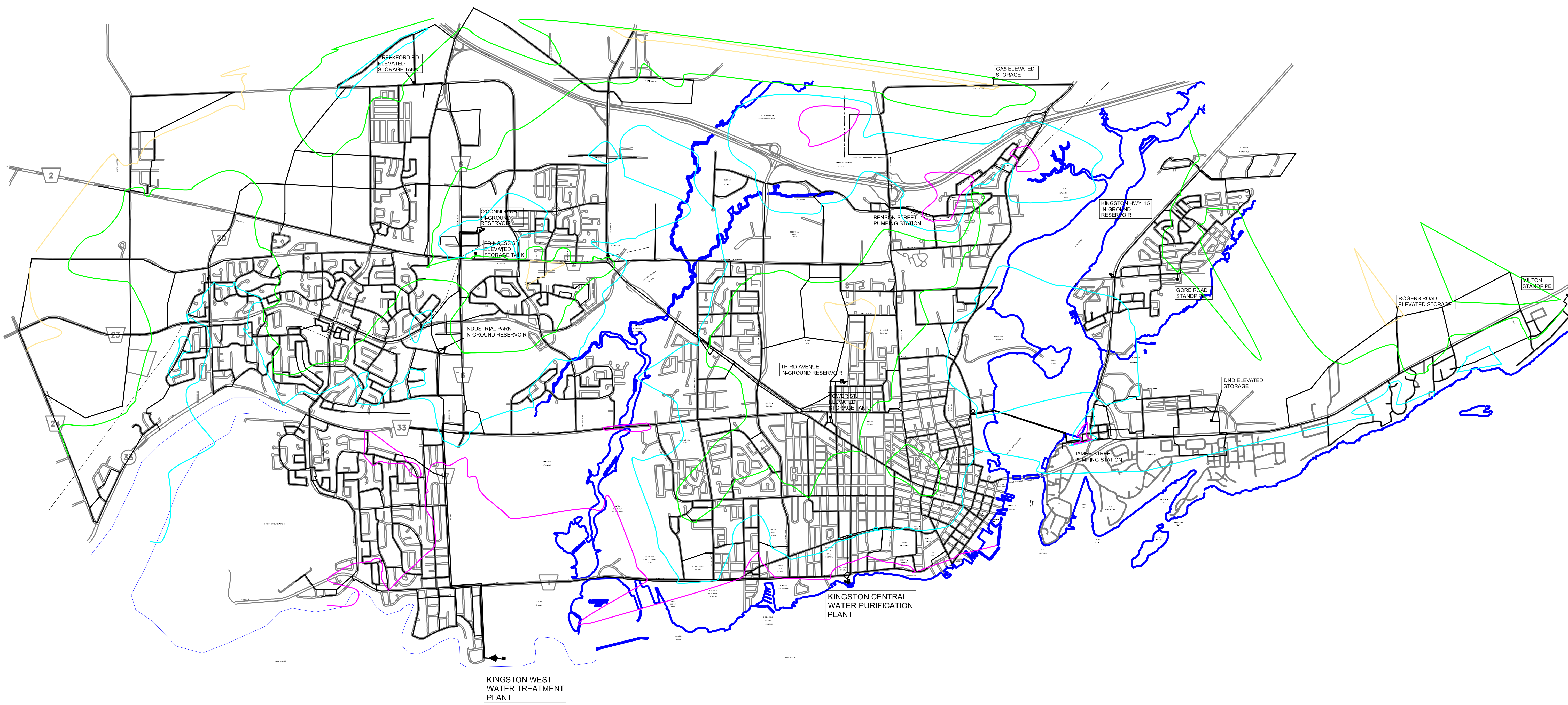
Based on the existing ground contours (**Figure B.1**), the existing pressure boundary between Pressure Zone 1 and Pressure Zone 2 generally remains below the ground elevation contour line of 105 m. In the area south of Taylor Kidd Boulevard, on both sides of Bayridge Drive, there are areas with elevations greater than 105 m that are not included within Pressure Zone 2.

For the study year 2026A, even without the "expanded study area", the existing pressure zone boundary between Pressure Zone 1 and Pressure Zone 2 in this area should be considered for realignment to generally remain below ground elevation 105 m. With the "expanded study area" further westerly (GA3), and the resulting water demands; hence, the system pressure, consideration for the realignment of this pressure zone boundary would be further increased.

The proposed realigned boundary between Pressure Zone 1 and Pressure Zone 2 in the expanded development area GA3 has been indicated in **Figure B.5**, on the following page.

The intent would be to minimize the Pressure Zone 1 service area, westerly of Collins Bay Road, and to maximize the Pressure Zone 2 service area, supplied from the Creekford Road Elevated Tank and from an expanded O'Connor Drive Reservoir and Pumping Station.

YEAR 2026A PEAK HOUR DEMAND PRESSURE CONTOURS



LEGEND:

	WATERMAINS
	PRESSURE ZONE BOUNDARY

PRESSURE CONTOURS (kPa)

	300
	400
	500
	600

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FIGURE B.4: PREFERRED SOLUTION
STUDY YEAR 2026A PEAK HOUR DEMAND
PRESSURE CONTOURS PLAN

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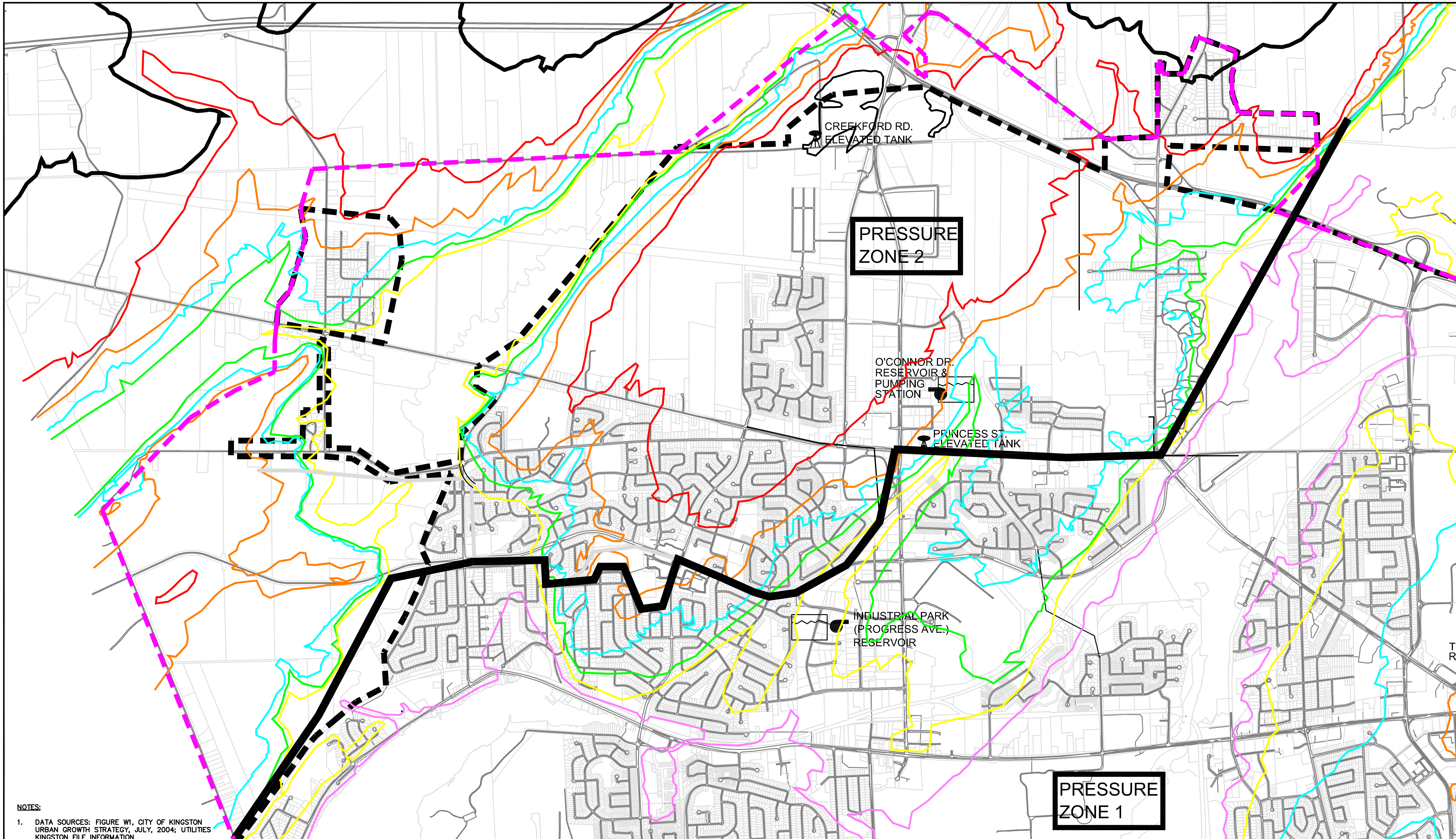

NOTES:

1. DATA SOURCES: FIGURE W1, CITY OF KINGSTON URBAN GROWTH STRATEGY, JULY, 2004; UTILITIES KINGSTON FILE INFORMATION

LEGEND

- REVISED PRESSURE ZONE BOUNDARY
- EXISTING PRESSURE ZONE BOUNDARY
- URBAN BOUNDARY
- EXPANDED STUDY AREA BOUNDARY
- EXISTING WATERMAINS

CONTOUR ELEVATIONS

- 85 m
- 90 m
- 95 m
- 100 m
- 105 m
- 110 m
- 120 m

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FIGURE B.5
PRESSURE ZONE 2 BOUNDARY
REALIGNMENT – STUDY YEAR 2026A

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The existing ground elevations in GA3, westerly of Collins Bay Road, also indicated that the proposed boundary between Pressure Zone 1 and Pressure Zone 2, as indicated in **Figure B.5**, would be the most suitable location. Implementation of the suggested realigned boundary between Pressure Zone 1 and Pressure Zone 2 would be subject to review by Utilities Kingston Operations and the availability of suitable valves (to be closed). Suitable valves to be closed to realign the pressure zone boundary should generally be available.

The available system pressures for study year 2026A during peak hour demand conditions, with the existing boundary between Pressure Zone 1 and Pressure Zone 2 realigned have been indicated in **Figure B.4**.

1.9 Water storage pumping stations and water booster pumping stations

1.9.1 Industrial Park Reservoir Pumping Station

The required flow from the Industrial Park Reservoir Pumping Station would be 19.0 ML/d (220 L/s) during the peak hour demand condition and **21 ML/d** (240 L/s) to satisfy the maximum day plus fire flow demand condition. The capacity of existing pumps is adequate for peak hour flow demand conditions and *marginally* adequate for the maximum day plus fire flow demand conditions. The existing pumps should be further evaluated.

1.9.2 Third Avenue Reservoir Pumping Station

The required flow from the Third Avenue Pumping Station, for the peak hour demand condition would be 30.2 ML/d (350 L/s) with a discharge pressure of 33.5 m. The required flow for the maximum day plus fire flow demand condition would be **35 ML/d** (400 L/s) with a discharge pressure of 29.0 m. Two existing pumps, operating in parallel, as would be required, may only be *marginally* adequate for the peak hour demand condition, but would *not* be capable of supplying the maximum day plus fire flow except if the pumps were in a “new” condition (not the case). There does not appear to be space available for additional pumps; accordingly, the existing pumps should be replaced to ensure the required performance.

The required capacity and the total dynamic head of the existing pumps at the Third Avenue Pumping Station would be reviewed during the next Phase of the Class Environmental Assessment. The existing power supply and motor control centre would also require review. It is likely that the existing motor control centre would require replacement from an age and to allow continued service to be provided during the pumps replacement.

The ground elevation at the Tower Street Elevated Tank is 105 m and the top water level is 139.5 m. The difference in the two elevations would be 34.5 m

(139.5 m – 105 m). Under peak hour demand conditions, the inlet pressure to the Tower Street Elevated Tank would be *close* to the top water level of the tank; accordingly, an altitude valve could be required on the inlet watermain. This would require further review during the next Phase of the Class Environmental Assessment.

1.9.3 An O'Connor Drive Reservoir Pumping Station

The required maximum day flow from an O'Connor Drive Reservoir Pumping Station would be 55.7 ML/d (645 L/s).

It should be noted that during a maximum day plus fire flow demand condition, the flow from the Creekford Road Elevated Tank must be supplemented by pumped flows from an O'Connor Drive Reservoir and Pumping Station. The Pumping Station would need to be able to provide a supplementary flow during the peak hour demand condition of 69 ML/d (800 L/s) at 63 m total dynamic head and provide a supplementary flow during the governing maximum day plus fire flow demand condition of **88.4 ML/d** (1023 L/s) at 60 m total dynamic head. This flow is more than twice the flow required for the study year 2026 [35 ML/d (minimum)].

This requirement could be satisfied in a similar fashion to that for 2026, with a total of 5 pumps, including the spare, sized at approximately 23.3 ML/d (270 L/s) at 62 m total dynamic head. The station would be similar to that for 2026, but with larger discharge header piping to accommodate the much-increased flow requirements. This would require further review during the next Phase of the Class Environmental Assessment.

1.9.4 A Highway 15 Reservoir Pumping Station

The required maximum flow from a Kingston Highway 15 Reservoir Pumping Station would be **19 ML/d** (220 L/s) during a maximum day plus fire flow condition. This would be unchanged from the 2026 alternative for the study year 2026.

1.9.5 Water booster stations to be retired

The Gardiners Road BS, the Sydenham Road BS, the Old Colony Road BS and the Collins Bay BS could all be retired once an O'Connor Drive Reservoir and Pumping Station and certain watermains have been provided.

1.9.6 A Benson Street BS

The discharge pressure from a Benson Road BS would be 690 kPa (100 psi). The required flow would be 12.1 ML/d (140 L/s). The required booster pumping station capacity would be **12.1 ML/d** at 40 m total dynamic head.

1.9.7 James Street BS

Referring to **Table B.3**, the water supplied to Kingston East through the James Street BS for the study year 2026 would be **20.3 ML/d** (235 L/s), which could readily be accommodated by the existing station with two pumps operating.

Referring to **Table B.3**, the water supplied to Kingston East through the James Street BS for the study year 2026A would be **31.8 ML/d** (368 L/s). As observed, the water supplied to Kingston East through the James Street BS has increased by 11.5 ML/d (a 50 per cent increase); accordingly, an increase in the capacity of the water booster pumps *would* be required.

Two of the three existing pumps would no longer be able to provide the required flows. The station firm capacity would need to be upgraded to approximately **33 ML/d** (380 L/s) at 42 m total dynamic head. This could be accomplished by upgrading the existing 3 pumps to 16.4 ML/d (190 L/s) at 42 m total dynamic head or by providing an additional fourth pump to provide the required additional capacity of 5.2 ML/d to 7 ML/d (60 L/s to 80 L/s) at 42 m total dynamic head.

The total dynamic head would require review during the next Phase of the Class Environmental Assessment to ensure that the top water levels of the downstream storage facilities, particularly in the southern portion of Kingston East, would all remain the same.

It should be possible to replace the existing pumps or add a fourth pump within the existing building envelope. The existing motor control centre would require replacement (to maintain the existing James Street BS operational) and the capacity of the existing electrical line power service and standby power engine-generator set would need to be verified to be adequate. Again, this would require review during the next Phase of the Class Environmental Assessment.

1.10 Water storage facilities

1.10.1 General

For existing reservoir expansions and, to a reduced extent, for potential new water storage reservoirs, the total storage capacity that would be required has been “calculated” to be somewhat greater than the “modelled” required operating storage capacity, in order to account for unusable storage (based on the existing reservoirs “available” water storage capacity and practical issues with regard to the operation of the reservoirs and site conditions).

The modelled storage capacity requirements have been provided, in the following sub-sections, for all in-ground water storage reservoirs. The "calculated" storage capacity requirements have been provided, immediately thereafter.

1.10.2 Industrial Park Reservoir

Based on modelling, the Industrial Park Reservoir would need to be expanded (primarily based on the increased water demands in GA3) to provide an additional storage capacity of 3.7 ML. A 3.7 ML reservoir expansion could readily be accommodated on the existing City-owned site.

The "calculated" expansion in the storage capacity would be **4.3 ML**, provided as one, interconnected cell.

1.10.3 Third Avenue Reservoir

Based on modelling, the Third Avenue Reservoir would need to be expanded to provide an additional storage capacity of 4.9 ML, which would be fire storage *only*.

The Third Avenue Reservoir expansion of 4.9 ML is required for the maximum day plus fire flow condition in Kingston Central. The required additional storage capacity has been confirmed by modelling a maximum day plus fire flow condition in Kingston Central.

The "calculated" storage capacity would be **7.2 ML** (one cell). A 7.2 ML reservoir expansion could be accommodated on the existing City-owned site.

1.10.4 An O'Connor Drive Reservoir

The water storage requirements in Kingston West, Pressure Zone 2, would be provided in the Creekford Road Elevated Tank and in an O'Connor Drive Reservoir. Based on modelling, an O'Connor Drive Reservoir would require 6.3 ML of fire storage and approximately 5.5 ML of equalization storage or, a total storage capacity of 11.8 ML.

The "calculated" storage capacity would be **13.0 ML**, provided as two cells, 6.5 ML each.

1.10.5 A Kingston Highway 15 Reservoir

The expanded development area of Kingston East, north of the motorized control valve would have an insignificant impact on the size of a Kingston Highway 15 Reservoir; accordingly, the required storage capacity would almost be the same as for the study year 2026.

The populations that would be serviced for the study years 2026 and 2026A, north of the motorized control valve, have been indicated in **Table B.7**, below, including the MOE Guideline requirements for fire flows for the actual populations being serviced in the study years 2026 and 2026A.

1.10.6 Rogers Side Road Elevated Water Storage Tank

A new Rogers Side Road Elevated Tank with a storage capacity of **6.8 ML** would be required.

Table B.7 – Populations Being Serviced and Fire Storage Required

Study year	**2026**	**2026A**
Population	12,081	12,443
Maximum day demand (ML/day)	10.98	11.21
Fire flow rate (L/s)	**220**	**220**
Fire flow duration (hrs)	**3**	**3**
A = Fire Storage (m^3)	2,376	2,376
B = Equalization Storage (m^3)	2,745	2,803
C = Emergency Storage (m^3)	1,280	1,295
Total storage requirement (m^3)	**6,400**	**6,474**

Based on the population being serviced in the northern portion of Kingston East, a Kingston Highway 15 Reservoir and Pumping Station with a reservoir capacity of 6.5 ML would be required (to provide the required equalization and fire storage).

The “calculated” storage capacity would be **7.0 ML**, provided as two cells, 3.5 ML each.

1.10.6 GA5 Elevated Water Storage Tank

The population to be serviced for the study year 2026A has been indicated in **Table B.8**, including the MOE Guideline requirements for the fire flow required for the actual population being serviced for the study year 2026A.

Table B.8 – Maximum Storage Capacity Required for GA5 Elevated Tank

Study year	**2026A**
Population	11,127
Maximum day demand (ML/day)	10.7
Fire flow rate (L/s)	200
Fire flow duration (hrs)	3
A = Fire Storage (m^3)	2,160
B = Equalization Storage (m^3)	2,675
C = Emergency Storage (m^3)	1,209
Total storage requirement (m^3)	**6,000**

The approximate ground elevation at a GA5 Elevated Tank would be 130 metres. The approximate tank inlet watermain pressure would be 285 kPa (28 m); accordingly, the top water level in the tank would be approximately 157.85 (0.15 m below the overflow invert).

The tank storage capacity (**6.0 ML**) and height would be just less than the existing Creekford Road Elevated Tank.

1.11 Watermain requirements

As indicated in **Section 1.1**, above, since the development plans are not known in the “expanded study area”, looped watermain systems have been provided, in an estimated logical manner, such that the water demands could be apportioned throughout the “expanded study areas”.

Of note and as indicated in **Section 1.3**, above, 28.5 ML/d (330 L/s) would need to be supplied to Kingston Central from the Kingston West WTP. This increased water supply would require the installation of the 1050 mm trunk watermain interconnection from the end of the existing watermain on Front Road to the intersection of King Street West and Sir John A. MacDonald Boulevard (4.1 kilometres) at some period beyond the study year 2016. Once installed, the remaining 0.9 kilometres of 1050 mm trunk watermain could be installed to complete the ultimate interconnection between the Kingston West WTP and the Kingston Central WPP.

The locations of all required infrastructure (including replacement and proposed new development watermains) to accommodate the water demands for an “expanded study area” for the study year 2026A have been indicated in **Figure B.3**, presented in **Item 1.6.2**, above.

1.12 Estimated cost of required infrastructure to accommodate the water demands for the preferred solution for the study years 2026 and 2026A

The estimated cost for the required infrastructure for the preferred solution for the study years 2026 (for comparison purposes) and 2026A, has been indicated in **Table B.9**, on following page. The costs indicated in **Table B.9** include 16% engineering fees. It should be expected that the estimated cost for the required infrastructure for the study year 2026A would be significantly higher than for the study year 2026.

It should also be noted that the retirement of the four existing water booster pumping stations in Kingston West could still proceed.

Table 9.2 - Estimated Costs for the Preferred Solution for the Study Years 2026 and 2026A

Infrastructure Description	Unit	Unit Cost	2026		2026A	
			Size	Cost	Size	Cost
Expansion of the existing Kingston West WTP "rated" water supply capacity	ML/day	$780,000	33	$25,740,000	85	$66,300,000
Expansion of the existing Industrial Park Reservoir	ML	$435,000	N/A	N/A	4.3	$1,870,500
New O'Connor Dr. Reservoir	ML	$435,000	8.8	$3,828,000	13.0	$5,650,500
New O'Connor Dr. Pumping Station		N/A	N/A	$1,900,000	N/A	$2,700,000
Expansion existing Third Avenue Reservoir	ML	$435,000	7.1	$3,088,500	7.2	$3,132,000
Replace pumps at Third Avenue PS		N/A		$250,000		$250,000
New Kingston Highway 15 Reservoir	ML	$435,000	7	$3,045,000	7	$3,045,000
New Kingston Highway 15 Pumping Station		N/A	N/A	$1,600,000	N/A	$1,600,000
Retire four existing Booster Stations		N/A	N/A	$200,000	N/A	$200,000
New Benson Street BS		N/A	N/A	-	N/A	$1,750,000
New GA5 Elevated Tank	ML	$800,000	N/A	-	6	$4,800,000
New Rogers Side Road Elevated Tank	ML	$800,000	N/A	-	6.8	$5,440,000
Upgrade pumps at the James Street BS			N/A	-	N/A	$700,000
New 900 mm discharge watermain from the Kingston West WTP	metres	$1,550	1,085	$1,681,750	1,085	$1,681,750
New 600 mm watermain on Front Rd. (Days Rd. to Bayridge Dr.)	metres	$1,300	1,370	$1,781,000	1,370	$1,781,000
New 600 mm watermain on Bayridge Dr. (Acadia Dr. to Taylor Kidd Blvd.)	metres	$1,300	2,083	$2,707,900	2,083	$2,707,900
New 600 mm watermain on O'Connor Dr. (from O'Connor Drive PS to Gardiners Rd.)	metres	$1,300	230	$299,000	230	$299,000
New 600 mm watermain on Gardiners Rd. (O'Connor Dr. to Cataraqui Woods Dr.)	metres	$1,300	631	$820,300	631	$820,300
New 400 mm watermain on Avenue Rd. (Princess St. to McMahon Ave.)	metres	$950	398	$378,100	398	$378,100
New 500 mm watermain on Third Ave. (MacDonnell St. to Alfred St.)	metres	$1,150	645	$741,750	645	$741,750
New 300 mm watermain across the Novelis property (east-west)	metres	$750	1,119	$839,250	1,119	$839,250
New 400 mm watermain on the Novelis property (north)	metres	$950	765	$726,750	765	$726,750
New 1050 mm interconnecting watermain on Front Rd.	metres	$1,750	2,000	$3,500,000	4,100	$7,175,000
New 400 mm interconnecting watermain on Princess St.	metres	$1,200	1,000	$1,200,000	1,000	$1,200,000
New 400 mm interconnecting watermain on John Counter Blvd.	metres	$1,150	1,300	$1,495,000	1,300	$1,495,000
New 500 mm wm. on Cataraqui Woods Dr. (Gardiners Rd. to Bayridge Dr.) ***	metres	$1,150	N/A	-	1,250	$1,437,500
New 400 mm wm. on Cataraqui Woods Dr. (Gardiners Rd. to Centennial Dr.)	metres	$950	N/A	-	775	$736,250
New 400 mm watermain on Bayridge Dr. (Cedarwood Dr. to Woodbine Rd.)	metres	$950	N/A	-	450	$427,500
New 500 mm watermain on Collins Bay Rd. (Princess St. to Woodbine Rd.)	metres	$1,150	N/A	-	860	$989,000
New 400 mm watermain on Division St. (Weller Ave. to Benson St.)	metres	$950	N/A	-	550	$522,500
Total (see notes on following page)				$55,850,000		$121,300,000

*** Provision of this watermain would be a significant undertaking, if provided by Utilities Kingston.

Notes: **1.** The costs indicated in Table A.2 are 2007 $ costs. The costs will increase over time based on the rate of inflation and the Toronto Construction Cost ENR Index
2. All costs include 16% engineering

9.13 Suggested sequence for the provision of infrastructure required for the "expanded study area" for the study year 2026A

1.13.1 General

The suggested sequence for the provision of the required infrastructure following the short-term study year 2011, following the short-term study year 2011 and following the mid-term study year 2016 has been indicated in a visual format in **Figure B.6** (on page 27). The required infrastructure for the "expanded study area" for the study year 2026A could prove to be a significant challenge for Utilities Kingston, based on the fact that "many" infrastructure requirements would be required for the study year 2011 and budget constraints would definitely be an issue. For this reason the proposed sequence for the provision of infrastructure, must take budget constraints into consideration and, although required for the short-term study year 2011, prioritize the major infrastructure requirements to suit. This would require input from Utilities Kingston regarding the proposed priority for the provision of the required additional infrastructure.

1.13.2 Infrastructure required for the near-term study year (2011)

The required infrastructure for the near-term study year (2011) have been presented below in the proposed sequential order of importance, relative to one another; although, again, the infrastructure so indicated have all been identified as required for the short-term study year 2011.

a) Industrial Park Reservoir

The required expansion (based on incorporating the required storage capacity into the existing reservoir) of the Industrial Park Reservoir for the study year 2026A would be 4.3 ML.

The storage capacity expansion of **4.3 ML** should be provided for the study year 2011.

b) Expansion of the Kingston West WTP

The expansion of the Kingston West WTP must remain as the *highest* priority to supply drinking water (particularly for Kingston West). Without this additional drinking water supply, the other required infrastructure, indicated as required for the short-term study year 2011, would be of much reduced value.

In order to accommodate the projected additional water demands for the “expanded study area” for the study year 2026A, the required increase in the “rated” capacity of the Kingston West WTP would be **88 ML/d** (assuming the “functional” water supply capacity of 95 ML/d remained available from the Kingston Central WPP).

Expansions to water treatment plants are normally provided to accommodate the water demands for a minimum of 20 years; accordingly, the prudent expansion for the study year 2011 should be **88 ML/d**. The system demand (i.e., the required discharge from the plant) would be 80 ML/d.

c) Provision of an O’Connor Drive Reservoir and Pumping Station

The new storage capacity of **13 ML** should be provided for the study year 2011. Dividing the reservoir into three cells (two at 4.5 ML each and a future cell of 4 ML), with the third 4 ML cell remaining as a future expansion, is an option; however, this could create operational and construction considerations. This would be a Utilities Kingston decision.

The required pump discharge header would be provided to accommodate potential future pumps to accommodate the study year 2026A.

1.13.3 Infrastructure required following the near-term study year (2011)

a) Expansion of the Third Avenue Reservoir

The required expansion (based on incorporating the required storage capacity expansion into the existing reservoir) of the Third Avenue Reservoir for the study year 2026A would be 7.2 ML.

The storage capacity expansion of **7.2 ML** should be provided for the study year 2011.

Simulation, using the water model, indicated that the *existing theoretical* firm pumping capacity of 31.6 ML/day (366 L/s) would not likely be sufficient to meet all demand conditions for the study year 2026A; accordingly, upgrades to the existing pumping station would be required.

The status of the existing pumps and the required pumping capacities should be undertaken during the next Phase of the Class Environmental Assessment.

b) A Kingston Highway 15 Reservoir

The provision of a Kingston Highway 15 Reservoir and Pumping Station would be required to satisfy the current required fire storage and supply as well as the peak hour demands in the northern portion of Kingston East.

Since phasing of the reservoir would not be prudent, the new storage capacity required for the study year 2026A of **7 ML** should be provided for the study year 2011.

The infrastructure size and the required piping and future pumping requirements of the Pumping Station for the study year 2026A should be provided for the study year 2011 in order to allow ready installation of future pumps and associated mechanical, electrical and control equipment, to accommodate the study year 2026A demands, or greater.

1.13.4 Infrastructure required following the mid-term study year (2016)

a) A Benson Street BS

A Benson Street BS would be required sufficiently before the study year 2026A. A Benson Street BS would be required once development commenced in development area GA5. The additional water demands, due to development in GA5, would reduce the system pressures in the service area from just east of Division Street to Montreal Street along Benson Road and other streets, just south of Highway 401, to below the minimum required pressure of 275 kPa (40 psi). Accordingly, a Benson Street Booster Station would be required prior to any significant development in GA5.

b) James Street BS upgrades

The existing pumps and motor control centre would require replacement following the study year 2016.

1.14 Watermains

1.14.1 Interconnecting watermains

To initiate the interconnection of Kingston West with Kingston Central (including Kingston East), the Bath Road valve (normally closed) would need to be opened and the one-kilometre long, 400 mm interconnecting watermain on Princess Street and the 400 mm watermain on John Counter Boulevard installed. These would be required for the short-term study year 2011.

Based on modelling, for the study year 2026A, a 4.1 km long, 1050 mm watermain interconnection, from the end of the existing Kingston West watermain on Front Road to the intersection of King Street West and Sir John A. MacDonald Boulevard, would be required following the mid-term study year 2016. This watermain could be provided in two stages. The first stage would be the provision of the 1050 mm watermain interconnection from the Front Road watermain in Kingston West to the King Street West watermain in Kingston Central (as required for the study year 2026). The second stage would be the extension of the 1050 mm interconnecting watermain to the intersection of King Street West and Sir John A. MacDonald Blvd (required for the study year 2026A).

The complete installation of the 1050 mm trunk watermain from the discharge locations from the Kingston West WTP on Front Road to the discharge locations from the Kingston Central WPP on King Street West should be provided for the study year 2026A, or shortly after, based on the status of the Kingston Central WPP, as determined by Utilities Kingston.

1.14.2 Other watermains

i) The provision of the 900 mm discharge watermain from the Kingston West WTP to Front Road should be considered, prior to the short-term study year 2011. Utilities Kingston Operations have indicated that this second plant discharge watermain should be considered as a *high priority* work activity (redundancy of a plant discharge watermain).

ii) The 600 mm discharge watermain from an O’Connor Drive Reservoir and Pumping Station to Gardiners Road should be provided for the study year 2011.

iii) Based on modelling, a new 600 mm watermain on Front Road, from Days Road, connecting to the existing 600 mm watermain on Bayridge Drive and the continuation of this 600 mm watermain on Bayridge Drive north from Acadia Drive to Taylor Kidd Boulevard has been identified as required in the short-term. Modelling also indicated that without the provision of this watermain, the pressures in the vicinity of Bayridge Drive and Taylor Kidd Boulevard and on Hudson Drive in the area of Downing Street, both in Pressure Zone 1, would be *less* than the minimum required water pressure of 275 kPa (40 psi). In addition, this watermain would provide a much desired, second Bath Road watermain crossing in Kingston West, allowing for significantly improved distribution of the system pressures in Kingston West.

    This watermain should be provided for the short-term year 2011 in order to satisfy the minimum required water pressure of 275 kPa.

iv) Modelling has indicated that a 500 mm watermain on Third Avenue (from MacDonnell Street to Alfred Street) should be provided for the short-term study year 2011 in order to satisfy the minimum required water pressure of 275 kPa.

v) Modelling has indicated the requirement for a 400 mm watermain to replace the existing 250 mm watermain on Avenue Road (on the east side and parallel to Sir John A. MacDonald Boulevard, from immediately north of Princess Street to McMahon Avenue), connecting the existing 400 mm watermains at both ends, should be provided for the short-term study year 2011. Increasing the diameter of this small section of watermain would significantly improve water pressures in areas to the north for all demand conditions, but most importantly, the available residual water pressure during a fire flow condition would be substantially increased.

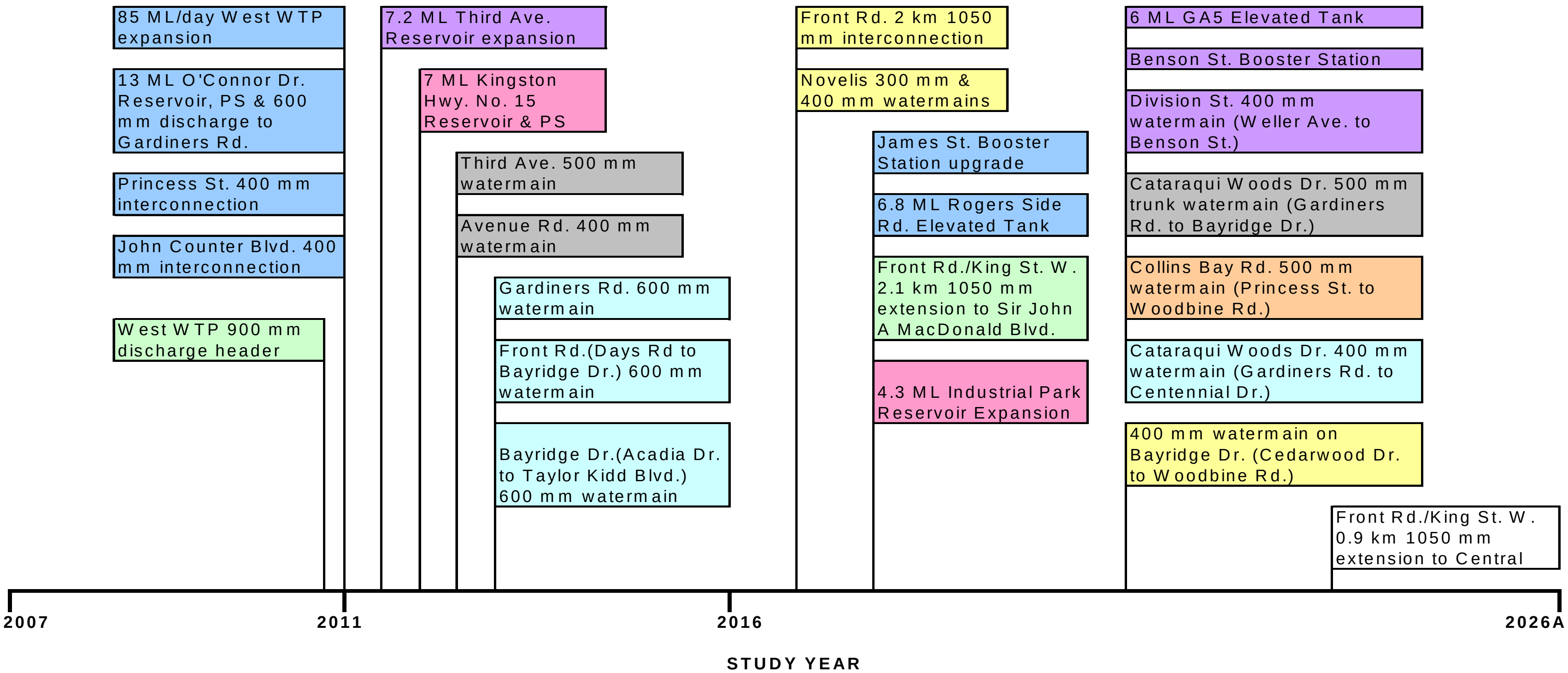
vi) As indicated in **Figure B.3**, a 500 mm watermain would be required on Cataraqui Woods Drive from Gardiners Road, westerly across Bayridge Drive, through the GA2 development area and south to Woodbine Road. It is understand that a 300 mm watermain is planned to extend west from the intersection of Cataraqui Woods Drive and Bayridge Drive through the GA2 development area and south to Princess Street. This planned 300 mm watermain should be a 500 mm watermain.

vii) The existing 300 mm watermain on Cataraqui Woods Drive, from Gardiners Road to Centennial Drive would need to be replaced by a 400 mm watermain for the study year 2026A.

viii) The existing 200 mm watermain on Bayridge Drive from Cedarwood Drive to Woodbine Road would need to be replaced by a 400 mm watermain for the study year 2026A.

ix) The existing 300 mm watermain on Division Street from Weller Avenue to Benson Street would need to be replaced by a 400 mm watermain for the study year 2026A.

Figure B.6 – Suggested Sequence to Provide Required Infrastructure for the Study Year 2026A



Notes: 1. The timeframe for the retirement of the water booster pumping stations has not been suggested in **Figure B.6**.

2. The additional infrastructure to accommodate "expanded development areas" A, B, C and D would not be significant and have not been identified.
3. A 500 mm watermain on Cataraqui Woods Dr. (from Gardiners Road to Taylor Kidd Boulevard) would be required, prior to development of GA3.

1.16 Retirement of water booster stations

1.16.1 Retirement of the Gardiners Road BS and Sydenham Road BS

The Gardiners Road BS could not be retired until an O'Connor Drive Reservoir and Pumping Station and the 600 mm discharge watermain, connecting to the existing 500 mm watermain on Gardiners Road, were provided. Once provided, the Gardiners Road BS could be retired and a direct flow through the existing water booster station site would be provided, allowing discharge directly to an O'Connor Drive Reservoir, to be pumped into Zone 2 to continue filling the Creekford Road Elevated Tank to the TWL.

The Sydenham Road BS could be retired following the installation of an O'Connor Drive Reservoir and Pumping Station plus the 400 mm watermain on Cataraqui Woods Drive, from Centennial Drive to Sydenham Road.

Once the Sydenham Road BS was retired, the south portion of Sydenham Road would become a dead-end watermain and a looped watermain system would be required.

Future planned watermains would address this condition except for the short section of Sydenham Road, south of Crossfield Avenue.

It is planned as part of development in the Cataraqui North development area to extend the 400 mm watermain on the northern portion of Centennial Drive easterly and southerly to the planned 400 mm watermain on Cataraqui Woods Drive. This planned 400 mm watermain on Cataraqui Woods Drive would extend easterly to connect to the existing 300 mm watermain on Sydenham Road.

A planned 250 mm watermain on Crossfield Avenue would connect from Centennial Drive to Sydenham Road. The connection of the 250 mm watermain on Crossfield Avenue to the existing 300 mm watermain on Sydenham Road would shorten the length of dead-end watermain on Sydenham Road.

The interconnection of the easterly end of the 250 mm watermain on Crossfield Avenue with the existing 300 mm watermain on Sydenham Road, would provide the required connections to address the dead-end condition on Sydenham Road, once the Sydenham Road BS was retired and provided with a 300 mm watermain in its place.

The proposed interconnection to address the dead-end issue has been indicated in **Figure B.5**.

1.16.2 Retirement of the Old Colony Road BS and Collins Bay BS

The Old Colony Road BS and the Collins Bay BS could be retired (once an O'Connor Drive Reservoir and Pumping Station was constructed) based on the priority established by Utilities Kingston for their retirement.

In order to retire the Old Colony Road BS and the Collins Bay Road BS for the short-term study year 2011, the existing 200 mm watermain on Bayridge Drive (from Cedarwood Drive to Woodbine Road, approx 420 metres) would need to be upgraded to 400 mm. Based on modelling, without this 400 mm watermain in place, the pressures at the highest point in Pressure Zone 2 would not be sufficient during peak hour demand periods, due to high pipe friction losses in the existing, reduced diameter, 200 mm watermain on Bayridge Drive.

A 400 mm watermain on Bayridge Drive (from Cedarwood Drive to Creekford Road) is planned for construction in the short-term (by the study year 2011) as part of private development in the area of GA2 West. In order to retire both water booster pumping stations in the shot-term study year 2011, the replacement of the existing 200 mm watermain with a 400 mm watermain on Bayridge Drive, from Cedarwood Drive to Woodbine Road would be required (at an estimated cost of $245,000).

Potentially, this might not be considered a significant budget issue as opposed to the required continued use of the Old Colony Road BS and the Collins Bay Road BS (a Utilities Kingston decision).

1.17 General Comments Regarding Implementation of Infrastructure for the "Expanded study area" for the Study Year 2026A

i) Budget constraints would be a significant issue in order to provide the required infrastructure for the study year 2011.

ii) The expansion of the Kingston West WTP remains the "highest" priority.

iii) The second 900 mm discharge watermain from the Kingston West WTP to Front Road should be constructed as soon as possible. This should be considered as high priority, particularly since the existing discharge watermain is cast iron and would be more susceptible to deterioration and potential fracture.

iv) Since an interconnected Kingston West and Kingston Central (including Kingston Central) water distribution systems is the basis of the preferred solution, the actual interconnection should be provided as soon as possible. This would require the provision of the one-kilometre long, 400 mm interconnecting watermain on Princess Street and the 1.3 kilometre long 400 mm watermain on John Counter Boulevard to be provided and the Bath Road valve opened.

The 4.1 km long 1050 mm interconnection watermain on Front Road and King Street West would be required after the mid-term study year 2016. The provision of the complete five-kilometre long 1050 mm trunk watermain should be considered prior to the study year 2026A. Once complete, the potential for supplying all water to the City of Kingston from an expanded Kingston West WTP and, in a more-future study year, the provision of a new water treatment plant to supply all water to the City of Kingston, would then be available for implementation.

v) The required increase in “rated” capacity of the Kingston West WTP would be **88 ML/d** (a water supply to the water distribution system of 80 ML/d)

The total water supply from the Kingston West WTP would be 121 ML/d (41 ML/d + 80 ML/d), with a “rated” capacity of 133.5 ML/d (45.5 ML/d + 88 ML/d). With this required “rated” plant capacity, the existing plant intake capacity has been investigated.

Based on preliminary calculations, the existing 1200 mm intake would be capable of accommodating the raw water supply requirement. Potentially, a minimum of two fiberglass 1200 mm, up-turned, bell-mouthed intake structures should eventually be provided, as opposed to the wooden-fabricated intake crib. This would require less maintenance to clean the top of the intake crib. This should be reviewed during the next Phase of the Class Environmental Assessment.

No short-term intake work activities would be required

vi) An O’Connor Drive Reservoir and Pumping Station would be required for the study year 2011 to provide the required maximum day and fire flow for Pressure Zone 2. Once provided, including the 400 mm watermain on Cataraqui Woods Drive, from Centennial Drive to Sydenham Road, the Gardiners Road BS and the Sydenham Road BS could be retired.

vii) The storage and pumping capacity of an O'Connor Drive Reservoir and Pumping Station would need to be increased from the study year 2026 required size to accommodate the increase in the water demand in Pressure Zone 2 for the study year 2026A.

viii) The four existing water booster pumping stations in Kingston West could be retired, as desired, once an O'Connor Drive Reservoir and Pumping Station and the required watermains were provided (a Utilities Kingston decision).

ix) The expansion of the Industrial Park Reservoir should be provided following the mid-term study year 2016.

x) The Third Avenue Reservoir expansion should be provided as soon as possible following the short-term study year 2011.

xi) The James Street BS upgrades should be provided following the mid-term study year 2016.

xii) A Kingston Highway 15 Reservoir and Pumping Station should be provided as soon as possible following the short-term study year 2011.

xiii) A Benson Street PS should be provided prior to any significant development in development area GA5.

xiv) A GA5 Elevated Storage Tank should be provided prior to any significant development in development area GA5.

xv) A Rogers Road Elevated Tank should be provided prior to any significant development in development area GA4.

1.18 Items to be addressed on an "as soon as possible basis" in order to implement the infrastructure required for the "expanded study area" for the study year 2026A, as opposed to infrastructure required for the study year 2026

1.18.1 General

The ability to provide the infrastructure required for the study year 2026A during the implementation of the required infrastructure for the study year 2026 should be considered.

Certain infrastructure requirements for the “expanded study area” for the study year 2026A would be stand-alone infrastructure that could readily be implemented following the study year 2016 with no impact on the infrastructure required for the study year 2026. This should be considered as desirable.

To accommodate the requirements for the study year 2026A would require certain infrastructure to be implemented at an earlier year.

The infrastructure requirements that would need to be considered at an earlier year, in order to allow the requirements for the study year 2026A to be readily implemented, have been identified. Additional infrastructure to accommodate “expanded study areas” A, B, C and D would not be significant and have not been identified.

1.18.2 Watermains

The 500 mm watermain in Pressure Zone 2 from Gardiners Road to Taylor Kidd Boulevard would be required to allow the required flow from the Creekford Road Elevated Tank and an O’Connor Drive Reservoir to be available for the development in development area GA3.

As indicated above, the size of currently planned development watermains for the study year 2026 (generally 300 mm) would need to be increased to 500 mm. In addition, a portion of the 500 mm watermain from Gardiners Road to Taylor Kidd Boulevard would require sections of existing smaller diameter watermains to be replaced with a 500 mm watermain.

The existing smaller diameter watermains could be replaced at a later date; however, the planned 300 mm watermains in GA2 (West) would need to be provided as 500 mm watermains. The decision to provide the increased size, 500 mm watermains would need to be implemented prior to the pending installation of the 300 mm watermains.

The provision of the increased diameter 500 mm watermains in GA2 would allow the option of the required water supply to development area GA3 to remain open during future development years. The existing watermains that would need to be *replaced* with the 500 mm watermain could take place at a later date, as dictated by the decision to expand the development area to include development area GA3.

It must be emphasized that the decision to install new 500 mm watermains as opposed to the currently planned 300 mm watermains would need to be addressed on a high priority basis. Once installed as 300 mm watermains, the cost to replace these new watermains would be undesirable. This sizing issue would be a Utilities Kingston decision.

This 500 mm watermain is the only watermain that would need to be addressed in the near future. All other watermains for the study year 2026A would be development watermains and would be provided on an as required basis.

1. 19 Class Environmental Assessment undertakings for the additional required infrastructure for the preferred solution for the “expanded study area” for the study year 2026A

1.19.1 General

The Class Environmental Assessment undertakings for the additional required infrastructure have been indicated in **Table B.10**, on the following page.

Table B.10 - Class Environmental Assessment Undertakings for the Required Infrastructure for the Study Year 2026A

	Schedule
Expansion of the Kingston West WTP	C
O’Connor Drive Reservoir and Pumping Station	B
Expansion of Third Ave. Reservoir	B
Expansion of Industrial Park Reservoir	B
Kingston Highway 15 Reservoir and Pumping Station	B
GA5 Elevated Water Storage Tank	B
Rogers Side Road Elevated Water Storage Tank	B
Replace pumps at Third Avenue Reservoir Pumping Station	B
Upgrades to James Street Booster Pumping Station	B
Decommissioning water booster pumping stations	B
Princess St. interconnecting 400 mm watermain	B[1]
John Counter Boulevard interconnecting 400 mm watermain	A[2]
Front Rd./King St. West interconnecting 1050 mm watermain	B[1]
Kingston West WTP 900 mm discharge watermain	A[2]
O’Connor Dr. 600 mm watermain (an O’Connor Drive Pumping Station to Gardiners Road)	A[2]
Gardiners Road 600 mm watermain (O’Connor Dr. to Cataraqui Woods Dr.)	A[2]
Front Rd./Bayridge Dr. 600 mm watermain	A[3]
Avenue Rd. 400 mm watermain	A[3]
Novelis 300 mm and 400 mm watermains	A[3]
Third Ave. 500 mm watermain	A[3]

Notes:
1. Would be a Schedule B undertaking due to the Little Cataraqui Creek crossing (Cataraqui Region Conservation Authority would require input).
2. If constructed within the existing road allowance (most probable)
3. Would generally be considered as Schedule A undertakings: unless, under special mitigating circumstances, the provision of the watermain could be considered as a Schedule B undertaking.

END

YEAR 2026A PEAK HOUR DEMAND PRESSURE CONTOURS

LEGEND:

WATERMAINS

PRESSURE ZONE BOUNDARY

PRESSURE CONTOURS (kPa)

300

400

500

600

utilities kingston
water sewer gas electricity networks
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Simcoe
SIMCOE ENGINEERING GROUP LIMITED
Consulting Engineers

SCALE: N.T.S.

JUNE 2007

104.24

UTILITIES KINGSTON
MASTER PLAN FOR WATER SUPPLY

FIGURE B.4: PREFERRED SOLUTION
STUDY YEAR 2026A PEAK HOUR DEMAND
PRESSURE CONTOURS PLAN

P:\....\10424\Master Plan Figures \Figure 9.4.dwg May 2007

APPENDIX C

NOTES:

1. DATA SOURCES: FIGURE W1, CITY OF KINGSTON URBAN GROWTH STRATEGY, JULY, 2004; UTILITIES KINGSTON FILE INFORMATION

LEGEND

150ø	500ø
200ø	600ø
250ø	750ø
300ø	900ø
400ø	1200ø
450ø	

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SCALE: N.T.S.

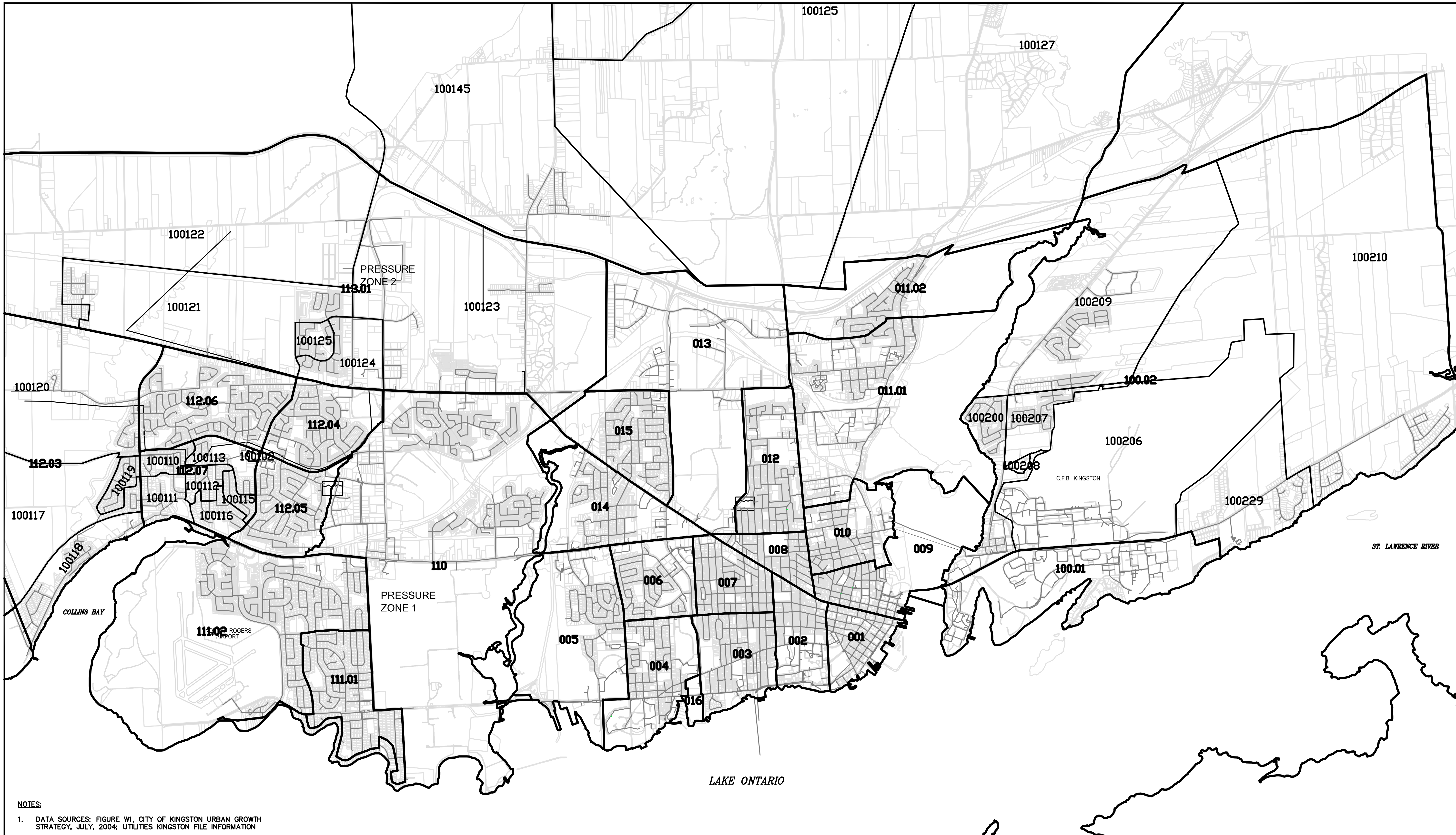
JUNE 2007

104.24

UTILITIES KINGSTON
MASTER PLAN FOR WATER SUPPLY

FIGURE 2.2:
YEAR 2006 CITY OF KINGSTON WATER DISTRIBUTION SYSTEM

APPENDIX D



NOTES:

1. DATA SOURCES: FIGURE W1, CITY OF KINGSTON URBAN GROWTH STRATEGY, JULY, 2004; UTILITIES KINGSTON FILE INFORMATION

LEGEND

CENSUS TRACT / DISSEMINATION AREA BOUNDARY

utilities kingston
water sewer gas electricity networks
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JUNE 2007

104.24

UTILITIES KINGSTON
MASTER PLAN FOR WATER SUPPLY

CITY OF KINGSTON CENSUS TRACTS & DISSEMINATION AREAS

APPENDIX E

PUBLIC INFORMATION CENTRE NO. 1
QUESTIONNAIRES

utilities kingston
water sewer gas electricity networks
all your utility services under one roof

Master Plan for Water Supply for the City of Kingston Urban Area

Public Information Centre held on November 29, 2006

Questionnaire

1 Are you a resident/property owner within the City of Kingston?

✓ No

2. Do you represent an industrial, commercial or institutional facility within the City of Kingston urban area?

No ✓

3. Do you agree that the two existing water distribution systems (Kingston Central and Kingston West) should be interconnected to form only one water distribution system, supplied by two drinking water supplies (West Water Treatment Plant and the Central Water Purification Plant)? ✓

4. Have you experienced, what you consider to be low drinking water pressures?

Yes ___ No ___

If yes, during what period(s) of the day?___

how often?

Frequently: Intermittently: ___ Very often: ___ Always

5. How would you classify your drinking water pressure at low-pressure periods?

Very low: Extremely low:

6. If an expansion to the drinking water supply facilities is required to accommodate future demands, do you have a preference as to whether the West Water Treatment Plant or the Central Water Purification Plant should be expanded (it should be remembered that the Central Water Purification Plant is located in the vicinity of historically significant buildings; whereas, the West Water Treatment Plant is located in an area readily available for expansion)?

No - Should be reevaluated. Central Plant is on a large site & only partially used as to Heritage [illegible] - 2005/6 [illegible] recently [illegible] without significant [illegible] except as to appearance - which is not done historically.

7. Do you have any comments regarding the scenario of potentially retiring one or both of the two existing water treatment plants and constructing a single, larger water treatment plant to supply drinking water to the entire City of Kingston? This is a matter of economics & economies of scale. Generally upstream sites preferred for water quality

8. Do you believe that there are other alternatives, in addition to those provided to date, that should be considered? ______

9. The following criteria have been identified to date in order to evaluate potential alternatives. Would you please rank the identified criteria in the order of importance that you believe should be applied with "1" being the "most important". Please insert your selected ranking numbers in the space provided, following each evaluation criteria identified to date. It should be noted that the order in which the identified evaluation criteria have been listed is random only.

Overall system operations: ; Design considerations:

Economics: 3; Natural environment: ___; Historical significance:

Public health: 1; Social impact: 2

10. Are there other evaluation criteria that you believe should be considered?

Fire protection - need for additional capacity beyond drinking water capacity - both volume & pressure.

This may have been worded, but I [illegible]

11. Do you have any comments regarding the Master Plan for Water Supply for the City of Kingston, which is following the Class Environmental Assessment process? ______

It is not clear where potential demand for Collins Bay Penitentiary Farm fits in. Experience & Economics indicate that the property will be developed as is an activity not suitable in long run in a [illegible] area (Area between King St, Palace Rd, Princess St. & Fairway Hills was largely rural - developed between 1952 & 1980) + have been on going discussion as to how might be developed since about 1990. For example this would help close the gaps on King St. between Clingan

+ Dwyer Center

this would be an opportunity to close the gap on King St. W. between Clyde(?) & Days(?) entrance.

12. Do you have any other comments? For water system infrastructure 25 years is a limited short time frame. While it fits(?) terms, it is useful to at least refer to major considerations / possible needs beyond that. E.g. Possible connection to Loyalist Twp. Not likely in 25 years perhaps but possible & should take place someday. When work being done on the westerly end of ~~Front Rd~~ Bath Rd, extra capacity ~~might be~~ should be created

I require a written response to my comments. Yes ___ No ✓
would be appreciated but not required - telephone?

Please print your name address, phone number and email address (if available)

Name: STEWART FYFE

Address: 212 ALWINGTON PL. Kingston K7L 4P8

Phone number: 613-542-2346

Email address: ___

Signature: Stewart Fyfe

Please return this completed questionnaire to the box provided (preferable) or mail/fax before December 8, 2006 to:

Chantal Chiddle, P. Eng.,
Project Manager
Utilities Kingston
1211 John Counter Blvd.
Kingston ON K7L 4X7
Phone: 613-546-1181; Ext.: 2356
Fax: 613-542-1463

The material at the open house only referred to one drinking water. Water systems & consumption go beyond that in both quantity & quality. Fire, street flushing, food processing, economic development, public health.

It is a major ~~ex~~ factor in determining where development can & should take place & its character & location of other infrastructure.

Also questions of water quality — & other forms of pollution becoming more relevant than the treatment considerations in design of present plant — drugs, viruses — may there be a need to upgrade treatment?

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Master Plan for Water Supply for the City of Kingston Urban Area

Public Information Centre held on November 29, 2006

Questionnaire

1. Are you a resident/property owner within the City of Kingston?

   Yes ✓

2. Do you represent an industrial, commercial or institutional facility within the City of Kingston urban area?

   Yes ___ No ✓

3. Do you agree that the two existing water distribution systems (Kingston Central and Kingston West) should be interconnected to form only one water distribution system, supplied by two drinking water supplies (West Water Treatment Plant and the Central Water Purification Plant)? ______

   YES. If we are really interested in →

4. Have you experienced, what you consider to be low drinking water pressures?

   Yes No ✓

   If yes, during what period(s) of the day? ______

   If yes, how often?

   Frequently: ___ Intermittently: ___ Very often: ___ Always:

5. How would you classify your drinking water pressure at low-pressure periods?

   Low: ___ Very low: Extremely low:

6. If an expansion to the drinking water supply facilities is required to accommodate future demands, do you have a preference as to whether the West Water Treatment Plant or the Central Water Purification Plant should be expanded (it should be remembered that the Central Water Purification Plant is located in the vicinity of historically significant buildings; whereas, the West Water Treatment Plant is located in an area readily available for expansion)?
It's pretty obvious that the primary growth areas (certainly in the West) should be served by the facility closest to the need. →

7. Do you have any comments regarding the scenario of potentially retiring one or both of the two existing water treatment plants and constructing a single, larger water treatment plant to supply drinking water to the entire City of Kingston? H, H, H ! ! !
You have to really convience me that you

8. Do you believe that there are other alternatives, in addition to those provided to date, that should be considered?
No.

9. The following criteria have been identified to date in order to evaluate potential alternatives. Would you please rank the identified criteria in the order of importance that you believe should be applied with "1" being the "most important". Please insert your selected ranking numbers in the space provided, following each evaluation criteria identified to date. It should be noted that the order in which the identified evaluation criteria have been listed is random only.

Overall system operations: 7; Design considerations: 3;

Economics: 4; Natural environment: 2; Historical significance: 1;

Public health: 5; Social impact: 6

10. Are there other evaluation criteria that you believe should be considered?
No.

11 Do you have any comments regarding the Master Plan for Water Supply for the City of Kingston, which is following the Class Environmental Assessment process? Not yet

Seeing the benefits of amalgamation
bare fruit we need to think and
grow as a single entity.
<u>However</u>, those who will see the greatest
benefit, (existing Western built up areas, and
future developments) <u>must</u> pay for it themselves.
An area rating tax structure for those who
benefit. We in the city core are having the costs
our infrastructure improvements, hence this
must apply in East and West. <u>It must not be
magically "spread" throughout the city!</u>

6. There is greater need in the west end; there is ample room for expansion; cost would no doubt be less. The impacts on the criteria found in question 9 would all be much reduced.

7. could build one big facility cheaper than running the existing two, (with expansion in the West plant). Where the heck would you put it? (and costs, infrastructure to site would be $, $

12. Do you have any other comments? Yes (see below)

I require a written response to my comments. Yes ✓ No ___ (for no. 12)

Please print your name address, phone number and email address (if available)

Name: P. Rubens

Address: 265 King St W

Phone number: (613) 542-1567

Email address: pm.rubens@sympatico.ca

Signature: [signature]

Please return this completed questionnaire to the box provided (preferable) or mail/fax before December 8, 2006 to:

Chantal Chiddle, P. Eng.,
Project Manager
Utilities Kingston
1211 John Counter Blvd.
Kingston ON K7L 4X7
Phone: 613-546-1181; Ext.: 2356
Fax: 613-542-1463

12

Chantal

We spoke about capacity and peak usage, and how peak usage meets the system capacity and that is why the city does not consider that there is excess capacity in the purification plant. Therefore, how is the city approaching infilling in the urban core, (40/60 split as per the pr[illegible]ure) when as I say we already use the excess capacity at peak?

Where the ~~[illegible] the~~ water supply [illegible] to come from? → West plant?

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Master Plan for Water Supply for the City of Kingston Urban Area

Public Information Centre held on November 29, 2006

Questionnaire

1. Are you a resident/property owner within the City of Kingston?

   Yes ✓ No ___

2. Do you represent an industrial, commercial or institutional facility within the City of Kingston urban area?

   Yes ✓ No

3. Do you agree that the two existing water distribution systems (Kingston Central and Kingston West) should be interconnected to form only one water distribution system, supplied by two drinking water supplies (West Water Treatment Plant and the Central Water Purification Plant)? _____

   ____

4. Have you experienced, what you consider to be low drinking water pressures?

   Yes No X

   If yes, during what period(s) of the day?______________________

   If yes, how often?

   Frequently: ___ Intermittently: ___ Very often: ___ Always: ___

5. How would you classify your drinking water pressure at low-pressure periods?

   Low: Very low: Extremely low:

6. If an expansion to the drinking water supply facilities is required to accommodate future demands, do you have a preference as to whether the West Water Treatment Plant or the Central Water Purification Plant should be expanded (it should be remembered that the Central Water Purification Plant is located in the vicinity of historically significant buildings; whereas, the West Water Treatment Plant is located in an area readily available for expansion)?

Cost, utility and aethetics need to be balanced and fully considered.

7. Do you have any comments regarding the scenario of potentially retiring one or both of the two existing water treatment plants and constructing a single, larger water treatment plant to supply drinking water to the entire City of Kingston? 2 plants offers emergency redundancy which is a very positive aspect.

8. Do you believe that there are other alternatives, in addition to those provided to date, that should be considered? ____

9. The following criteria have been identified to date in order to evaluate potential alternatives. Would you please rank the identified criteria in the order of importance that you believe should be applied with "1" being the "most important". Please insert your selected ranking numbers in the space provided, following each evaluation criteria identified to date. It should be noted that the order in which the identified evaluation criteria have been listed is random only.

Overall system operations: 2; Design considerations: 5;

Economics: 6; Natural environment: 3; Historical significance: 4;

Public health: 1; Social impact: ___

10. Are there other evaluation criteria that you believe should be considered?

Security of the system

11. Do you have any comments regarding the Master Plan for Water Supply for the City of Kingston, which is following the Class Environmental Assessment process? ____

6

or deserve to be able to waste water

also believe that the public would

support a political motion that

waste be priced to deter waste

would be happy to elaborate on

one of these thoughts or participate in

any round table discussions on the

educational/pricing topics

Phillip Brown

12. Do you have any other comments? ______________________________

____

____

require a written response to my comments. Yes No X

Please print your name address, phone number and email address (if available)

Name: Phillip Brown

Address: 9 Morton St.

Phone number: 613 545·1410

Email address: pjbrown@kcs.net

Signature: ______________________________

Please return this completed questionnaire to the box provided (preferable) or mail/fax before December 8, 2006 to:

Chantal Chiddle, P. Eng.,
Project Manager
Utilities Kingston
1211 John Counter Blvd.
Kingston ON K7L 4X7
Phone: 613-546-1181; Ext.: 2356
Fax: 613-542-1463

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Master Plan for Water Supply for the City of Kingston Urban Area

Public Information Centre held on November 29, 2006

Questionnaire

1. Are you a resident/property owner within the City of Kingston?

   ✓ No ___

2. Do you represent an industrial, commercial or institutional facility within the City of Kingston urban area?

   ___ No ✓

3. Do you agree that the two existing water distribution systems (Kingston Central and Kingston West) should be interconnected to form only one water distribution system, supplied by two drinking water supplies (West Water Treatment Plant and the Central Water Purification Plant)? _____

4. Have you experienced, what you consider to be low drinking water pressures?

   No ✓ EXISTING SYSTEMS SHOULD BE USED

   If yes, during what period(s) of the day? CONSIDERING THERE IS AREA ~~RATING~~ THIS MUST BE CONSIDERED

   If yes, how often?

   Frequently: ___ Intermittently: ___ Very often: ___ Always:

5. How would you classify your drinking water pressure at low-pressure periods?

   Low: Very low: Extremely low: Good

6. If an expansion to the drinking water supply facilities is required to accommodate future demands, do you have a preference as to whether the West Water Treatment Plant or the Central Water Purification Plant should be expanded (it should be remembered that the Central Water Purification Plant is located in the vicinity of historically significant buildings; whereas, the West Water Treatment Plant is located in an area readily available for expansion)?

More information need for such a general question.

7. Do you have any comments regarding the scenario of potentially retiring one or both of the two existing water treatment plants and constructing a single, larger water treatment plant to supply drinking water to the entire City of Kingston?

Don't do it

8. Do you believe that there are other alternatives, in addition to those provided to date, that should be considered? ____________________

9. The following criteria have been identified to date in order to evaluate potential alternatives. Would you please rank the identified criteria in the order of importance that you believe should be applied with "1" being the "most important". Please insert your selected ranking numbers in the space provided, following each evaluation criteria identified to date. It should be noted that the order in which the identified evaluation criteria have been listed is random only.

Overall system operations: ___; Design considerations: 3;

Economics: 2; Natural environment: 5; Historical significance: 6,

Public health: 1; Social impact: 4

10. Are there other evaluation criteria that you believe should be considered?

Building sufficient capacity for the future.

11. Do you have any comments regarding the Master Plan for Water Supply for the City of Kingston, which is following the Class Environmental Assessment process? ____________________

12. Do you have any other comments? I would like to be kept informed of the progress of this project

I require a written response to my comments. Yes ___ No ___

Please print your name address, phone number and email address (if available)

Name: [illegible]

Address: 901 Front Rd.

Phone number: 613-389-4358

Email address: [illegible]

Signature: [illegible]

Please return this completed questionnaire to the box provided (preferable) or mail/fax before December 8, 2006 to:

Chantal Chiddle, P. Eng.,
Project Manager
Utilities Kingston
1211 John Counter Blvd.
Kingston ON K7L 4X7
Phone: 613-546-1181; Ext.: 2356
Fax: 613-542-1463

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Master Plan for Water Supply for the City of Kingston Urban Area

Public Information Centre held on November 29, 2006

Questionnaire

1 Are you a resident/property owner within the City of Kingston?

X No

2. Do you represent an industrial, commercial or institutional facility within the City of Kingston urban area?

No X

3. Do you agree that the two existing water distribution systems (Kingston Central and Kingston West) should be interconnected to form only one water distribution system, supplied by two drinking water supplies (West Water Treatment Plant and the Central Water Purification Plant)? _______

Don't Know.

4. Have you experienced, what you consider to be low drinking water pressures?

No X

If yes, during what period(s) of the day?____________________

If yes, how often?

Frequently: ___ Intermittently: ___ Very often: ___ Always:

5. How would you classify your drinking water pressure at low-pressure periods?

Low: Very low: Extremely low:

6. If an expansion to the drinking water supply facilities is required to accommodate future demands, do you have a preference as to whether the West Water Treatment Plant or the Central Water Purification Plant should be expanded (it should be remembered that the Central Water Purification Plant is located in the vicinity of historically significant buildings; whereas, the West Water Treatment Plant is located in an area readily available for expansion)?

Likely West Water But the terms + methods has to be well thought out.

7. Do you have any comments regarding the scenario of potentially retiring one or both of the two existing water treatment plants and constructing a single, larger water treatment plant to supply drinking water to the entire City of Kingston? Options + details of pros/cons has to be presented + well understood. Single source not necessarily best as there is no fall back position

8. Do you believe that there are other alternatives, in addition to those provided to date, that should be considered? unknown

9. The following criteria have been identified to date in order to evaluate potential alternatives. Would you please rank the identified criteria in the order of importance that you believe should be applied with "1" being the "most important". Please insert your selected ranking numbers in the space provided, following each evaluation criteria identified to date. It should be noted that the order in which the identified evaluation criteria have been listed is random only.

Overall system operations: 3; Design considerations: 4;

Economics: 4; Natural environment: 1; Historical significance: 5;

Public health: 2; Social impact: 6

10. Are there other evaluation criteria that you believe should be considered?

Define social impact?

11 Do you have any comments regarding the Master Plan for Water Supply for the City of Kingston, which is following the Class Environmental Assessment process? N/A

12. Do you have any other comments? Combining West system has political implications + financial issues that have to be addressed as a result of amalgamation agreements.

require a written response to my comments. Yes No X

Please print your name address, phone number and email address (if available)

Name: ________________________________

Address: ________________________________

Phone number: ________________________________

Email address: ________________________________

Signature: ________________________________

Please return this completed questionnaire to the box provided (preferable) or mail/fax before December 8, 2006 to:

Chantal Chiddle, P. Eng.,
Project Manager
Utilities Kingston
1211 John Counter Blvd.
Kingston ON K7L 4X7
Phone: 613-546-1181; Ext.: 2356
Fax: 613-542-1463

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Master Plan for Water Supply for the City of Kingston Urban Area

Public Information Centre held on November 29, 2006

Questionnaire

Are you a resident/property owner within the City of Kingston?

✓ No

2. Do you represent an industrial, commercial or institutional facility within the City of Kingston urban area?

No ✓

3. Do you agree that the two existing water distribution systems (Kingston Central and Kingston West) should be interconnected to form only one water distribution system, supplied by two drinking water supplies (West Water Treatment Plant and the Central Water Purification Plant)? YES

4. Have you experienced, what you consider to be low drinking water pressures?

✓ No

If yes, during what period(s) of the day? LATE AFTERNOON (SUMMER)

If yes, how often?

Frequently: ___ Intermittently: ✓ Very often: ___ Always:

5. How would you classify your drinking water pressure at low-pressure periods?

Low: ✓ Very low: Extremely low:

6. If an expansion to the drinking water supply facilities is required to accommodate future demands, do you have a preference as to whether the West Water Treatment Plant or the Central Water Purification Plant should be expanded (it should be remembered that the Central Water Purification Plant is located in the vicinity of historically significant buildings; whereas, the West Water Treatment Plant is located in an area readily available for expansion)?
NO

7. Do you have any comments regarding the scenario of potentially retiring one or both of the two existing water treatment plants and constructing a single, larger water treatment plant to supply drinking water to the entire City of Kingston? NOT QUALIFIED TO RESPOND

8. Do you believe that there are other alternatives, in addition to those provided to date, that should be considered? I DON'T KNOW

9. The following criteria have been identified to date in order to evaluate potential alternatives. Would you please rank the identified criteria in the order of importance that you believe should be applied with "1" being the "most important". Please insert your selected ranking numbers in the space provided, following each evaluation criteria identified to date. It should be noted that the order in which the identified evaluation criteria have been listed is random only.

Overall system operations: 5; Design considerations: 6;

Economics: 3; Natural environment: 2; Historical significance: 7;

Public health: 1; Social impact: 4

10. Are there other evaluation criteria that you believe should be considered?
NO

11 Do you have any comments regarding the Master Plan for Water Supply for the City of Kingston, which is following the Class Environmental Assessment process? NOT AT THIS TIME

12. Do you have any other comments? No

require a written response to my comments. Yes No ✓

Please print your name address, phone number and email address (if available)

Name: Rick Thorburn

Address: 573 Sycamore St

Phone number: 634 2435

Email address: rick.thorburn@sympatico.ca

Signature: RTh

Please return this completed questionnaire to the box provided (preferable) or mail/fax before December 8, 2006 to:

Chantal Chiddle, P. Eng.,
Project Manager
Utilities Kingston
1211 John Counter Blvd.
Kingston ON K7L 4X7
Phone: 613-546-1181; Ext.: 2356
Fax: 613-542-1463

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Master Plan for Water Supply for the City of Kingston Urban Area

Public Information Centre held on November 29, 2006

Questionnaire

1 Are you a resident/property owner within the City of Kingston?

✓ No

2. Do you represent an industrial, commercial or institutional facility within the City of Kingston urban area?

Yes ___ No ✓

3. Do you agree that the two existing water distribution systems (Kingston Central and Kingston West) should be interconnected to form only one water distribution system, supplied by two drinking water supplies (West Water Treatment Plant and the Central Water Purification Plant)? ?

4. Have you experienced, what you consider to be low drinking water pressures?

No ✓

If yes, during what period(s) of the day?______________________

If yes, how often?

Frequently: ___ Intermittently: ___ Very often: ___ Always:

5. How would you classify your drinking water pressure at low-pressure periods?

Very low: Extremely low:

6. If an expansion to the drinking water supply facilities is required to accommodate future demands, do you have a preference as to whether the West Water Treatment Plant or the Central Water Purification Plant should be expanded (it should be remembered that the Central Water Purification Plant is located in the vicinity of historically significant buildings; whereas, the West Water Treatment Plant is located in an area readily available for expansion)?

The West Water Treatment Plant expanded

7. Do you have any comments regarding the scenario of potentially retiring one or both of the two existing water treatment plants and constructing a single, larger water treatment plant to supply drinking water to the entire City of Kingston? Have one water treatment plant (drinking water) to supply all of Kingston

8. Do you believe that there are other alternatives, in addition to those provided to date, that should be considered? I am not sure

9. The following criteria have been identified to date in order to evaluate potential alternatives. Would you please rank the identified criteria in the order of importance that you believe should be applied with "1" being the "most important". Please insert your selected ranking numbers in the space provided, following each evaluation criteria identified to date. It should be noted that the order in which the identified evaluation criteria have been listed is random only.

Overall system operations: ; Design considerations:

Economics: ___; Natural environment: ; Historical significance:

Public health: ; Social impact:

10. Are there other evaluation criteria that you believe should be considered?

1 Do you have any comments regarding the Master Plan for Water Supply for the City of Kingston, which is following the Class Environmental Assessment process?

12. Do you have any other comments? ____________________________
____
____
____

require a written response to my comments. Yes ___ No

Please print your name address, phone number and email address (if available)

Name: ____

Address: ____

Phone number: ____

Email address: ____

Signature: ____

Please return this completed questionnaire to the box provided (preferable) or mail/fax before December 8, 2006 to:

Chantal Chiddle, P. Eng.,
Project Manager
Utilities Kingston
1211 John Counter Blvd.
Kingston ON K7L 4X7
Phone: 613-546-1181; Ext.: 2356
Fax: 613-542-1463

PUBLIC INFORMATION CENTRE NO. 2
QUESTIONNAIRES

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Master Plan for Water Supply for the City of Kingston Urban Area

Public Information Centre No. 2 held on March 19, 2007

Questionnaire

1. Are you a resident/property owner within the City of Kingston?

   Yes X No

2. Do you represent an industrial, commercial or institutional facility within the City of Kingston urban area?

   Yes No X

3. Do you represent a governing authority such as the MOE, MNR or other?

   Yes No X Which? ______

4. How would you classify your drinking water pressure at low-pressure periods?

   Low: Very low: Extremely low: Never low

5. Have you experienced, what you consider to be low drinking water pressures?

   Yes No X

   If yes, during what period(s) of the day? ______

   If yes, how often?

   Frequently: ___ Intermittently: ___ Often: ___ Always: ___

6. Do you have any comments regarding the potential interconnection of the two existing water supply and distribution systems [Kingston West and Kingston Central (including Kingston East)] to form a single City of Kingston water supply and distribution system, supplied by the Kingston

Advantages: ① Delays construction of additional water treatment
② Gives more flexibility

Disadvantages: ① ~~Huge~~ Construction of water pipe along Front Rd + King St. West, Perhaps King St. could be improved (consistent width)

West Water Treatment Plant (WTP) and the Kingston Central Water Purification Plant (WPP)?

7 An expansion of the Kingston West WTP is required to accommodate the future demands for an independent Kingston West water supply and distribution system (**Alternative 1**) *and* an interconnected Kingston West and Kingston Central (including Kingston East) water supply and distribution system (**Alternative 2**).

The expansion of the Kingston Central WPP is not considered prudent due to the age of the facility and the fact that it is located in the vicinity of historically significant buildings. The Kingston West WTP is located on a site available for expansion.

Do you agree that the expansion of the Kingston West WTP, as opposed to expanding the Kingston Central WPP to accommodate the water demands for the City of Kingston for the study year 2026, as is being assumed, is a prudent decision?

Yes X No If no, why? __________

8. Do you have any comments regarding **Alternative 3**, retiring the existing Kingston Central WPP and expanding the existing Kingston West WTP to provide the *total* drinking water supply to a single, interconnected City of Kingston water distribution system? Advantage is ~~freeing~~ creating additional waterfront parkland, including a swimming dock, in area which has high usage

9. For **Alternative 2** an interconnecting watermain would not be required on Front Road and King Street West until shortly after the year 2011. →

For **Alternative 3,** a large diameter trunk watermain 1050 mm (42") would be required from the Kingston West WTP to the Kingston Central WPP.

If the interconnection on Front Street and King Street West (**Alternative 2**) was provided as a 1050 mm watermain between the years 2011 and 2016, this watermain could be extended easterly and westerly to provide the required trunk watermain interconnection for **Alternative 3**. With this trunk watermain in place, the decision, with regard to the potential retirement of the Kingston Central WPP, could be extended until after the year 2011. The large diameter trunk watermain would be required between the years 2011 and 2016.

With the knowledge that the Kingston Central WPP could potentially require retirement by the year 2026, do you have any comments regarding the sequential provision of the 1050 mm trunk watermain from the Kingston West WTP to the Kingston Central WPP between the years 2011 and 2016?

No, other than the impact of the actual construction

10. Do you have any comments regarding **Alternative 4**, retiring the existing Kingston West WTP *and* the Kingston Central WPP and constructing a new, single, large capacity water treatment plant to supply all the drinking water to the entire City of Kingston? I assume that the decision will be based mostly on economics. ~~and~~

11. Do you believe that there are other alternatives, in addition to those provided at this Public Information Centre, which should be considered?

12. To date, the following criteria have been identified in order to evaluate the potential alternatives. Would you please rank the identified criteria in the order of importance that you believe should be applied with "1" being the "most important". Please insert your selected ranking numbers in the space provided, following each evaluation criteria identified to date. It should be noted that the order in which the identified evaluation criteria have been listed is random only.

Overall system operations: 5; Design considerations: 2;

Economics: 4; Natural environment: 3; Historical significance: 7;

Public health: 1; Social impact: 6

13. Are there other evaluation criteria that you believe should be considered?

Even though I have given a lower ranking to social impact & historical significance, I feel strongly that they should be accomodated ~~to~~ in spite of what might prove to be an additional cost

14. Do you have any comments regarding the Master Plan for Water Supply for the City of Kingston, which is following the Class Environmental Assessment process? ______________________________

15. Do you have any other comments? ______________________________

Do you wish a written response to your comments? Yes ___ No X but feel free to contact me!

Please print your name address, phone number and email address (if available)

Name: Elizabeth Hamacher

Address: 2 Beverley Street

Phone number: 549-1591

Email address: hamacher@post.queensu.ca

Signature: E. Hamacher

Please return this completed questionnaire to the box provided (preferable) or mail/fax, to be received by March 26, 2007, to:

Chantal Chiddle, P. Eng.,
Project Manager
Utilities Kingston
1211 John Counter Blvd.
Kingston ON K7L 4X7
Phone: 613-546-1181; Ext.: 2356
Fax: 613-542-1463

LETTERS FROM GOVERNING AUTHORITIES

Ministry of the Environment

P.O. Box 22032
Kingston, Ontario
K7M 8S5
613/549-4000 or 1-800/267-0974
Fax: 613/548-6908

Ministère de l'Environnement

C.P. 22032
Kingston (Ontario)
K7M 8S5
613/549-4000 ou 1-800/267-0974
Fax: 613/548-6908

Ontario

December 22, 2006

Utilities Kingston
1211 John Counter Boulevard
PO Box 790
Kingston, Ontario
K7L 4X7

Attention: Chantal Chiddle, P.Eng.

Dear Ms. Chiddle:

Re: Master Plan for Water Supply for the City of Kingston Urban Area

Thank you for your November 20, 2006 letter concerning the above project. I have provided a copy to our Drinking Water Compliance staff for their information. If they have comments or concerns about the project, we will ensure that the comments are provided to you. We request a copy of the Master Plan for our review and files.

Copies of notices and other project information should be directed to:

Vicki Mitchell
Environmental Assessment Coordinator
Ministry of the Environment, Eastern Region
1259 Gardiners Road
PO Box 22032
Kingston, ON K7M 8S5

Master Planning Process

The Master Plan document and future information packages should clearly explain the Master Plan process and the approach that will be followed. The Master Plan process is discussed in section A.2.7 and Appendix 4 of the *Municipal Class Environmental Assessment* (Municipal Class EA). Examples of notices for public consultation and study completion are provided in Appendix 4 of the Municipal Class EA.

The Master Plan should list the specific projects that will be carried out in the future, and identify the project schedule of each of these projects. In addition, the Master Plan should discuss future environmental assessment requirements for both schedule B and C projects identified in the Plan, in terms of future public consultation opportunities, further notification requirements, and future opportunities to request Part II Orders for the specific projects in the Plan.

The Master Plan, and the notices issued for review of the Plan, should clearly indicate that requests for an order to comply with Part II of the Environmental Assessment Act would be possible only for those projects within the Master Plan, and not the Master Plan itself. Part II Order requests would need to be made at the time the Notices of Completion are issued for the specific projects.

The proponent should be aware that as part of the program to monitor the effectiveness of the Master Plan approach, proponents are required to briefly summarize how the Master Plan followed Class EA requirements and provide this summary to the Environmental Assessment and Approvals Branch in Toronto, including copies of mandatory notices.

In order to meet Phases 1 and 2, this Ministry's expectation is that the Master Plan should include definition of the problem or opportunity to be addressed, evaluation of alternative solutions to the problem, description of the environmental impacts of these alternatives, proposed mitigation measures, and a description of the preferred alternative or system of alternatives. The evaluation of alternatives and supporting technical information (including supporting technical studies) must be provided at a level of detail such that: advantages, disadvantages and trade-offs of each alternative are clearly explained; the environmental impacts of each alternative on all aspects of the environment are assessed (natural, social, economic, technical considerations); the rationale for the selection of the preferred alternative is clear and comprehensive; and there is a clear, traceable decision making process.

If you have questions or concerns about the above comments, please contact me at (613) 540-6852.

Yours sincerely,

VM

Vicki Mitchell
Environmental Assessment Coordinator
Technical Support Section
Eastern Region
VLM/sh

CATARAQUI REGION CONSERVATION AUTHORITY
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March 26, 2007

File: SPP 6-8

VIA EMAIL & MAIL

Ms. Chantal Chiddle, P.Eng
Project Manager
Utilities Kingston
1211 John Counter Boulevard
Kingston ON K7L 4X7

Dear Ms. Chiddle,

RE: REQUEST FOR COMMENTS
MASTER PLAN FOR WATER SUPPLY FOR THE CITY OF KINGSTON AREA
PUBLIC INFORMATION CENTRE NO. 2

Staff of the Cataraqui Region Conservation Authority (CRCA) are writing with input to the above-noted study. Our comments are further to a letter of request from Mr. Larry Manley of Hatch Mott McDonald (formerly Simcoe Engineering Group Limited) (dated March 7, 2007) and our attendance at Public Information Centre No. 2 on March 19, 2007.

We have reviewed the information package that was distributed at Public Information Centre No. 2 and provide the following comments about the alternatives and evaluation criteria. Our comments are in response to the questionnaire that was distributed (Questions 1 – 5 are not applicable).

6. There is compelling evidence in support of the connection of the two existing water supply and distribution systems in the City of Kingston (Kingston Central/East and Kingston West). The installation of a large diameter water pipe across the mouth of the Little Cataraqui Creek (as shown on Alternatives 2, 3, and 4) must be completed in a manner that reflects the presence of fish habitat, significant wetlands, and flood conveyance/storage in that vicinity. This may require installation of the pipe under the bed of the Creek. The CRCA must be consulted as part of the design and installation of this pipe.

7. Yes. From our tour of the Kingston Central facility on March 22, 2007, we aware that Utilities Kingston has made recent investments in its equipment and controls. Over the longer term, we recognize that there are limitations at the Kingston Central facility that are imposed by the size and location of the site, and by the age and layout of the existing building.

8. Many communities with a population that is similar to Kingston have only one water treatment facility. One advantage that is associated with continuing to operate two linked facilities is planned redundancy. In the event that one facility had to be closed (perhaps due to a spill into the source water, or a problem with the equipment), then the second facility could continue to supply water to the entire distribution network.

9. It would seem logical to install the connection between the two systems as soon as possible. As per our response to Question 8, a connection between the Kingston Central/East and Kingston West systems would enable planned redundancy.

10. The construction of a single water treatment facility (Alternative 4) could allow for the use of advanced treatment methods, and would simplify and perhaps reduce the cost of daily operations.

    We note that the proposed location (Lake Ontario Park) is also valuable as public waterfront open space, which is a limited resource in the City of Kingston. Also, if a new intake were installed at the Lake Ontario Park site, then it would be located immediately downstream of the Kingston West wastewater treatment facility, as well as the outlet of the Little Cataraqui Creek. We therefore tend to favour Alternative 3 (expand the Kingston West facility) over a new facility at Lake Ontario Park. We are aware that there are few options for locating a new public facility along the Kingston waterfront.

    The findings of the Eastern Lake Ontario – Upper St. Lawrence River Intake Protection Zone Study (see our response to Question 15 below) will be useful for locating a new intake in a location with the least potential for chronic or event-based contamination of the source water.

11. We recommend that water conservation and the replacement of leaking water mains be explicitly included within each of the Alternatives. The amount of existing and future water demand that is satisfied through a strategic, well-funded campaign on each of those aspects should be the starting point for the evaluation process.

    We note that each Alternative is based on the continued use of Lake Ontario as the source of the City's drinking water. The Master Plan exercise does not appear to have considered alternative inland ground and surface water sources.

12. We offer the following ranking for the proposed evaluation criteria:

Public health	= 1
Natural environment	= 2
Overall system operations / Design considerations	= 3
Economics	= 4
Social impact	= 5
Historical significance	= 6 (not important)

13. No, we do not have additional evaluation criteria to recommend. However, we do have suggestions for four of the existing criteria, as follows:

The *Natural Environment* criterion should be modified by: (1) the addition of the term "ecological" to the phrase "aquatic and terrestrial systems", and (2) the addition of the phrase "impact on flood conveyance and storage." The CRCA has information such as the Central Cataraqui Region Natural Heritage Study and floodplain mapping that could be used by Utilities Kingston in the evaluation process.

The *Economics* criterion should acknowledge the need for life cycle costing of all infrastructure components.

The *Public Health* criterion should evaluate the potential use of advanced treatment methods (such as the application of ultraviolet light) in the various Alternatives.

Does the phrase "security of water supply" under the *Design and Operations* criterion refer to the reliability of the source water? Utilities Kingston should obtain its source ("raw") water from a location that has the least potential for chronic or event-based contamination. This could be evaluated at present using the raw water quality data from each of the existing intakes, and in the future through the findings of the Eastern Lake Ontario – Upper St. Lawrence River Intake Protection Zone Study (see Question 15 below). There should be special attention given to long term exposure by consumers to chemical contaminants, many of which are present in wastewater effluent and stormwater runoff, and some of which are not removed through standard water treatment processes.

14. We support the initiative by Utilities Kingston to undertake a Water Supply Master Plan exercise. As part of our agreement with the Ontario Ministry of the Environment to coordinate source water protection for the Cataraqui area, we have been asked to summarize the outcomes of such exercises within our jurisdictional area. We look forward to learning about the outcomes of the evaluation process.

15. The CRCA is presently working on an Eastern Lake Ontario – Upper St. Lawrence River Intake Protection Zone Study with in-kind support from Utilities Kingston and four other municipal utilities. Funding is being provided from the Ontario Ministry of the Environment through its Source Protection Technical Studies Grant Program. This research will generate knowledge about water movement and existing/potential contamination along the Kingston shoreline, and it will delineate protection zones around each of the existing municipal residential drinking water system intakes. A majority of the technical work is being completed by the Queen's University Centre for Water and the Environment, in conjunction with the National Water Research Institute of Environment Canada. We anticipate that the study will be completed in late 2008. As noted above, the findings of the research will be helpful in making decisions about the future of Kingston's water supply.

Thank you for the opportunity to provide comments at this stage of the Master Plan exercise. If you have any questions about our comments, please contact me at (613) 546-4228 ext. 224, or via email at robmcrae@cataraquiregion.on.ca. Please kindly inform our office of the next Public Information Centre and/or the release of a draft report.

Yours truly

Rob McRae MCIP, RPP
Project Manager, Source Water Protection

c.c. Larry Manley, P.Eng, Hatch Mott McDonald, via fax (613) 389-2442
Kevin Hall, PhD and Leon Boegman, PhD, Queen's University Centre for Water and the Environment, via email

APPENDIX F

YEAR 2011 PEAK HOUR DEMAND PRESSURE CONTOURS

(PRESSURE ZONES 2A, 2B AND 2C COMBINED INTO A SINGLE PRESSURE ZONE 2)

LEGEND:

WATERMAINS

PRESSURE CONTOURS (kPa)

300
400
500
600

utilities kingston
water sewer gas electricity networks
all your utility services under one roof

Simcoe
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SCALE: N.T.S.

JUNE 2007

104.24

UTILITIES KINGSTON
MASTER PLAN FOR WATER SUPPLY

FIGURE 7.1: ALTERNATIVE 2
YEAR 2011 PEAK HOUR DEMAND
PRESSURE CONTOUR PLAN

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YEAR 2026 PEAK HOUR DEMAND PRESSURE CONTOURS

(PRESSURE ZONES 2a, 2b AND 2c COMBINED INTO A SINGLE PRESSURE ZONE 2)

LEGEND:

WATERMAINS

PRESSURE CONTOURS (kPa)

300

400

500

600

utilities kingston
water sewer gas electricity networks
all your utility services under one roof

Simcoe
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JUNE 2007

104.24

UTILITIES KINGSTON
MASTER PLAN FOR WATER SUPPLY

FIGURE 7.2: ALTERNATIVE 2
YEAR 2026 PEAK HOUR DEMAND
PRESSURE CONTOUR PLAN

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APPENDIX G

NOTES:

1. DATA SOURCES: FIGURE W1, CITY OF KINGSTON URBAN GROWTH STRATEGY, JULY, 2004; UTILITIES KINGSTON FILE INFORMATION

LEGEND

- URBAN BOUNDARY
- EXPANDED STUDY AREA BOUNDARY
- EXISTING WATERMAINS
- NEW WATERMAINS
- INTERCONNECTING WATERMAINS
- PRESSURE ZONE BOUNDARY
- NEW/UPGRADED FACILITY
- RETIRED

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MASTER PLAN FOR WATER SUPPLY

FIGURE 9.1: CITY OF KINGSTON WATER DISTRIBUTION SYSTEM STUDY YEAR 2026A