
Technical Appendix 1 - Study Area

1 Appendix Introduction

This Technical Appendix is intended to provide a summary of the baseline information used to support the Water Distribution Master Plan. Included in this summary is:

- A summary of the background information;
- An overview of the project study areas; and,
- An overview of the City's existing water system and proposed Regional system upgrades.

2 Data Sources & Related Studies

This section summarizes the various data sources and activities that were used to form our basis of understanding for this Master Plan.

2.1 Digital Infrastructure and GIS Data

The City provided a wide range of detailed water system and other infrastructure data. A summary of the key digital data sources relevant to this study include:

- Water system infrastructure GIS database;
- Municipal utility infrastructure GIS database;
- Environmental features GIS database;
- Municipal parcel and land use information; and,
- City water billing records.

2.2 Relevant Historic Reports

A review of relevant reports was completed for additional project context and information pertinent to the confirmation of design parameters, including:

- Water Supply and Distribution Operations Master Plan (WSDOMP) – Stantec, 2015
- Water Supply Master Plan Update (WSMPU) – Stantec, 2015
- Development Charges Background Study – Hemson, 2012
- City Wide Growth Forecast (from the Rapid Transit Phase 1 Background Report) – BrookMcIlroy, nblc, & CH2MHill, 2014
- Consolidation of Waterloo North Pressure Zones – Staging and Implementation Plan – Stantec, 2016
- City of Waterloo Capital Budget – City of Waterloo, 2015
- Northdale Neighbourhood Streetscape Master Plan – IBI Group, 2016
- Waterloo Sanitary Master Plan – Stantec, 2015
- Design Guidelines and Supplemental Specifications for Municipal Services – Region of Waterloo, 2014
- Region of Waterloo Criticality Analysis of Water Distribution Infrastructure – GM BluePlan, 2016
- Infrastructure Asset Management Analysis Report (IAMAR) – GM BluePlan, 2016

2.3 Water System InfoWater Hydraulic Model

A copy of the Region’s newly developed all-pipe model was used as the base model for all hydraulic modelling activities.

2.4 Historic Water System SCADA Records

A review of the Region’s SCADA data was used to validate our understanding of current system performance and facility operations.

2.5 Hydrant Test Results

The City’s historic hydrant test results were used to confirm the accuracy of the InfoWater model results.

2.6 City and Regional Consultation

Several workshops were held with City and Regional staff to review various study elements, confirm data sources, validate system configuration and performance, and discuss proposed upgrades and strategy options.

3 Study Area

The City of Waterloo is located within the Region of Waterloo and southern Ontario. The City covers a total area of over 64 km² and a 2011 population of 102,731 (derived from the census population of 98,780 plus a 4% census undercount). The City also has a significant non-permanent student population centered near the City's major universities. Growth within the City is projected to occur as both residential (permanent and student) and employment growth in specific intensification and Greenfield areas. The intensification areas are primarily located in the Uptown core, Northdale development, and light rail transit (LRT) corridor while the Greenfield growth areas are located primarily to the City's Northwest.

3.1 Natural Heritage

The City of Waterloo's Official Plan includes a set of policies to protect and enhance its Natural System. To ensure the long-term health and viability of the Natural System, and the continued provision of its ecosystem services, the City has committed to maintaining, enhancing, and restoring its Natural System through land use planning policies, restoration initiatives, sound management, stewardship, education, and acquisition.

To remain proactive and build upon existing environmental management capabilities, the City of Waterloo approved a new Environmental Strategy in 2010. The Environmental Strategy has five areas of focus:

- Energy, air and waste - The goal is to use energy and resources efficiently, while reducing greenhouse gas emissions and waste.
- Planning and growth - The goal is to guide design and development to support a livable city.
- Water resources - The goal is to protect the quality and quantity of our water resources.
- Greenspace - The goal is to sustain and enhance terrestrial resources, including parks, trees, and other greenspaces.
- Environmental awareness and culture - The goal is to foster stewardship of the natural environment, and to build a culture of continuous environmental improvement.

The City also promotes environmental sustainability “through a broad range of practices, including developing communities and buildings that are energy and water efficient, reducing greenhouse gas emissions, eliminating point source and fugitive contaminants, efficiently managing stormwater, effectively reducing and managing solid waste, and protecting biodiversity.”¹ In so doing, the City supports such strategies as building compact communities, reducing resource consumption with growth, creating places and spaces that are resistant to climate change impacts, and encouraging designs that include sustainable design standards, low impact measures for development and energy efficiency.

3.2 Cultural Heritage and Archaeology

3.2.1 Cultural Heritage

City of Waterloo Council approved a Built Heritage Strategy in 2015. Conservation of Waterloo’s cultural heritage resources is a shared responsibility involving various City departments, property owners, and other stakeholders. The Built Heritage Strategy emphasizes actions that the City can undertake to strengthen its support of community partners and its leadership role in the collective effort to conserve cultural heritage resources. It recommends ways to conserve heritage buildings and cultural heritage landscapes that are valued for their architectural, historic or contextual characteristics. To this end, the Strategy identifies short, medium and long term priorities for heritage conservation to strengthen heritage conservation and management in Waterloo.

3.2.2 Archaeology

Before approving a land development project regulated by legislation, the City of Waterloo – like all Ontario municipalities – is required to undertake an archaeological assessment of all lands that are part of the project. Assessments are required when the land is known to have an archaeological site on it, or has the potential to have archaeological resources.

Public development projects such as highway or road construction, or sewer construction require an archaeological assessment under the Environmental Assessment Act directly or through a Class Environmental Assessment. In many cases, an environmental assessment determines the need for an archaeological assessment, which is completed as part of the overall environmental assessment process. Upon completion, the archaeological assessment must be sent to the Ministry of Tourism, Culture and Sport for review to ensure the terms and conditions of the archaeological assessment were met and that any archaeological sites found were properly conserved.

¹ Official Plan, City of Waterloo, October 2014, pg.165

4 Existing Water System Overview

Figure 1 and **Figure 2** provide an overview of the City’s water system, which forms part of the Region of Waterloo’s Integrated Urban System. The Region is responsible for the treatment and supply of water to the City’s distribution system, while the City is responsible for the local distribution and delivery of water to the end user. The Region owns and operates all supply and transmission infrastructure including water treatment plants, supply wells, pumping stations, storage facilities, boundary valves, and transmission watermain infrastructure. The City owns and operates all distribution infrastructure including watermains, hydrants, main valves, and services.

4.1 Existing Water System Configuration

Within the City, the water system is configured into six separate pressure zones operating at varying hydraulic grade lines (HGL). The distribution system depends on a number of pumping stations and storage facilities to adequately supply and convey water to the system. **Table 1** and **Figure 1** summarizes the existing system’s infrastructure.

The following provides a brief summary of the System’s Pressure Zones.

4.1.1 Waterloo Pressure Zone 4

Pressure Zone 4 (Wat 4), located in northeast Waterloo, is the City’s largest pressure zone with the lowest elevation. The pressure zone is supplied by the William Street Water Treatment Plant (WTP) and bulk transfers from the City of Kitchener via:

- Hallman Road Motorized Control Valve #3 (MV3) – Primarily supplied by the Mannheim WTP
- Erb Street Butterfly Valve – Primarily supplied by the Strange Street WTP

Wat 4 also conveys flows to portions of the IUS outside of the City including:

- Kitchener Zone 4A, which is supplied through the unmonitored Hawkswood and Falconridge Pressure Reducing Valves (PRVs)
- Woolwich Stockyards which is supplied through a monitored watermain
- St. Jacobs and Elmira, which is supplied through a monitored transmission main to the St. Jacobs Reservoir and Pump Station for distribution

Pressure Zones 4B and 4C are also supplied by Wat 4 through the Laurel Tank from the Northfield Pumping Station and Lakeshore Pumping Station, respectively.

4.1.2 Waterloo Pressure Zone 4B

Waterloo Pressure Zone 4B (Wat 4B) is a small closed pressure zone that relies on supply from the Laurel Tank located in Wat 4. The zone is boosted through operations at the Northfield PS.

4.1.3 Waterloo Pressure Zone 4C

Waterloo Pressure Zone 4C (Wat 4C) is a small closed pressure zone that relies on supply from the Laurel Tank located in Wat 4. The zone is boosted through operations at the Lakeshore PS.

4.1.4 Waterloo Pressure Zone 5

Waterloo Pressure Zone 5 (Wat 5) is the City's second largest pressure zone, and is operated at a slightly higher HGL than Wat 4. The pressure zone is supplied through both internal and external sources. The primary internal supply source comes from the Erb Street Supply and can be supplemented in the future through the Waterloo North supply. Externally, Wat 5 is supplied by the Mannheim WTP as flow is conveyed through the Hallman Road Motorized Control Valve #2 (MV2) from Kitchener Zone 5. Additionally, water from Wat 5 supplements Wat 4 during peak demand periods through the Erb Street PRV.

Wat 5 contains Well W10 which, previously, directly supplied the distribution system. The well is currently offline but is available in the future if needed.

4.1.5 Waterloo Pressure Zone 6

Waterloo Pressure Zone 6 (Wat 6) is the City's third largest pressure zone, and is operated at a higher HGL than Wat 5. Wat 6 is supplied through external sources from the Mannheim WTP through the University Elevated Tank (ET) in Kitchener Zone 6. Under emergency conditions, a check valve opens to allow Wat 7 to be supplied by Wat 6.

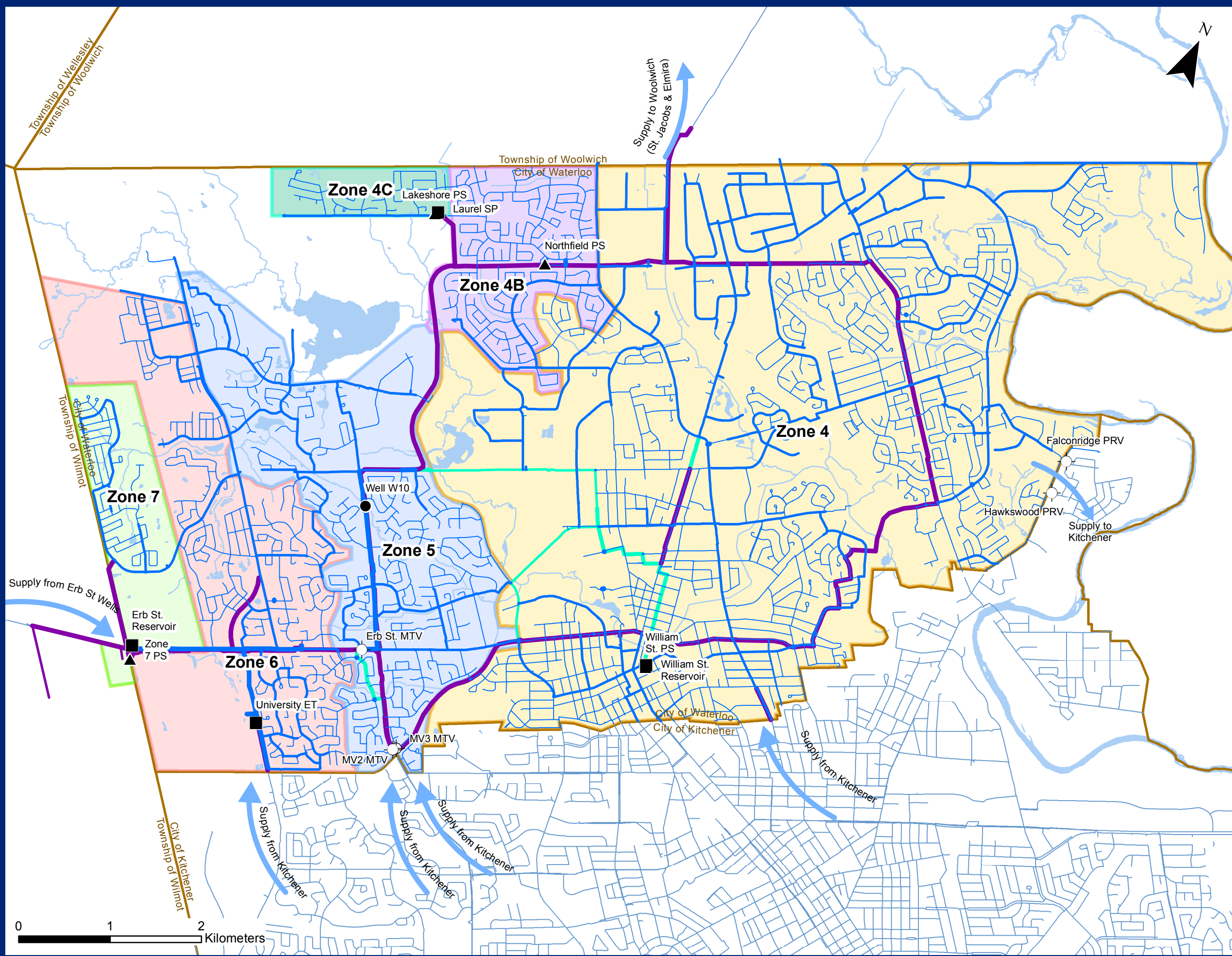
4.1.6 Waterloo Pressure Zone 7

Waterloo Pressure Zone 7 (Wat 7) is located farthest west of the City, and operates at the highest HGL within the water system. This zone is internally supplied by the Erb Street Supply through the Zone 7 Pumping Station. Under emergency conditions, a check valve opens to allow Wat 7 to be supplied by Wat 6.





Wat 7 also conveys flows to portions of the IUS outside of the City including:

- St. Agatha, which is supplied through the Zone 7 Pumping Station
- Waterloo Region Emergency Services Training and Research Complex (WRESTRC) through the Zone 7 Pumping Station






Figure 1 - Existing Water System



Water Infrastructure

-  Pumping Station
-  Reservoir
-  Well
-  Valve



Watermain (mm)

-  < 200 mm
-  250 - 350 mm
-  > 400 mm
-  Regional Watermains
-  Dual Watermains

Pressure Zone

-  Wat 4
-  Wat 5
-  Wat 4B
-  Wat 6
-  Wat 4C
-  Wat 7

Environmental Features

-  Municipal Boundary
-  River, Lake

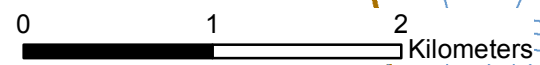
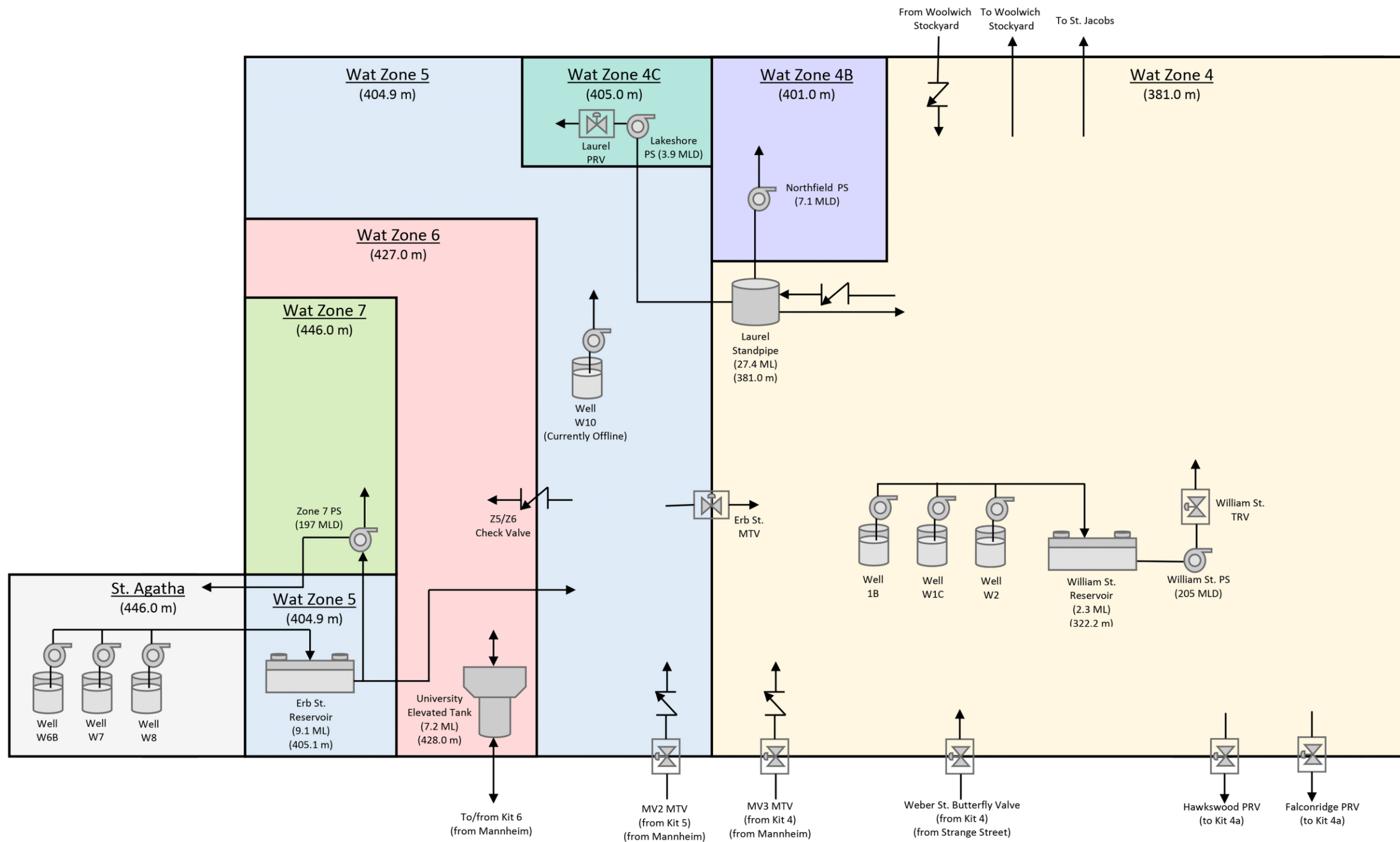


Figure 2 - Water Schematic



Water Infrastructure










-  Reservoir
-  Elevated Tank (Volume) (Top Water Level)
-  Stand Pipe (Volume)
-  Pump (Firm Capacity)
-  Well
-  Pressure Reducing Valve (PRV)
-  Motor Control Valve (MTV)
-  Throttle Control Valve (TRV)
-  Check Valve

Table 1 - Existing Water System Configuration and Infrastructure

| Pressure Zone | Wat 4 | Wat 4B | Wat 4C | Wat 5 | Wat 6 | Wat 7 |
|--------------------|---------------------------------|------------------------------------|--|-----------------------------|--|--|
| HGL (m) | 381.0 | 401.0 | 405.0 | 404.9 | 427.0 | 446.0 |
| Internal Supply | William St | - | - | Erb Street Supply | - | Erb Street Supply |
| | Waterloo North (Future) | | | Well W10 (Not in Operation) | | |
| | | | | Waterloo North (Future) | | |
| External Supply | From Wat 5 (through Erb St MTV) | From Wat 4 (through Northfield PS) | From Wat 4 (through Lakeshore PS from Laurel Tank) | Mannheim WTP (through MV2) | Mannheim WTP (through University ET) | Wat 6 to Wat 7 Check Valve (Emergency) |
| | Mannheim WTP (through MV3) | | | | Wat 5 to Wat 6 Check Valve (Emergency) | |
| Pumping Station | Laurel PS (Not in Operation) | Northfield PS | Lakeshore PS | - | - | Zone 7 PS |
| Storage Facilities | Laurel Tank | - | - | Erb St Res | University ET | - |

4.1.7 Pumping Stations

The Region currently has four pumping stations (PS) to deliver water to the City's distribution system as follows:

- Northfield PS pumps supply from the Laurel Tank to Wat 4B
- Lakeshore PS pumps supply from Laurel Tank to Wat 4C
- William Street PS pumps supply from the William Street Reservoir to Wat 4
- Zone 7 PS pumps supply from the Erb Street Reservoir to Wat 7, the WRESTRC, and St. Agatha
- Laurel PS pumps supply from the Laurel Tank to Wat 4 and is currently not in operation
-

Table 2 summarizes the pump station's current configuration and rated capacity.

Table 2 - Existing Water System Pump Stations²

| Facility | Pressure Zone | Pump | Design Flow Rate (L/s) | Design Head (m) | Zone Target HGL (m) |
|---------------------------------|---------------|--------------|------------------------|-----------------|---------------------|
| William St PS | Wat 4 | WB-1 | 91 | 67 | 381 |
| | | WB-2 | 114 | 67 | |
| | | WB-3 | 114 | 67 | |
| Northfield PS | Wat 4B | WB-6 | 29 | 20 | 401 |
| | | WB-7 | 53 | 20 | |
| | | WB-8 | 77 | 20 | |
| Lakeshore PS | Wat 4C | WB-16 | 15 | 24 | 405 |
| | | WB-17 | 15 | 24 | |
| | | WB-18 | 15 | 24 | |
| | | WB-19 (fire) | 114 | 27 | |
| Zone 7 PS | Wat 7 | WB-20 | 19 | 44 | 446 |
| | | WB-21 | 39 | 43 | |
| | | WB-22 | 39 | 43 | |
| | | WB-23 (fire) | 100 | 41 | |
| | | WB-24 (fire) | 167 | 25 | |
| Laurel PS (Not in Operation) | Wat 4 | WB-13 | 300 | 16 | 381 |
| | | WB-14 (fire) | 300 | 16 | |

² Region of Waterloo Water Supply and Distribution Operations Master Plan, Stantec, 2015

4.1.8 Storage

The Region has three storage facilities supporting the City’s water system as follows:

- Laurel Tank receives supply from Wat 4 and provides capacity to Wat 4, Wat 4B, and Wat 4C
- William Street Reservoir receives storage from the William Street Wells and provides capacity Wat 4
- Erb Street Reservoir receives supply from the Erb Street Wells and provides capacity to Wat 5 and Wat 7
- University ET receives supply from Kitchener Zone 6 and provides capacity to Wat 6

Table 3 summarizes the City’s existing storage facilities with current water levels and design volumes.

Table 3 - Existing Water System Storage Facilities³

| Facility | Pressure Zone | Base Elevation (m) | Low Water Level (m) | High Water Level (m) | Volume (ML) |
|--------------------------|---------------|--------------------|---------------------|----------------------|-------------|
| Laurel Tank | Wat 4 | 355.0 | 355.0 | 381.0 | 27.4 |
| William Street Reservoir | Wat 4 | 319.1 | 320.0 | 322.2 | 2.3 |
| Erb Street Reservoir | Wat 5 | 400.4 | 400.4 | 405.1 | 9.1 |
| University ET | Wat 6 | 386.5 | 415.8 | 428.0 | 7.2 |

³ Region of Waterloo Water Supply and Distribution Operations Master Plan, Stantec, 2015

4.1.9 Internal Water Supply

The Region has three sources of internal groundwater supply, located within the City of Waterloo, as follows:

- William Street Reservoir is supplied by three groundwater wells which provide capacity to Wat 4 through the William Street PS
- Erb Street Wells is supplied by four groundwater wells which provide capacity to Wat 5 and Wat 7 through the Erb Street Reservoir
- Well W10 is a single well which supplies the distribution system directly to Wat 5.

Table 4 summarizes the City’s existing groundwater supply wells with design flow rates and design head.

Table 4 - Existing Water System Groundwater Supply Wells⁴

| Facility | Pressure Zone | Supply Well | Design Flow Rate (L/s) | Design Head (m) | Status |
|-------------------------------------|---------------|-------------|------------------------|-----------------|---------|
| William Street Reservoir | Wat 4 | W1B | 60 | 32 | Online |
| | | W1C | 44 | 25 | Offline |
| | | W2 | 61 | 33 | Online |
| Erb Street Wells | Wat 5 | W6-A | 37 | 79 | Offline |
| | | W6-B | 53 | 79 | Online |
| | | W7 | 106 | 87 | Online |
| | | W8 | 129 | 96 | Online |
| Well W10 (Directly to Distribution) | Wat 5 | W10 | 36 | 67 | Offline |

⁴ Region of Waterloo Water Supply and Distribution Operations Master Plan, Stantec, 2015

4.1.10 Watermains

The City of Waterloo owns 443 km of distribution watermains within the City limits and an additional 8 km of watermains which are co-owned with the Region. **Table 5** summarizes the distribution watermains by age, material, and diameter as owned by the City or co-owned with the Region by percentage of total length.

Table 5 - Existing Water System Watermains

| Watermain Diameter | City Owned | Dual Owned | Watermain Material | City Owned | Dual Owned | Watermain Age | City Owned | Dual Owned |
|--------------------|------------|------------|--------------------|------------|------------|---------------|------------|------------|
| ≤100 mm | 5% | - | AC | 1% | - | ≤1960 | 12% | 42% |
| 150 mm | 46% | - | CI | 31% | 76% | 1960-1980 | 30% | 46% |
| 200 mm | 21% | - | DI | 13% | 16% | 1980-2000 | 33% | 3% |
| 250 mm | 2% | - | HDPE | <1% | - | >2000 | 22% | 8% |
| 300 mm | 25% | 52% | PVC | 52% | 8% | Unknown | 3% | <1% |
| ≥400 mm | 1% | 47% | Unknown | 2% | <1% | | | |

4.2 Regional Planned Upgrades

Through the Region's 2015 WSDOMP and additional studies a number of Regional projects are proposed to enhance and optimize the transmission and operations of the City of Waterloo's water supply within the IUS. The proposed water system upgrades are intended to occur before 2031. **Figure 3** highlights these proposed Regional projects, as described below.

4.2.1 Upgrade Strange Street WTP to Include William Street Wells

The amalgamation of the William Street Wells and Strange Street Water Treatment Plant into a single treatment work will consist of:

- Conveyance of William Street Wells flows to the Strange Street Water Treatment Plant
- Upgrade Strange Street Water Treatment Plant to accommodate increase flow and treatment requirements

Anticipated Competition Date: 2019

4.2.2 Weber Street MTV Control Valve

Upgrade to Weber Street MTV Control Valve to accommodate increase flow transfers into Waterloo Zone 4

Anticipated Competition Date: 2019

4.2.3 Waterloo North WTP

To enhance the security of supply within the City while reducing the reliance on supply from the Mannheim Water Treatment Plant, an additional groundwater source - Waterloo North - will be constructed and fed directly into the Laurel Tank. This new supply source is intended to provide water to Wat 4 with the option of supplementing flows to Wat 5 through the existing Lakeshore Pumping Station.

Anticipated Competition Date: >2021

4.2.4 Erb Street Facility Capacity Restoration

The Erb Street supply will have restored capacity and improved operations which will also enhance internal security of supply. With this upgrade, an additional pressure reducing valve will be installed to allow water to be transferred from Wat 6 to Wat 5 during emergency conditions when the Erb Street supply is offline.

Anticipated Competition Date: Completed

4.2.5 Wat 5 Consolidation

Due to similar operating HGLs among Wat 4B, Wat 4C and Wat 5, the Region plans to integrate Wat 4B and Wat 4C into the existing Wat 5. The consolidation of Wat 5 requires reconfiguration of existing valving, the construction of new transmission watermains, and the decommissioning of the Northfield PS. The additional trunk infrastructure, highlighted in **Figure 3**, generally consists of:

- 300 mm Wat 5 watermain on Erbsville Road from Regal Place to Conservation Drive, Forest Gate Crescent to Laurelwood Drive
- 300 mm Wat 5 watermain on Erbsville Road from Forest Gate Crescent to Laurelwood Drive
- 400 mm Wat 5 watermain on Erbsville Road from Keats Way to Willow Wood Drive
- 300 mm Wat 5 watermain on Conservation Drive from Beaver Creek Road to Erbsville Road
- 300 mm Wat 5 watermain on Conservation Drive from Westmount Road to Coldstream Drive
- 300 mm Wat 5 watermain on Beaver Creek Road from Laurelwood Drive to Conservation Drive
- 300 mm Wat 5 watermain on Bearinger Road from Laurel Gate Drive to Pineridge Road
- 300 mm Wat 5 watermain on Columbia Street West from Erbsville Road to Cavendish Drive
- 300 mm Wat 4 watermain on Columbia Street West from Old Post Road to Hagey Boulevard

Anticipated Competition Date: 2021

4.2.6 Planned Future Regional Watermain Works

Additional Regional transmission watermain works are planned to be completed prior to 2031 consisting of the following:

- 300 mm Wat 4 watermain on Columbia Street West from Old Post Road to King Street North
- 400 mm Wat 4 watermain on King Street North from Columbia Street West to Noecker Street

**Figure 3 - Regional WSDOMP
 Water System Upgrades**

Water Infrastructure

- ▲ Pumping Station
- Reservoir
- Well
- New Valves
- ⊙ Valve
- ◆ Treatment Plant

Watermain (mm)

- < 200 mm
- 250 - 350 mm
- > 400 mm
- Proposed Watermains
- Regional Watermains
- Dual Watermains

Water Pressure Zone

- + Wat 4
- + Wat 6
- + Wat 7
- + 4B, 4C, and 5 to be consolidated into Wat 5

Environmental Features

- Municipal Boundary
- River, Lake

