



INTEGRATED SANITARY MASTER PLAN
Municipal Class Environmental Assessment –
Volume 2 (Technical Memorandums)

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Prepared for:
City of Kitchener

Prepared by:
Stantec Consulting Ltd.

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Table of Contents

EXECUTIVE SUMMARY	V
ACRONYMS / ABBREVIATIONS.....	X
1 INTRODUCTION	1
1.1 Study Area	1.1
1.2 Municipal Class Environmental Assessment Process	1.2
1.2.1 Class EA Project Classification	1.5
1.2.2 Section 16 Order Process	1.5
1.3 Consultation	1.6
1.3.1 Project Contact List	1.6
1.3.2 Project Notices	1.6
1.3.3 Public Consultation	1.7
1.3.4 Agency Stakeholder Consultation	1.8
1.3.5 Indigenous Consultation	1.9
1.4 Report Organization.....	1.9
1.4.1 Technical Memos	1.10
2 PROBLEM STATEMENT AND OPPORTUNITY IDENTIFICATION	2.1
3 PLANNING & POLICY FRAMEWORK.....	3.1
3.1 Federal Legislation.....	3.1
3.1.1 Canadian Environmental Assessment Act	3.1
3.1.2 Fisheries Act.....	3.1
3.1.3 Species at Risk Act.....	3.1
3.2 Provincial Policies and Legislation.....	3.2
3.2.1 The Planning Act	3.2
3.2.2 Provincial Policy Statement	3.2
3.2.3 Endangered Species Act.....	3.3
3.2.4 Climate Change.....	3.4
3.2.5 Grand River Conservation Authority.....	3.4
3.3 Municipal Planning Policies	3.4
3.3.1 Region of Waterloo Official Plan	3.4
3.3.2 Region of Waterloo Wastewater Treatment Master Plan	3.5
3.3.3 City of Kitchener Official Plan	3.5
4 EXISTING CONDITIONS	4.1
4.1 Natural, Social, and Economic Environment	4.1
4.1.1 Social Environment.....	4.1
4.1.2 Natural Environment.....	4.1
4.1.3 Economic Contributions.....	4.1
4.2 Existing Population	4.1
4.3 Existing Sanitary System	4.5
4.3.1 Background Reports.....	4.5
4.3.2 Cross-Border Agreements.....	4.5
4.3.3 Existing Infrastructure and Inventory	4.7
4.3.4 Monitored Flow	4.10



Integrated Sanitary Master Plan

4.4	Sanitary Hydraulic Model.....	4.17
4.4.1	Existing Hydraulic Model and Platform Review.....	4.17
4.4.2	Model Updates.....	4.18
4.4.3	Flow Generation Updates.....	4.18
4.4.4	External Flow Input and Boundary Conditions.....	4.18
4.4.5	Hydraulic Model Calibration.....	4.21
4.4.6	Hydraulic Model Validation.....	4.24
5	FUTURE SANITARY SYSTEM CONDITIONS.....	5.1
5.1	Population and Growth Projections.....	5.1
5.2	Hydraulic Model Updates.....	5.3
5.2.1	Future Population.....	5.3
5.2.2	Infrastructure Updates.....	5.3
5.2.3	Pumping Stations.....	5.3
6	DESIGN CRITERIA & LEVEL OF SERVICE.....	6.1
6.1	Sanitary Collection System Criteria.....	6.1
6.1.1	Design Sewage Flows.....	6.1
6.1.2	Sewer Design.....	6.4
6.1.3	Design of Pump Stations.....	6.5
6.2	Sanitary Collection System Level of Service.....	6.6
6.2.1	Sanitary Sewers.....	6.7
6.2.2	Pump Stations.....	6.9
6.2.3	Sensitivity Testing.....	6.9
7	ASSESSMENT OF EXISTING AND FUTURE SANITARY INFRASTRUCTURE.....	7.10
7.1	Design Criteria.....	7.10
7.2	Climate Change.....	7.11
7.3	Critical Failure Analysis.....	7.11
7.4	Modelling & Analysis.....	7.12
7.4.1	Assessment Approach.....	7.12
7.4.2	Assessment Results.....	7.12
7.5	Condition-Based System Assessment.....	7.38
7.5.1	Assessment Approach.....	7.38
7.5.2	Assessment Results.....	7.39
8	DEVELOPMENT & EVALUATION OF SERVICING STRATEGY ALTERNATIVES..	8.1
8.1	Evaluation Criteria.....	8.1
8.2	Alternative Servicing Solutions.....	8.2
8.2.1	Alternative 1 – Do Nothing.....	8.2
8.2.2	Alternative 2 – Shaping Community Growth.....	8.2
8.2.3	Alternative 3 – Infrastructure Updates.....	8.3
8.2.4	Alternative 4 – Data Acquisition, Flow Monitoring and Inflow and Infiltration Mitigation Programs.....	8.3
8.3	Alternative Infrastructure Update Solutions.....	8.4
8.4	Recommended Servicing Solutions.....	8.33
8.5	Municipal Class Environmental Assessment Project Schedule Classification.....	8.33
9	PROJECT IMPLEMENTATION.....	9.1
9.1	Capital Projects.....	9.1
10	INNOVATION.....	10.1



Integrated Sanitary Master Plan

10.1	What is a Smart City and Smart Utility?.....	10.1
10.2	Foundation of a Smart Utility: Digital Transformation	10.1
10.3	The Smart Utility as the Digital Utility of the Future	10.3
10.4	Energy Optimization and Renewable Energy	10.4
10.5	Recommendations	10.5
11	CLOSING.....	11.1

LIST OF TABLES

Table ES-1-1: Summary of Budgetary Estimates	ix
Table 4-1: Existing Population	4.1
Table 4-2: City of Kitchener Cross-Border Agreements	4.6
Table 4-3: Sanitary Pump Station Information	4.9
Table 4-4: Flow Meter & Metershed Characteristics.....	4.13
Table 4-5: Available 2021 Rain Gauge Network.....	4.15
Table 4-6: Storm Event Characteristics	4.16
Table 4-7: Existing Model Boundary Conditions	4.19
Table 4-8: Dry Weather Flow Parameters	4.21
Table 5-1: Population Projections	5.1
Table 5-2: Updated Pumping Station Firm & Rated Capacities Based on Theoretical Operation	5.4
Table 6-1: Domestic Sewage Generation Rates.....	6.2
Table 6-2: ICI Sewage Generation Rates	6.3
Table 6-3: Extraneous Flow Generation Rates.....	6.3
Table 6-4: Comparison of Sanitary Pipe Design Criteria	6.4
Table 6-5: Comparison of Sanitary MH Design Criteria.....	6.4
Table 6-6: Pump Station Criteria.....	6.6
Table 7-1: Selected Critical Trunk Sewers for Failure Analysis.....	7.11
Table 7-2: Existing Conditions Sanitary Sewer Problem Areas.....	7.14
Table 7-3: Existing Conditions Pumping Station Performance	7.15
Table 7-4: 2031 Future Conditions Sanitary Sewer Problem Areas	7.22
Table 7-5: 2031 Future Conditions Pumping Station Performance	7.23
Table 7-6: 2051 Future Conditions Sanitary Sewer Problem Areas	7.30
Table 7-7: 2051 Future Conditions Pumping Station Performance	7.31
Table 7-8: Gravity Sewers Currently in Poor Condition	7.39
Table 8-1: Evaluation Criteria.....	8.1
Table 8-2: Sewer Design Criteria	8.5
Table 8-3: Existing and Future Conditions Capacity-Based Sewer Solutions	8.7
Table 8-4: Alternatives Evaluation	8.11
Table 8-5: Climate Change Impacts to Proposed Solutions	8.13
Table 8-6: Sewer Asset Renewal Projects (Near-Term).....	8.17
Table 8-7: Sanitary Pumping Station Asset Renewal Projects	8.31
Table 8-8: Sanitary Pumping Station Scada System Upgrades	8.31
Table 8-9: MCEA Project Schedule Classifications	8.33
Table 9-1: Short Term Projects (2024 - 2027) Prioritization & Annual Costing	9.2
Table 9-2: Medium Term Projects (2028 – 2031) Prioritization & Annual Costing	9.6
Table 9-3: Data Acquisition & Management Programs Annual Costing	9.6
Table 9-4: Summary of Annual Costing for 2024 - 2031	9.7
Table 9-5: Long-Term Projects (2032 - 2051).....	9.1



LIST OF FIGURES

Figure 1-1: Study Area 1
Figure 1-2: Municipal Class Environmental Assessment Process..... 3
Figure 4-1: Social Environment..... 4.2
Figure 4-2: Natural Environment..... 4.3
Figure 4-3: Economic contributions 4.4
Figure 4-4: Sanitary Sewer System 4.8
Figure 4-5: Trunk Sewer Network and Sewershed Classification..... 4.11
Figure 4-6: 2021 Flow Monitoring Program Meter & Rain Gauge Locations 4.12
Figure 4-7: 2021 Flow Meter Schematic 4.15
Figure 4-8: Boundary Conditions Locations..... 4.20
Figure 4-9: Hydraulic Model Wet Weather Validation at the WWTP 4.24
Figure 5-1: Growth Projections 5.2
Figure 7-1: Existing Conditions Sanitary Sewer System Dry Weather Flow HGL & Surcharge Results. 7.17
Figure 7-2: Existing Conditions Sanitary Sewer System 5-Year HGL & Surcharge Results 7.18
Figure 7-3: Existing Conditions Sanitary Sewer System 10-Year HGL & Surcharge Results 7.19
Figure 7-4: Existing Conditions Sanitary Sewer System 25-Year HGL & Surcharge Results 7.20
Figure 7-5: 2031 Future Conditions Sanitary Sewer System Dry Weather Flow HGL & Surcharge Results 7.25
Figure 7-6: 2031 Future Conditions Sanitary Sewer System 5-Year HGL & Surcharge Results 7.26
Figure 7-7: 2031 Future Conditions Sanitary Sewer System 10-Year HGL & Surcharge Results 7.27
Figure 7-8: 2031 Future Conditions Sanitary Sewer System 25-Year HGL & Surcharge Results 7.28
Figure 7-9: 2051 Future Conditions Sanitary Sewer System Dry Weather Flow HGL & Surcharge Results 7.34
Figure 7-10: 2051 Future Conditions Sanitary Sewer System 5-Year HGL & Surcharge Results 7.35
Figure 7-11: 2051 Future Conditions Sanitary Sewer System 10-Year HGL & Surcharge Results 7.36
Figure 7-12: 2051 Future Conditions Sanitary Sewer System 25-Year HGL & Surcharge Results 7.37
Figure 7-13: Gravity Sewers Currently in Poor Condition 7.43
Figure 8-1: Proposed Capacity-Based Solutions 8.9
Figure 8-2: 2051 Future Conditions Sanitary Sewer System 25-Year HGL & Surcharge Results with Proposed Capacity-Based Solutions 8.10
Figure 8-3: Capacity-Based Solutions Sensitivity – 25-Year Climate Change HGL & Surcharge Results 8.15
Figure 10-1: Utility of the Future Components and Desired Outcomes 10.2
Figure 10-2: Digital UOTF Integration with Enterprise Data Management and Analytics Platform 10.4

LIST OF APPENDICES

APPENDIX A CONSULTATION.....1

VOLUME 2 TECHNICAL MEMORANDUMS

Technical Memo 1 – Background Review

Technical Memo 2 – Hydraulic Analysis

- Technical Memo 2a: Model Assessment and Software Recommendation
- Technical Memo 2b: Model Plan
- Technical Memo 2c: Calibration
- Technical Memo 2d: Modelling Scenarios

Technical Memo 3 (including TM4) – Sanitary Servicing Analysis & Capital Infrastructure Funding and Risk Analysis and Implementation Plan

Technical Memo 5 – Design Criteria & Level of Service





**City of Kitchener Integrated
Sanitary Master Plan –
Technical Memo #1:
Background Review**

Final

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**CITY OF KITCHENER INTEGRATED SANITARY MASTER PLAN – TECHNICAL MEMO #1:
BACKGROUND REVIEW**


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Prepared by 
(signature)


Marc Telmosse, P.Eng. – Modelling Lead

Prepared by 
(signature)

Paula Hohner, MScPI, MCIP, RPP – Public Consultation & EA Process Lead

Reviewed by 
(signature)

Dave Eadie, P.Eng. – Master Plan Lead

Approved by 
(signature)

Jeff Paul, P.Eng. – Project Manager



Table of Contents

1.0	INTRODUCTION	1.1
2.0	DESKTOP REVIEW	2.1
2.1	BACKGROUND REPORTS.....	2.1
2.2	GEOGRAPHIC INFORMATION SYSTEM (GIS LAYERS).....	2.5
2.3	POPULATION AND LAND USE	2.6
2.3.1	Land Use.....	2.6
2.3.2	Population Distribution	2.7
2.4	NATURAL HERITAGE ENVIRONMENT	2.8
2.4.1	Archaeological Resources.....	2.8
2.4.2	Built Cultural Heritage and Cultural Heritage Landscapes	2.8
2.4.3	Natural Heritage.....	2.9
2.5	SANITARY SEWER NETWORK	2.11
2.5.1	Sanitary Sewer Inventory	2.11
2.5.2	MH Junctions Inventory.....	2.14
2.5.3	Pump Stations.....	2.17
2.5.4	Hydraulic Model	2.18
2.6	FLOW MONITORING AND RAIN GAUGE DATA	2.18
2.6.1	2016 Monitoring Program.....	2.18
2.6.2	Monitoring Activities 2017 – 2020.....	2.18
2.6.3	Rainfall Data	2.20
3.0	2021 FLOW MONITORING PLAN	3.1
3.1	OBJECTIVE	3.1

LIST OF TABLES

Table 2-1:	Sanitary Servicing Development Related Capital Projects (From CoK Development Charges Background Study, 2019)	2.2
Table 2-2:	City of Kitchener Cross-Border Agreements.....	2.3
Table 2-3:	City of Kitchener Critical GIS Layers	2.6
Table 2-4:	Sanitary Sewer Material Distribution.....	2.11
Table 2-5:	Sanitary Sewer Diameter Inventory and Distribution	2.13
Table 2-6:	Sanitary Sewer Age Distribution.....	2.13
Table 2-7:	Sewer Data Gap Analysis Summary	2.14
Table 2-8:	Junction (MH) Data Gap Analysis Summary	2.14
Table 2-9:	Pump Station Assessment Report Availability & Status.....	2.17
Table 2-10:	Flow Monitoring Program Summary (2017-2020).....	2.19
Table 2-11:	Recent Significant Rainfall Event Comparison	2.21



**CITY OF KITCHENER INTEGRATED SANITARY MASTER PLAN – TECHNICAL MEMO #1:
BACKGROUND REVIEW**

LIST OF FIGURES

Figure 2-1: Grand River Source Protection Policy Viewer Extract (groundwater)	2.10
Figure 2-2: City of Kitchener Sanitary Sewer System	2.12
Figure 2-3: Missing Attributes in the Sanitary Sewer GIS Database	2.15
Figure 2-4: Missing Attributes in the Sanitary Junction GIS Database	2.16
Figure 2-5: Available Permanent Rain Gauges	2.22
Figure 2-6: Cumulative Rainfall Data (2016-2019)	2.23
Figure B-1: Map 3 Land Use - City of Kitchener Official Plan	B.1
Figure B-2: Map 6 Natural Heritage System – City of Kitchener Official Plan	B.2
Figure B-3: Map 9 Cultural Heritage Resources - City of Kitchener Official Plan	B.3
Figure B-4: Map 3a Urban Area - Region of Waterloo Official Plan	B.4
Figure B-5: Map 4 Greenlands Network - Region of Waterloo Official Plan	B.5
Figure B-6: Map 6a Urban Area Source Water Protection Areas - Region of Waterloo Official Plan	B.6
Figure B-7: Map 6f Other Source Water Protection Areas - High Microbial Risk Management Zones - Region of Waterloo Official Plan.....	B.7
Figure B-8: Map 6g Other Source Water Protection Areas - Region of Waterloo Official Plan	B.8
Figure B-9: Map 7a The Countryside - Region of Waterloo Official Plan	B.9

LIST OF APPENDICES

APPENDIX A BACKGROUND DOCUMENT REVIEW

**APPENDIX B SELECT MAPS FROM THE CITY OF KITCHENER AND THE REGION
OF WATERLOO OFFICIAL PLANS**

APPENDIX C 2021 FLOW MONITORING PLAN



CITY OF KITCHENER INTEGRATED SANITARY MASTER PLAN – TECHNICAL MEMO #1: BACKGROUND REVIEW

Introduction
December 10, 2021

1.0 INTRODUCTION

The City of Kitchener (City) has retained Stantec Consulting Ltd. (Stantec) to complete the Integrated Sanitary Master Plan (ISAN-MP). The purpose of the ISAN-MP is to develop an overall master plan to guide the future needs of the City with respect to growth development and infrastructure renewal to account for updated population and employment growth projections to the 2051 planning horizon, building on the work/studies previously completed and integrating available information from ongoing studies/programs. Following the Class Environmental Assessment (EA) Process, priority and strategic projects will be evaluated to continue to efficiently and effectively operate the system, implement best management practices (including growth tracking and digital innovation), and sustainable staging and funding of capital projects.

The following tasks will be carried out for the completion of the ISAN-MP, including a series of Technical Memoranda (TM) that will comprise the content of the final Master Plan document:

- **Task 1: Background Data Review (TM#1)**
- Task 2: Hydraulic Analysis (TM#2)
- Task 3: Sanitary Servicing Plan (TM#3)
- Task 4: Capital Infrastructure Funding and Risk Analysis (TM#4)
- Task 5: Design Criteria, Level of Service & Sensitivity Analysis (TM#5)
- Task 6: Growth Management and Implementation Plan (TM#6)
- Task 7: Communications and Community Engagement
- Task 8: Sanitary Servicing Master Plan / Innovation Strategy

Task 1 involves a background data review to collect, consolidate and analyze existing information that will be used throughout the ISAN-MP. Key information includes the existing hydraulic model, available flow/rainfall monitoring data, pump station supervisory control and data acquisition (SCADA) data, geographic information system (GIS) layers, sanitary asset management ratings, capital projects completed and scheduled (including status), current development applications, water consumption records, and population data / projections. A desktop review is also included of the existing natural, socio-economic and cultural (heritage/archaeology) environments in sufficient detail to satisfy the requirements of the ISAN-MP process.

Of importance is the rapid review of the available rainfall and flow monitoring data to confirm data coverage, quality and usability for model flow generation parameters and calibration, as well as overall system characterization (I/I, surcharge). This early review, along with model review, provides the basis for the recommendations for the 2021 Flow Monitoring Plan.



CITY OF KITCHENER INTEGRATED SANITARY MASTER PLAN – TECHNICAL MEMO #1: BACKGROUND REVIEW

Desktop Review
December 10, 2021

2.0 DESKTOP REVIEW

2.1 BACKGROUND REPORTS

The City of Kitchener (CoK) has undertaken various studies of portions of its sanitary sewer network to better understand functional capacity and overall performance in specific areas. As well, asset management plans for the Sanitary Utility were completed in both 2013 and most recently in 2019 outlining a detailed analysis of the current condition and forecast for sanitary infrastructure. There are also ongoing studies and programs related to pumping stations (SCADA implementation and assessment), and rainfall/sanitary flow monitoring. A long list of documents was provided by the City, ranging from specific studies and environmental assessments to City-wide policy and design criteria.

Background information review highlights are briefly summarized in **Appendix A** with the planned applicability to the ISAN-MP. For ease of organization, the reports have been categorized into the following headings.

- Sewer Related
- Growth Related
- Capital Planning Related
- Policy Related
- Criteria Related
- Engagement Related

A selection of key documents to be relied upon for this ISAN-MP include:

Sanitary Sewer System Model Update (AECOM, 2019)

This is the basis of the City's existing model and includes infrastructure understood to be inclusive to 2016. The existing model is considered calibrated to 2016 data.

Pumping Station Assessment Reports (Genivar/WSP, 2012 & Burnside, 2020)

Twenty-six (26) pumping station assessment reports have been provided. Many of these have been updated as recently as 2020/2021. See **Section 2.5.3**.

- **Data Gap:** Breslau Pump Station - no recent assessment report. The Township of Woolwich is working with their consultant to determine upgrade needs for increased capacity, and information is not expected to be immediately ready. There will be an initial reliance on the 2013 assessment associated with the Victoria PS.



**CITY OF KITCHENER INTEGRATED SANITARY MASTER PLAN – TECHNICAL MEMO #1:
BACKGROUND REVIEW**

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December 10, 2021

2020 Capital Budget & 10-Year Forecast (CoK, 2019) + 2021 to 2030 Projects & Funding

These documents identify the currently planned projects to the 2030 planning horizon, including their projected capital costs and funding mechanisms. The projects associated with development are summarized in **Table 2-1**.

Table 2-1: Sanitary Servicing Development Related Capital Projects (From CoK Development Charges Background Study, 2019)

Project Sheet #	Project Description	Timing
SA9	Old Mill Pumping Station	2020 ^a
SA1	Biehn Drive and Strasburg South Sanitary Trunk Extension	2020-2022
SA16	Otterbein (Forwell) Sanitary Pumping Station Upgrades	2024-2025
SA2	Borden Greenway Trunk Sewer	2025
SA5	Falconridge Sanitary Pumping Station Upgrades	2024-2025
SA8	Middle Strasburg Creek Sanitary Sewer Trunks	2022-2024
SA14	Upper Hidden Valley Sewage Facility	2020-2027
SA18	Doon South Sanitary Pumping Station - Forcemain	2026-2028
SA17	Dodge Drive Sanitary Sewer & Road Upgrades	2027-2028

a) “New” Old Mill Pump Station is currently being rebuilt in 2021

This list will be updated with status and timing as the ISAN-MP proceeds to future planning horizon development. In addition, the City of Kitchener Capital Forecast (2020-2029) outlines various planned infrastructure upgrades associated with general Network Remediation and Improvements along with proposed Engineering Capital Projects (Full Reconstruction, New Construction. As part of the ISAN-MP, the status and any revisions to proposed prioritization will be revisited in consultation with Development Services.

Design Criteria Guidelines/Specifications

- City of Kitchener Design Standards & Procedures Manual – Wastewater Pumping Facilities (2003/Updated 2013)
- Region of Waterloo and Area Municipalities Design Guidelines and Supplemental Specifications for Municipal Services (2018)
- City of Kitchener Development Manual Update (2021)
- Region of Waterloo Sewer Use By-Law 21-036 (effective January 1, 2022)

Design guidelines are important references to review to align the ISAN-MP assessment with local and regional expectations and practices. These will be reviewed as part of the ISAN-MP to compare to other jurisdictions and against best practices. Through this process, sensitivity analysis scenarios will be developed and assessed to understand the implications of maintaining the existing assessment and design approach versus other potential approaches.



CITY OF KITCHENER INTEGRATED SANITARY MASTER PLAN – TECHNICAL MEMO #1: BACKGROUND REVIEW

Desktop Review
December 10, 2021

The recommended assessment and design approaches will be used for the existing and future conditions assessments, as well as solution development ISAN-MP supporting tasks.

Cross-Border Agreements (Various)

There are several servicing agreements with the adjacent municipalities as summarized in **Table 2-2**:

Table 2-2: City of Kitchener Cross-Border Agreements

ID	Municipality	Location	Discharge	Maximum Sewage Flow (L/s)	Notes
1	Township of Woolwich	Breslau	Inflow to Kitchener (Victoria PS)	189 L/s	2017 (update). Woolwich allocated 50% of Victoria PS flow capacity.
2		Safety Kleen	Pumped Inflow to Kitchener	38 L/s (2am to 5am)	1991. Private industrial treated wastewater under Grand River to Otterbein (Forwell) PS (connects at JCT-88). Restricted discharge between 2am and 5am. Flow is measured.
3	City of Cambridge	Sportsworld	Outflow to Cambridge	None Reported	2012. Payment to Cambridge based on water consumption. Drainage Area defined. Expires 2032.
4		Conestoga College	Pumped Inflow to Kitchener WWTP	None Reported	2011. Forcemain directly to WWTP.
5	Township of Wilmot	Mannheim Village Estates	Pumped Inflow to Kitchener	7.05 L/s	2015. Measured annually at pump station (max 77 units can be serviced). Discharge to MH311511 (Ottawa St).
6	Region of Waterloo	925 Erb Street West Landfill	Pumped Inflow to Kitchener	30 L/s	2017. Leachate to MH310088. Region measures flow at the Landfill pumping stations.
7	City of Waterloo	Ira Needles (Boardwalk)	Inflow to Kitchener	None Reported	2011. For water, stormwater management and sanitary services.
8		Various Residential	Inflow to Kitchener and Outflow to Waterloo	None Reported	1996. Sewage treatment paid based on water consumption. 34 Kitchener properties to Waterloo; 105 Waterloo properties to Kitchener.
9		Bridgeport North (Falconridge)	Inflow to Kitchener and Pumped Outflow to Waterloo	None Reported	2000. Falconridge PS to Bridgeport PS (Region) to Waterloo system. Kitchener pays for volume treated in Waterloo.
10		Bridgeport PS	Pumped Outflow to Waterloo	None Reported	1996. Kitchener pays servicing fee equal to Regional Treatment Rate for the portion of actual metered sewage flows based on water usage ratio between Waterloo and Kitchener to Bridgeport PS.



CITY OF KITCHENER INTEGRATED SANITARY MASTER PLAN – TECHNICAL MEMO #1: BACKGROUND REVIEW

Desktop Review
December 10, 2021

These agreements will be reviewed and incorporated into the ISAN-MP with any recommendations for modifications or updates.

Region of Waterloo 2018 Wastewater Treatment Master Plan (CIMA+, 2018)

The Wastewater Treatment MP provides assessment details, recommendations, and projected needs for the Region's WWTPs. Some key findings:

- The Kitchener existing (71,840 m³/d) and 2051 (103,150 m³/d) Average Day Flow are within the WWTPs rated capacity of 122,745 m³/d.
- A deviation from the Preston WWTP to the Kitchener WWTP is expected before 2041.
- Neither growth, nor level of treatment upgrades/modifications are identified as necessary for the Kitchener WWTP.
- The operating details of the Kitchener WWTP suggest that trunk hydraulics are not sensitive to the operation of the plant headworks. Data from the Region has been requested, including influent channel drawings and recent SCADA data corresponding with the September 21, 2021 large storm event.

Water Consumption vs Processing Charges

Through the 2022 budget preparation, a comparison of water consumption charges against waste treatment from 2003 to 2020 revealed a 32% delta in average sewage processed versus water sold to Kitchener. This variation can be an indication of significant extraneous flow entering the sanitary collection system, which will be a key focus of the ISAN-MP. Flow monitoring data will be used to help identify areas of the collection system that generate elevated dry weather groundwater infiltration and/or rainfall-derived inflow and infiltration to support a long-term infiltration and inflow (I/I) reduction strategy.

Community Engagement Policy (CoK, 2018)

The City's engagement policy has been reviewed and our team has begun consulting and coordinating with the City representatives for point of contact and public engagement requirements.

It is understood that public consultation is an important component of the ISAN-MP to help ensure concerns and ideas are captured and considered. The ISAN-MP is a process that will recommend a strategy for the CoK Sanitary Utility to continue to provide a high level of service to its customers. For the ISAN-MP to be successful, the plan must be accepted by the community. As such frequent and meaningful engagement activities must be prioritized.

Kitchener Growth Management Plan (CoK, 2019)

The Kitchener Growth Management Plan provides guidance and strategy within the Official Plan to guide growth in the CoK. Informed by overarching Regional and Provincial initiatives, the plan is expected to guide the evolving growth projections and distribution of the growth targets to identified greenfield and intensification areas, in collaboration with the sanitary servicing assessment of the ISAN-MP.



CITY OF KITCHENER INTEGRATED SANITARY MASTER PLAN – TECHNICAL MEMO #1: BACKGROUND REVIEW

Desktop Review
December 10, 2021

Sanitary System Asset Management Plan (CoK, 2018)

The CoK sanitary asset management plan identified that the existing collection system is generally in good shape and relatively new. There are still some older sewers that were identified and the condition of these (and any others of interest) will be considered in the assessment of the collection system performance. The prioritization of upgrade needs and timing must consider the recommendations and findings of the asset management plan to integrate rehabilitation and replacement needs into the ISAN-MP servicing opportunities.

2.2 GEOGRAPHIC INFORMATION SYSTEM (GIS LAYERS)

CoK maintains an enterprise geographic information system (GIS), containing geospatial datasets covering a variety of useful information for the ISAN-MP. The sewer asset geodatabase layers form the basis from which to review and update the City's wastewater hydraulic model network, along with land use, population, address points, geocoded water billing records, and digital elevation model (DEM) data. These sources of information also support the development of supportive mapping that enhance interpretation and the communication of results.

Critical GIS layers received to date from the City and downloaded from Kitchener GeoHub (<https://open-kitchenergis.opendata.arcgis.com/>) for use in the ISAN-MP are described in **Table 2-3**. Other background layers associated with municipal boundaries, address points, buildings, park space, transportation networks (roads, railways), watercourses, and natural heritage features have also been collected. Additional shapefiles that may be deemed useful for the ISAN-MP and/or hydraulic model development will be collected as the need arises.



**CITY OF KITCHENER INTEGRATED SANITARY MASTER PLAN – TECHNICAL MEMO #1:
BACKGROUND REVIEW**

Desktop Review
December 10, 2021

Table 2-3: City of Kitchener Critical GIS Layers

GIS Layer Name	Key Attributes	Intended Use
Sanitary Maintenance Holes (MH)	MH ID Cover elevation Manhole Depth Installation Year	Model review and update/build
Sanitary Pipes	Pipe ID Category Pipe Size Upstream Invert Downstream Invert Pipe Slope Installation Year	Model review and update/build
Sanitary Pumping Stations	Pumping Station Name Pumping Station Location Installation Year	Model review and update/build
Kitchener Growth Management Plan	KGMP Growth District Boundary KGMP Plans Draft Approved KGMP Plans Future Staging KGMP Intensification Areas Existing	Future Growth Areas
Parcels-Persons-Jobs	Category Subcategory Land-Use Description Existing Persons Existing Jobs Existing Persons Jobs	Graphics, model update, flow monitoring characterization, model calibration, future population projections

2.3 POPULATION AND LAND USE

All maps referenced from the City of Kitchener and the Region of Waterloo Official Plans are provided in **Appendix B**.

2.3.1 Land Use

The Region of Waterloo is an upper-tier municipality which encompasses seven local municipalities including the City of Kitchener. The *Regional Official Plan* (ROP, Region of Waterloo, 2015) is the regional guiding document for directing growth and change throughout the Region for the next 20 years and aligning growth with Provincial policies. The plan also implements the main growth goals identified by the Regional Growth Management Strategy. The *City of Kitchener Official Plan* (2014) provides policies to address local issues and characteristics, while aiming to balance the social, economic and environmental



CITY OF KITCHENER INTEGRATED SANITARY MASTER PLAN – TECHNICAL MEMO #1: BACKGROUND REVIEW

Desktop Review
December 10, 2021

interests of the community. The Official Plan must adhere to ROP policies, but also includes local considerations.

Much of the City is identified as a City Urban “built up area” (Kitchener Official Plan, Map 1, see **Appendix B**). An “Urban Growth Centre” is located near the intersections of Victoria Street, King Street and Weber Street which represents the historic city centre or “downtown Kitchener”. Designated Greenfield Areas are located predominately near the Grand River east of Lackner Boulevard and in the southwest portion of the City.

An ROP “Protected Countryside” area is located in southwest Kitchener. Protected Countryside represents a continuous band of environmental features and agricultural lands surrounding the Urban Area designation that is to be permanently protected. Two other “Countryside” areas are shown in Southwest Kitchener. If development will occur in those areas, specific Official Plan policies will apply.

Individual land use descriptions are provided in Map 3 of the City of Kitchener Official Plan and will be reviewed according to the evaluation of alternatives. Natural Heritage features in the Official Plan are discussed in the Natural Heritage Environment Section.

GIS shapefiles of land use, zoning and the Kitchener Growth Management Strategy (KGMS) were provided from the City for use in the study, including the identification of anticipated growth areas, and creation of hydraulic model subcatchments that will be used to confirm sanitary pump station and trunk sewer drainage areas (see next section).

2.3.2 Population Distribution

The existing population distribution is very important to understand and incorporate adequately in the ISAN-MP, under both existing and projected future conditions. The Planning Department provided the Parcels-Persons-Jobs (PPJ) information which represents an estimate of the existing residential and employment equivalent populations distributed at the parcel level, considering the land use and zoning of the underlying parcels. The data provided is the best available data for use in the ISAN-MP, recognizing it is an estimate based on unit counts and zoning at the time of definition (October 2021), with less confidence in the employment values given the inherent uncertainty associated with the nature and variable location of the workforce.

This information is a solid foundation for use in the update to the hydraulic model subcatchment development. Population data is used to characterize the spatial distribution of sewage flow generation in the hydraulic model, is used in model calibration to corroborate monitored per capita sewer flow generation rates as compared against water consumption data, and is the basis for projecting future flows and capacity constraints in the system from which the ISAN-MP sanitary servicing recommendations are established.



Desktop Review
December 10, 2021

2.4 NATURAL HERITAGE ENVIRONMENT

A review of existing environmental conditions is undertaken during the Master Plan/Class EA process in order to help inform the development and evaluation of alternative solutions. This includes the existing socio-economic environment, natural heritage and cultural heritage environments, in addition to technical reviews and modeling of the wastewater infrastructure systems.

2.4.1 Archaeological Resources

It is a requirement under the Municipal Class EA planning process to consider archaeological resources through the evaluation of alternative solutions. Much of the study area may retain archaeological potential; however, the extent of this potential is currently unknown. The *Region of Waterloo Archaeology Facilities Master Plan* (1989) provides a Regional-level scan of archaeology potential. The document will be reviewed once alternatives are identified to consider the proximity of potential projects to areas of archaeology potential. Recommendations for further archaeological assessment will be made upon the identification of project study areas, with reference to the Ministry of Heritage, Sport, Tourism, and Culture Industries' (MHSTCI) *Criteria for Evaluating Archaeological Potential checklist*.

2.4.2 Built Cultural Heritage and Cultural Heritage Landscapes

It is also a requirement under the Municipal Class EA planning process to consider cultural heritage resources through the evaluation of alternative solutions. The City has a rich and diverse cultural history seen through its Built Cultural Heritage Resources, and a number of Cultural Heritage Landscapes, some of which have been identified on the City's Municipal Register of Cultural Heritage Properties. The City of Kitchener Municipal Heritage Register includes Part IV (individually designated properties), Part V (heritage conservation district) properties, and Municipal Heritage Register- listed properties. The City of Kitchener *Cultural Heritage Landscapes (CHL) study* (2014) identified 55 Cultural Heritage Landscapes identified in Appendix D of the CHL report. Of these, the plan identifies specific parks and open areas, cemeteries, transportation corridors, heritage estates, neighbourhoods, and other properties such as commercial and industrial sites with historic interest among them.

The City of Kitchener Official Plan includes a Cultural Heritage Resources Map (Map 9) which identifies four Heritage Conservation Districts (HCD) primarily near the city centre. Heritage Corridors are located between HCDs which provide linkages. The Grand River is identified as a Canadian Heritage River and Cultural Heritage Landscapes are also identified on the map at six properties throughout the city.

These reports and plans will be reviewed once alternatives are identified to consider the proximity of projects to areas of identified cultural heritage resources. Upon the identification of project study areas, screening of potential cultural heritage resources will be undertaken, with reference to the MHSTCI's *Criteria for evaluating potential for Built Heritage Resources and Cultural Heritage Landscapes*. Recommendations for further study will be made based on the cultural heritage screening results.



CITY OF KITCHENER INTEGRATED SANITARY MASTER PLAN – TECHNICAL MEMO #1: BACKGROUND REVIEW

Desktop Review
December 10, 2021

2.4.3 Natural Heritage

The City of Kitchener municipal boundaries are located within the Natural Heritage System (NHS) included in the ROP. The City of Kitchener Official Plan (2014) must adhere to Regional and local land use policies including the NHS. NHS features are defined as “Landscape Level Systems”, “Core Environmental Features” and “Supporting Environmental Features”, and the linkages between them as components of the Greenland Network. (ROP, Chapter 7 and Map 4). These are defined below with respect to the City of Kitchener.

While the policies do not always preclude development in these areas, they are intended to protect them from adverse impacts of development by allowing limited, compatible forms of development.

2.4.3.1 Significant Natural Areas

Landscape Level Systems consist of Significant Valleylands, Environmentally Sensitive Landscapes, Provincial Greenbelt Natural Heritage System, Regional Recharge Areas, and the Southwest Kitchener Policy Area, as illustrated on the ROP Map 4.

Significant Valleylands are primarily located along the Grand River, as shown on ROP Map 4. A Regional Recharge area and the Southwest Kitchener Policy Area are located in the southwest of the City of Kitchener. There are no Provincial Greenbelt Natural Heritage System features in the City of Kitchener.

The CoK Official Plan Land Use Descriptions (Map 3) and the Natural Heritage System (Map 6) identifies “Landscape Level Systems” such as significant valleys, environmental sensitive landscapes, as well as “Kitchener Core Environmental Features”.

Core Natural Heritage features are predominately along the Grand River and areas such as ravines and other valleylands. Region Core Environmental Features are also shown in areas of the city associated with woodlots and watercourses.

Significant Wildlife Habitat areas and Significant Landforms are illustrated on Map 6. Areas of significant wildlife habitat are located near the Sportsworld Drive interchange in south Kitchener and to the west of Homer Watson Boulevard near Highway 401, Doon Valley, and along the Grand River. Ecological Restoration Areas are identified along watercourses, most of which are the central portions of the city associated with watercourses.

A portion of the southwest of the City is identified as “Protected Countryside” and “Prime Agricultural Area” (ROP, Map 7 and Map 7a). An area of Prime Agricultural Land is located in the Southwest of the City of Kitchener boundaries. The Official Plan map notes that the “exact location of Countryside Line” is yet to be determined. A portion of Countryside is located in the Southwest of the CoK boundaries. Protected Countryside is defined in the Land Use section.



CITY OF KITCHENER INTEGRATED SANITARY MASTER PLAN – TECHNICAL MEMO #1: BACKGROUND REVIEW

Desktop Review
December 10, 2021

2.4.3.2 Source Water Protection

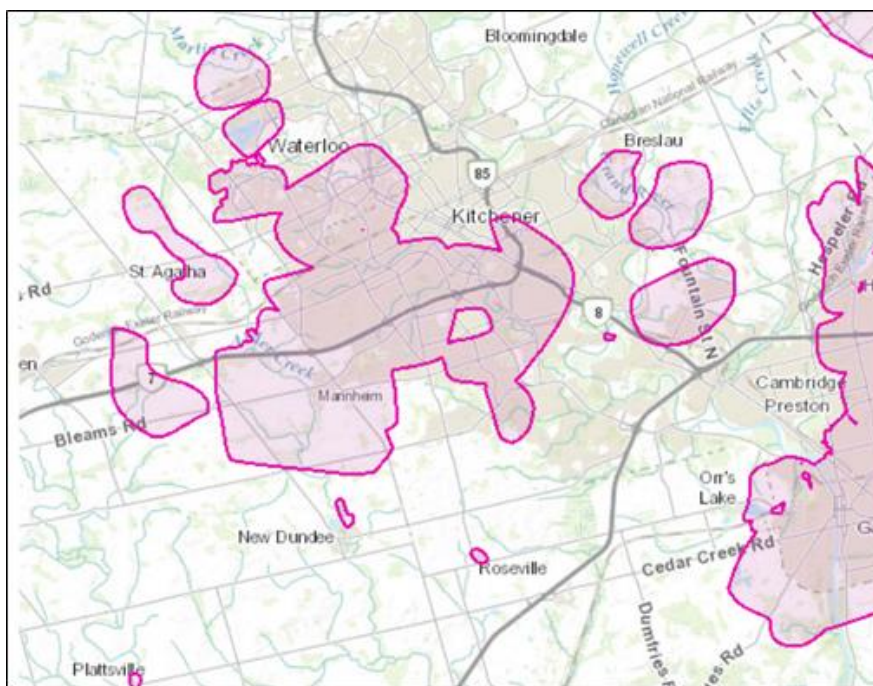
Source Water Protection areas for the City of Kitchener are identified in the ROP (Maps 6a, 6f, 6g) and Map 8 of the Kitchener Official Plan.

- Surface Water Intake Protection Zones are located in the southwest of the City of Kitchener, primarily encompassing the area between Fairway Road and the Grand River.
- Wellhead Protection Sensitivity Areas are associated with wells in the City of Kitchener. Municipal Wells are located along the Grand River east of Lackner Boulevard, near the Fairway Road North Bridge over the Grand River. Most other wells are located West of King Street near Westmount Road, Fairview Road/Manitou Drive, east of Huron Road, and near Ottawa Street and the Conestoga Parkway.
- A Southwest Kitchener Policy Area is included near Fischer Hallman Road and New Dundee Road which will include a Regional Recharge area with borders to be determined.

The Grand River Source Protection Plan also applies to the study area. In accordance with Ontario's *Clean Water Act (CWA)*, the Region of Waterloo has enacted policies through the Grand River Source Protection Plan (SPP) to protect groundwater sources within the Region. An update of the Grand River SPP came into effect February 3, 2021. The SPP policies work to reduce risk by regulating proposed and existing activities which have been identified as posing significant threats to drinking water safety. Depending on the hydrology and geology of an area, as well as potential risks posed by activities onsite, different policies under the SPP may apply to the Study Area.

Figure 2-1 identifies an excerpt from the Grand River Source Protection Plan policy mapping tool. The tool identifies groundwater sensitive areas predominately along the Grand River and in the west and southwest of the City.

Figure 2-1: Grand River Source Protection Policy Viewer Extract (groundwater)



CITY OF KITCHENER INTEGRATED SANITARY MASTER PLAN – TECHNICAL MEMO #1: BACKGROUND REVIEW

Desktop Review
December 10, 2021

2.5 SANITARY SEWER NETWORK

The City's sewer asset GIS data (see **Section 2.2**) for the sanitary sewer collection system infrastructure was downloaded from the City's Open Data website and is considered representative to July 2021, which is the basis of the ISAN-MP. Relevant information includes pipe geometry such as size, invert, length, and slope, as well as material, construction date, etc. The information available from the collection system shapefiles (line and point) form the basis for the model network development. The following sections summarize the data that was extracted from the provided shapefiles, the initial data quality check, and pertinent assumptions. **Figure 2-2** provides an overview of the sanitary sewer system within the City boundary.

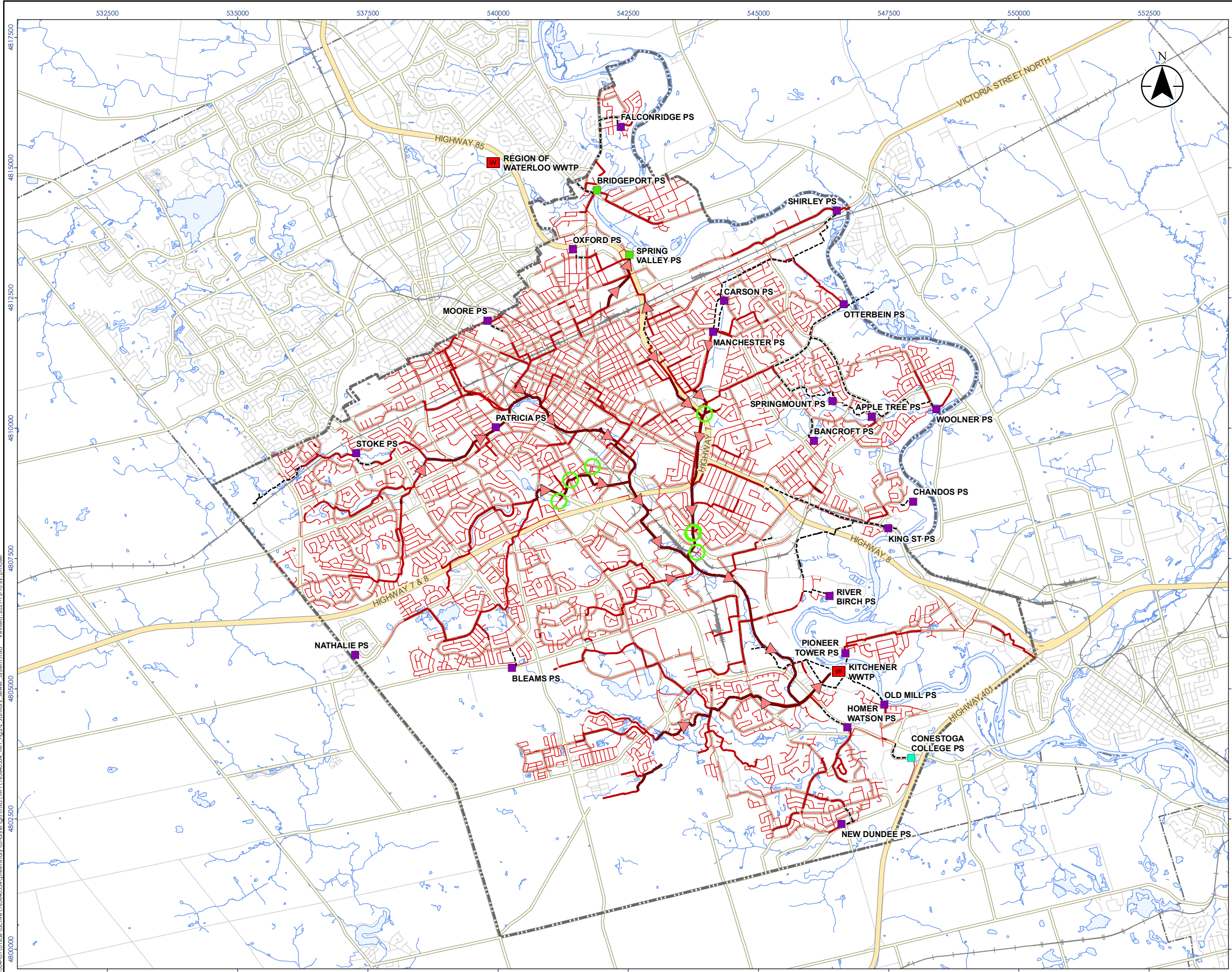
2.5.1 Sanitary Sewer Inventory

The sanitary sewer material inventory distribution is summarized in **Table 2-4** and shows that over 45% is composed of polyvinyl chloride (PVC) pipe. The remainder is split amongst several pipe materials, including asbestos cement (AC), Vitrified Clay Pipe (VCP), Concrete Pipe, non-reinforced (CP), etc. Approximately 0.4% of the piping material is unknown. This information can support decision-making on ISAN-MP pipe replacement and hydraulic model roughness values.

Table 2-4: Sanitary Sewer Material Distribution

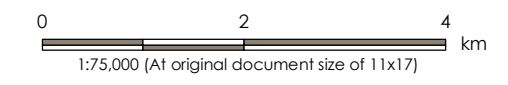
Material	Length (km)	Percentage
Polyvinyl Chloride (PVC)	417.13	48.78%
Asbestos Cement (AC)	213.40	24.96%
Vitrified Clay Pipe (VCP)	112.08	13.11%
Concrete Pipe, non-reinforced (CP)	83.89	9.81%
High Density Polyethylene (HDPE)	10.21	1.19%
Polypropylene (PE)	5.59	0.65%
Reinforced Concrete Pipe (RCP)	7.70	0.90%
Ductile Iron Pipe (DIP)	1.24	0.15%
Steel Pipe (SP)	0.13	0.01%
Corrugated Metal Pipe (CMP)	0.08	0.01%
Unknown	3.70	0.43%
Total	855.14	100%



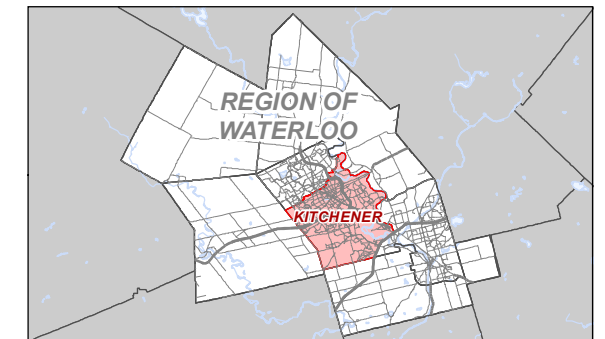


Legend

- Wastewater Treatment Plant
- Sanitary Pumping Station (City of Kitchener)
- Sanitary Pumping Station (Region of Waterloo)
- Sanitary Pumping Station (Other)
- ▶ Flow Direction
- Syphon Pipe
- Forcemain
- Sanitary Sewer (Diameter)**
- 825 - 2250 mm
- 375 - 750 mm
- 100 - 300 mm
- Expressway / Highway
- Major Road
- Minor Road
- Railway
- Watercourse
- Waterbody
- City of Kitchener Boundary
- Other Municipal Boundary



- Notes**
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 City of Kitchener
 Prepared by PRM on 2021-12-10
 Technical Review by FB on 2021-12-10

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Figure No.

2-2

Title

Sanitary Sewer System

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 Revised: 2021-12-10 By: pmoser
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 4805000
 4807500
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 4812500
 4815000
 4817500

**CITY OF KITCHENER INTEGRATED SANITARY MASTER PLAN – TECHNICAL MEMO #1:
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Desktop Review
December 10, 2021

Table 2-5 provides the distribution of pipe network in the asset data, which indicates that the City’s sanitary sewer system is primarily gravity-based. There are approximately 818 km of gravity sanitary sewers within the study area, with pipe diameters ranging from 100 mm to 2250 mm. Over 85% of the sanitary system has pipe diameters of 450 mm or less. There is very little length of siphon, but several forcemains associated with the number of pump stations in the system (see **Section 2.5.3**).

Table 2-5: Sanitary Sewer Diameter Inventory and Distribution

Diameter (mm)	Length (m)					
	Gravity	Force-main	Stub	Siphon	Total	%
D<200	3,143	1,944	-	81	6,393	0.7%
200<=D<250	430,214	2,439	97	182	432,933	50.6%
250<=D<350	255,434	4,024	12	37	259,507	30.3%
350<=D<450	43,014	18,305	-	18	63,338	7.4%
450<=D<850	61,943	6,103	-	41	68,087	8.0%
850<=D<1050	5,998	-	-	-	5,998	0.7%
1050<=D<1650	13,454	-	-	-	13,454	1.6%
D>=1650	5,429	-	-	-	5,429	0.6%
Total Length	818,628	32,816	109	360	855,138	100%

Table 2-6 presents the sewers by year of installation, based on attribute “Installati”, indicating 3% of sewers as over 70 years in the ground. Almost 50% of the sewers have been built in the last 30 years.

Table 2-6: Sanitary Sewer Age Distribution

Year of Construction	Count	Percentage
Pre 1930	100	0.7%
1930-1939	142	1.0%
1940-1949	181	1.3%
1950-1959	1,139	8.2%
1960-1969	1,673	12.0%
1970-1979	2,018	14.5%
1980-1989	1,731	12.5%
1990-1999	1,681	12.1%
2000-2009	2,666	19.2%
2010-2019	2,447	17.6%
2020-2021	107	0.8%
Total	13,880	100%



**CITY OF KITCHENER INTEGRATED SANITARY MASTER PLAN – TECHNICAL MEMO #1:
BACKGROUND REVIEW**

Desktop Review
December 10, 2021

A data gap analysis was performed on the GIS data. A summary review of missing pipe diameter, pipe slope, and pipe length (e.g., zero or negative diameter and length, etc.) are presented in **Table 2-7** and shown and **Figure 2-3**. A thorough review was also conducted to identify potential errors in the data by assessing extreme values such as pipe invert elevation higher than 500 m or less than 200 m, and pipe dimensions that did not appear to be consistent with adjoining pipes. Data gaps were addressed partially through additional data received from the City and using engineering judgment. This process will be further presented and elaborated on in **TM2B: Modelling Plan**.

Table 2-7: Sewer Data Gap Analysis Summary

Sewer Characteristic	Number of Missing or Outlier Values	Percent of Total (13,973 sewer segments)
Upstream Invert (only)	178	1.2%
Downstream Invert (only)	213	1.5%
Upstream and Downstream Inverts	638	4.6%
Length	10	0.07%
Slope	758	5.4%
Diameter	6	0.04%

The database is generally complete, meaning there are few gaps or zeros in critical attributes. TM2 will address the continuity of sewer profiles and connectivity that may result from input errors in the GIS data.

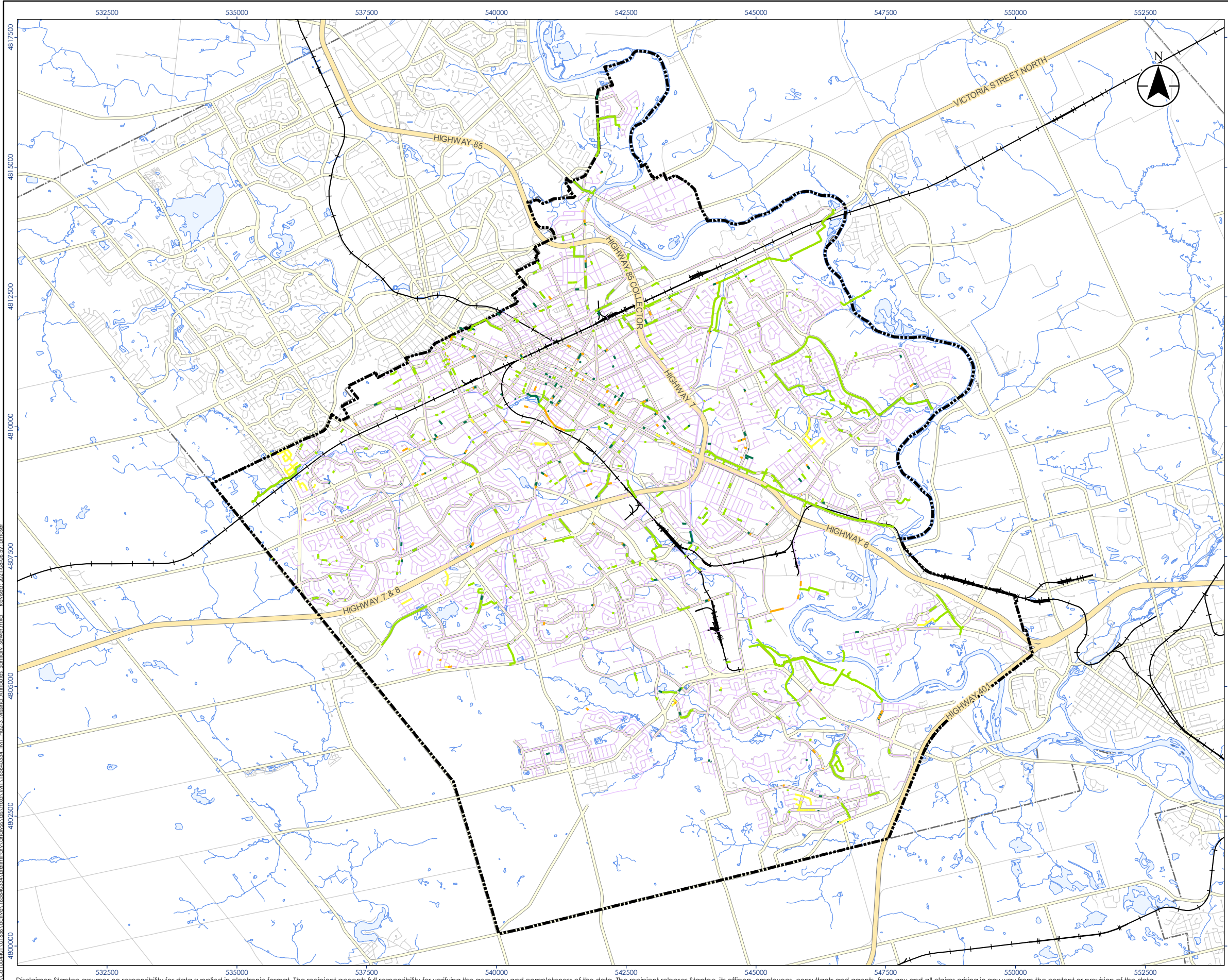
2.5.2 MH Junctions Inventory

The study area contains a total of 12,683 MH junctions based on the downloaded GIS data. Over 7% of the ground elevations were missing from the supplied data and will have to be inferred from the LiDAR data that we understand will be provided by the City. The missing depth (around 9% missing) and invert information will be inferred from the rim elevations and invert pipe elevations. A summary of gap analysis for sanitary manholes can be found in **Table 2-8**. The location of the identified MHs with missing ground elevation and missing depth is shown in **Figure 2-4**.

Table 2-8: Junction (MH) Data Gap Analysis Summary

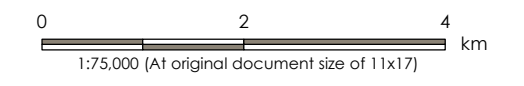
MH Characteristic	Number of Missing or Outlier Values	% Missing MH Junctions (Total 12,683)
Ground Elevation	976	7.7%
Depth	1,129	8.9%





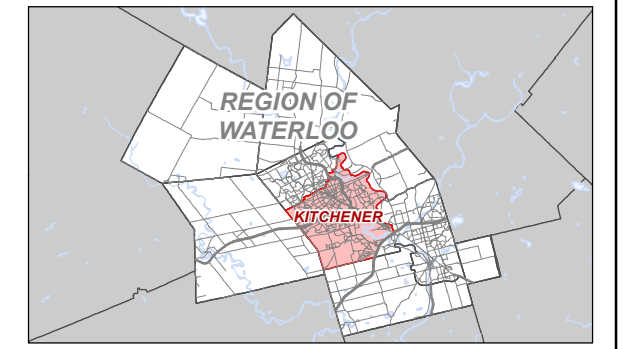
Legend

- City of Kitchener Boundary
- Sanitary Sewer
- Missing Slope (758)
- Missing U/S Invert (178)
- Missing Pipe Length (10)
- Missing Pipe Diameter (6)
- Missing D/S Invert (213)
- Missing U/S and D/S Invert (638)
- Expressway / Highway
- Major Road
- Minor Road
- Railway
- Watercourse
- Waterbody
- Municipal Boundary



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Figure No.

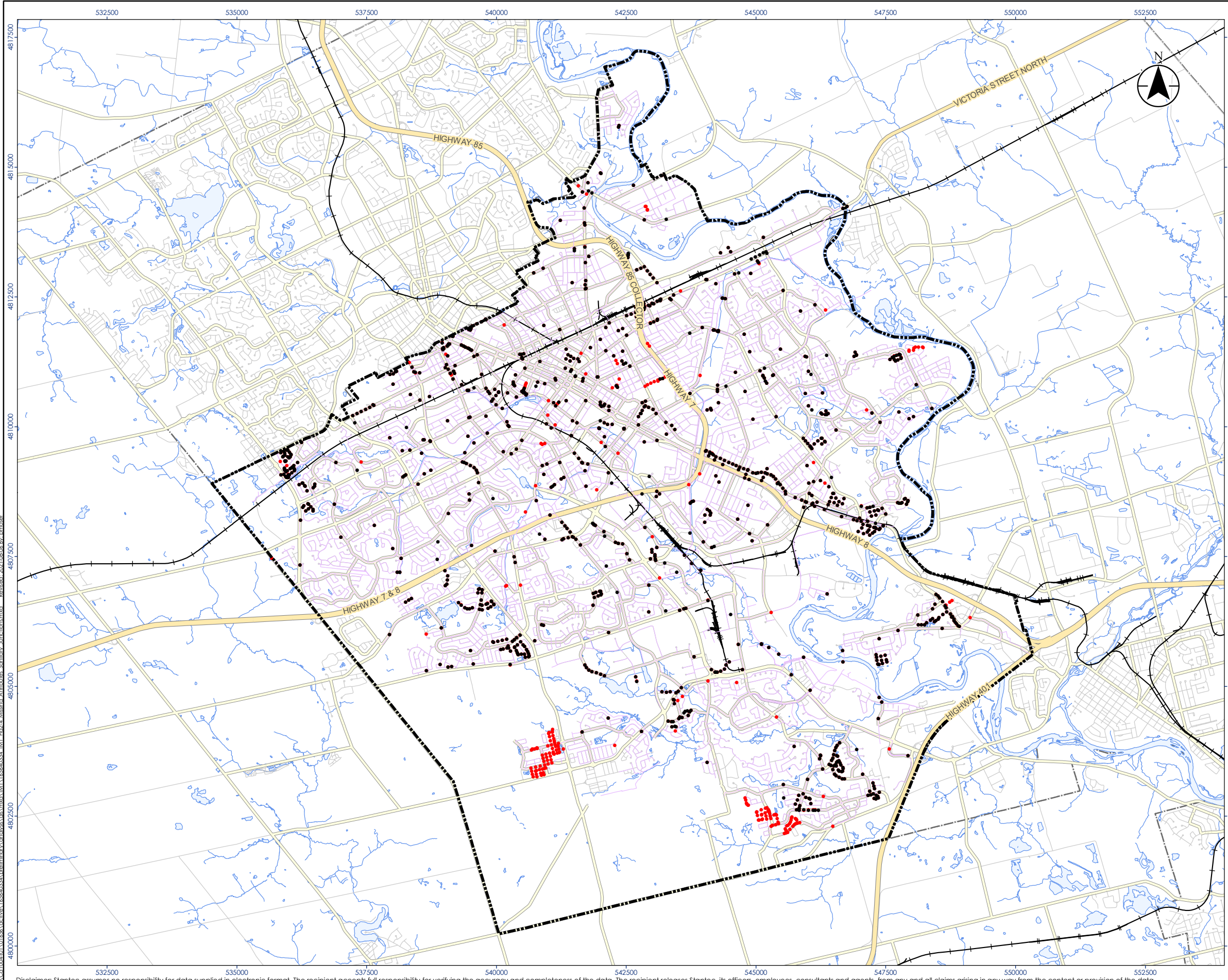
2-3

Title

**Missing Attributes in the Sanitary Sewer
 GIS Database**

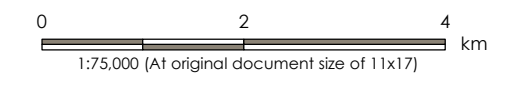
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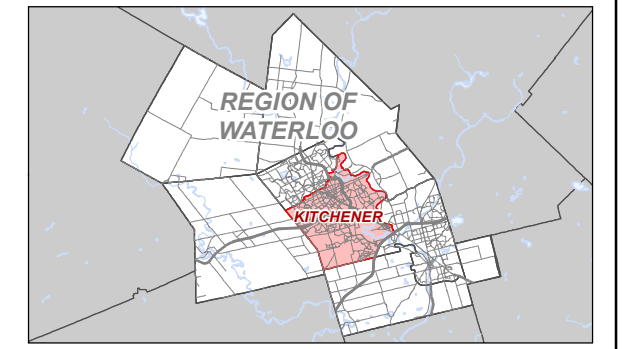
Legend

- City of Kitchener Boundary
- Missing Ground Elevation (976)
- Missing MHs Depth (1129)
- Sanitary Sewer
- Expressway / Highway
- Major Road
- Minor Road
- Railway
- Watercourse
- Waterbody
- Municipal Boundary



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Figure No.

2-4

Title

Missing Attributes in the Sanitary Junction GIS Database

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BACKGROUND REVIEW**

Desktop Review
December 10, 2021

2.5.3 Pump Stations

The pump station assessment reports include wet well diameter, depth, pump start and stop levels, pump station draw down test data and other relevant information. Pump station assessment reports are available and updated (2020/2021) for 20 of 26 pump stations, and the 2012-2013 are available for 5 locations. The location and ownership of the pump stations is shown in **Figure 2-2**.

Table 2-9: Pump Station Assessment Report Availability & Status

PS No.	Name	Ownership	Report Year	Notes
01	Bleams	Kitchener	2012	Being Decommissioned
02	Nathalie	Kitchener	2022	Proposed
-	Manheim	Township of Wilmot	2012	
03	Stoke	Kitchener	2020	
04	Patricia	Kitchener	2021	
05	Moore	Kitchener	2021	Considering Decommissioning
06	Oxford	Kitchener	2020	
08	Falconridge	Kitchener	2020	Formerly Melitzer
09	Shirley	Kitchener	2012	Includes Breslau SPS
10	Carson	Kitchener	2021	
11	Manchester	Kitchener	2021	
12	Otterbein	Kitchener	2021	
13	Springmount	Kitchener	2021	
14	Bancroft	Kitchener	2020	
15	Apple Tree	Kitchener	2020	
16	Woolner Trail	Kitchener	2021	Formerly Zeller and Grand River South
17	Chandos	Kitchener	2021	
18	King St	Kitchener	2020	Formerly Freeport
19	River Birch	Kitchener	2021	
20	Pioneer Tower	Kitchener	2021	
21	Old Mill	Kitchener	-	Being Rebuilt in 2021
22	Homer Watson	Kitchener	2021	
24	New Dundee	Kitchener	2021	Formerly Doon South
-	Spring Valley	Region of Waterloo	2013	
-	Bridgeport	Region of Waterloo	2013	
PS No. carried forward from previous modelling reports				



CITY OF KITCHENER INTEGRATED SANITARY MASTER PLAN – TECHNICAL MEMO #1: BACKGROUND REVIEW

Desktop Review
December 10, 2021

2.5.4 Hydraulic Model

The City maintains a hydraulic model of its wastewater collection system. It was initially developed using InfoSWMM during the City-wide Sanitary System Capacity Study (AECOM, 2011). In 2019 the City updated this model using 2016 sewer flow monitoring data. This most recent model will be reviewed in detail and act as the starting point in the revision and update of the modelling tool for use in this ISAN-MP. The findings of our model review are provided in deliverables in support of **Task 2: Hydraulic Analysis**:

TM #2a: Model Assessment and Software Recommendations

TM #2b: Modelling Plan

2.6 FLOW MONITORING AND RAIN GAUGE DATA

The City has undertaken multiple flow monitoring activities over the years since the last hydraulic model calibration in 2019. The historic monitoring data is further reviewed as part of the 2021 flow monitoring program development, presented in **Appendix C**.

2.6.1 2016 Monitoring Program

The 2016 temporary monitoring program was undertaken and consisted of the installation of 15 temporary flow monitors and 5 rain gauges for over a three-month period. The purpose of the monitoring program was to support the calibration of the City's sanitary hydraulic InfoSWMM model.

2.6.2 Monitoring Activities 2017 – 2020

Details of the flow monitoring programs from 2017 to 2020 are provided in **Table 2-10** including monitoring site name, maintenance hole ID, starting date, ending date, pipe size and the general purpose of installation. The main purposes for the flow monitoring programs were monitoring sanitary pipe and trunk sewer capacity in support of development reviews, inflow and infiltration (I &I) Investigations, and some pump station studies. The overall monitoring periods were around 6 to 8 months and the monitoring pipe diameters range from 200 mm to 1200 mm.



**CITY OF KITCHENER INTEGRATED SANITARY MASTER PLAN – TECHNICAL MEMO #1:
BACKGROUND REVIEW**

Desktop Review
December 10, 2021

Table 2-10: Flow Monitoring Program Summary (2017-2020)

Program	Site Name	MH_ID	Start Date	End Date	Dia (mm)	Purpose
2017 Spring	24 WabanakiDr_ MH303002	303002	3/30/2017	10/26/2017	700	Seasonal/Annual
2017 Spring	26 PioneerDr_ MH303091	303091	3/29/2017	11/2/2017	250	Seasonal/Annual
2017 Spring	27 PioneerDr_ MH303092	303092	3/29/2017	11/2/2017	1200	Seasonal/Annual
2017 Spring	28 BiehnDr_ MH303724	303724	3/29/2017	11/2/2017	600	Seasonal/ Annual
2017 Spring	29 BalzerRd_ MH300575	300575	3/30/2017	10/26/2017	750	Seasonal/ Annual
2017 Dev	31 OttawaStN_ MH301627	301627	4/27/2017	8/10/2017	675	Development
2017 Dev	32 GraberPlace_ MH307722	307722	4/21/2017	9/19/2017	900	Development
2018 Spring	34 OttawaStN_ MH307731	307731	5/24/2018	NA	825	Trunk sewers
2018 Spring	35 GraberPl_ MH301193	301193	5/24/2018	12/12/2018	675	Trunk sewers
2018 Spring	36 SheldonAveN_ MH300990	300990	5/24/2018	12/5/2018	825	Trunk sewers
2018 Spring	37 ShelleyDr_ MH300300	300300	5/25/2018	12/5/2018	750	Trunk sewers
2018 Spring	38 ConnaughtPl_ MH300194	300194	5/25/2018	12/12/2018	450	Trunk sewers
2018 Spring	39 ConnaughtPl_ MH300190	300190	5/25/2018	11/29/2018	375	Trunk sewers
Activa/David Bergey	40 ActivaAve_ MH311440	311440	9/6/2018	10/16/2018	525	Development
Falconridge Investigation	41 SchneiderCreek East_ MH300583	300583	2/1/2019	6/11/2019	1200	Trunk sewers
Falconridge Investigation	43 FalconridgeDr_ San-311719	311719	2/28/2019	7/28/2019	375	Trunk sewers
Hidden Valley PS	44 MH2000145 (Flume)	2000145	5/23/2019	11/24/2019	200	Pumping station study
Hidden Valley PS	45 MH2000155 (Flume)	2000155	5/23/2019	11/24/2019	200	Pumping station study
Hidden Valley PS	47 MH300045	300045	5/23/2019	11/24/2019	375	Pumping station study
Design & Approval	49 Isaiah_ MH312813	312813	6/20/2019	10/20/2019	300	I & I Investigation



CITY OF KITCHENER INTEGRATED SANITARY MASTER PLAN – TECHNICAL MEMO #1: BACKGROUND REVIEW

Desktop Review
December 10, 2021

Program	Site Name	MH_ID	Start Date	End Date	Dia (mm)	Purpose
Design & Approval	50 Blears_MH312371	312371	6/20/2019	10/20/2019	250	I & I Investigation
2019 PS Capacity	51 WoolnerTrail_MH2001531	2001531	7/4/2019	10/5/2019	360	Pumping station study
2019 PS Capacity	52 PioneerTower_MH311079	311079	7/4/2019	10/5/2019	450	Pumping station study
Kingsway 2020	53 KingswayDr_MH300530	300530	2/5/2020	5/5/2020	300	Development
Kingsway 2020	54 FairwayRdS_MH300121	300121	2/5/2020	5/5/2020	450	Development
Kingsway 2020	55 CedarwoodsCres_MH300527	300527	2/19/2020	5/19/2020	250	Development
Kingsway 2020	56 GreenfieldAve_MH300542	300542	2/19/2020	5/19/2020	250	Development
Kingsway 2020	57 WilsonAve_MH300089	300089	2/18/2020	5/18/2020	250	Development
Kingsway 2020	58 KingswayDr_MH300540	300540	2/18/2020	5/18/2020	300	Development
Penelope 2020	59 PenelopeDr_MH309786	309786	2/18/2020	5/18/2020	200	Development
Penelope 2020	60 PenelopeDr_MH309637	309637	2/18/2020	5/18/2020	200	Development

2.6.3 Rainfall Data

Two (2) permanent rain gauges are located at City Hall and at the Kitchener Operations Facility. The locations of the two existing rain gauges are presented in **Figure 2-5**. The distance between the two sites is around 6.2 km. Additional permanent rain gauge installations external to the City are also presented, including the University of Waterloo, Waterloo International Airport, and two Grand River Conservation Authority (GRCA) weather stations. This data will be reviewed for applicability in terms of location, measured timestep, and ease of data retrieval as part of the calibration process.

A preliminary review of available data from these gauges was completed to evaluate the suitability of the rain data for use in hydraulic model re-calibration and assessment efforts through the ISAN-MP. There are many missing rainfall records in 2020, and thus has been excluded from this initial review. **Figure 2-6** shows the cumulative rainfall at two selected sites per each year from 2016 to 2019. The result indicates the total rainfall volumes have differences in 2016, 2017, 2018, and 2019 and the percentage difference ranged from -6.5% to +14.1%.

Rainfall events were subsequently identified and characterized based on a twelve-hour inter-event time. For the purposes of this ISAN-MP, a significant rainfall event was classified as any event with total depth greater than 10 mm in less than 12 hours. **Table 2-11** presents a summary of collected rain events from



**CITY OF KITCHENER INTEGRATED SANITARY MASTER PLAN – TECHNICAL MEMO #1:
BACKGROUND REVIEW**

Desktop Review
December 10, 2021

2017 and 2019 at the two rain gauge locations. These two years showed the greatest relative difference between rain gauge locations and were thus selected for further analysis.

Table 2-11: Recent Significant Rainfall Event Comparison

Location	Event #	Begin	End	Total Depth (mm)	Duration (hours)	Average Intensity (mm/hr)
Kitchener Operations Facility	1	4/5/2017 23:25	4/7/2017 2:00	20.4	26.7	0.77
	2	4/20/2017 7:50	4/21/2017 10:00	25.6	26.3	0.98
	3	6/22/2017 9:05	6/23/2017 10:30	27.6	25.5	1.08
	4	7/16/2017 12:05	7/17/2017 1:50	21.2	13.8	1.53
	5	9/4/2017 16:35	9/4/2017 20:35	11.8	4.1	2.89
	6	4/18/2019 17:40	4/20/2019 15:25	30.0	45.8	0.65
	7	5/25/2019 5:15	5/25/2019 17:15	31.0	12.1	2.57
	8	7/15/2019 23:45	7/17/2019 9:05	26.4	33.4	0.79
	9	10/1/2019 14:30	10/4/2019 0:45	33.8	58.3	0.58
	10	10/30/2019 10:55	11/1/2019 2:35	35.4	39.7	0.89
City Hall	1	4/5/2017 20:40	4/7/2017 15:15	41.0	42.7	0.96
	2	4/20/2017 7:45	4/21/2017 9:25	30.8	25.7	1.20
	3	6/22/2017 9:05	6/23/2017 9:40	27.8	24.6	1.13
	4	7/16/2017 11:55	7/17/2017 1:20	26.4	13.5	1.96
	5	9/4/2017 15:40	9/4/2017 19:25	19.4	3.8	5.06
	6	4/18/2019 17:25	4/20/2019 14:50	42.4	45.5	0.93
	7	5/25/2019 4:35	5/25/2019 15:35	26.0	11.1	2.35
	8	7/16/2019 11:55	7/17/2019 14:50	17.4	27.0	0.64
	9	10/1/2019 13:45	10/4/2019 0:50	41.0	59.2	0.69
	10	10/30/2019 8:40	11/1/2019 2:40	47.0	42.1	1.12

The total depth, duration and average intensity can be significantly different between two sites, given the spatial variability of storm cells across the geography and topography the scale of Kitchener. As the ISAN-MP hydraulic modeling tasks include model calibration to a range of wet weather events, a high level of confidence in the spatial distribution of the rainfall data is required in order to reduce uncertainty associated with variable storm volume, intensity and duration, and its impacts on wet weather flow generation in the collection system. The proposed 2021 flow monitoring program in Section 3 and **Appendix C** considers this further.



CITY OF KITCHENER INTEGRATED SANITARY MASTER PLAN – TECHNICAL MEMO #1: BACKGROUND REVIEW

Desktop Review
December 10, 2021

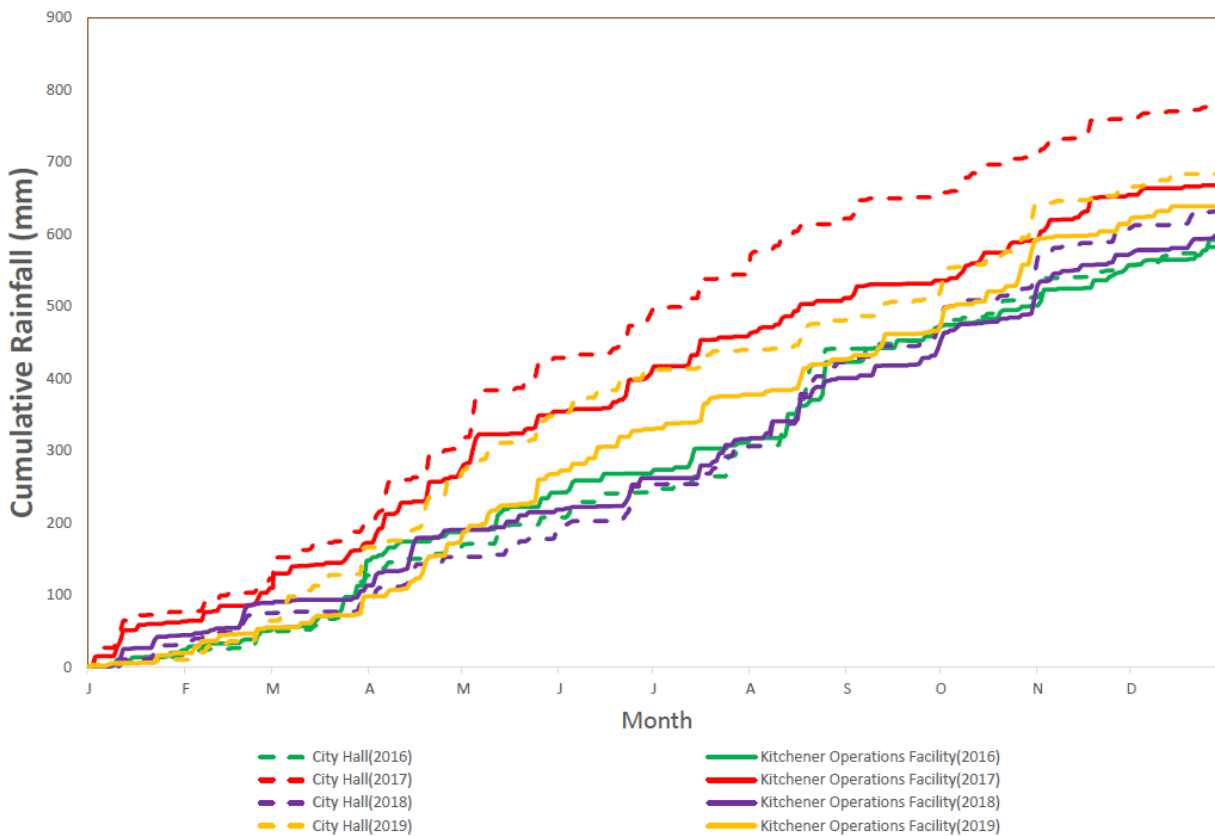


Figure 2-6: Cumulative Rainfall Data (2016-2019)



CITY OF KITCHENER INTEGRATED SANITARY MASTER PLAN – TECHNICAL MEMO #1: BACKGROUND REVIEW

2021 Flow Monitoring Plan
December 10, 2021

3.0 2021 FLOW MONITORING PLAN

One of the most important components of Task 1 of the ISAN-MP is the early review of the available rainfall and flow monitoring data. In conjunction with our review of the previously document model builds and calibration findings, this review allows us to generate an informed flow monitoring plan to enhance the understanding of the City's wastewater collection system response and performance.

There are several considerations that were factored into the development of the 2021 monitoring plan:

- Previous Model Calibration Monitor Locations
- Previous Model Calibration Performance
- Existing Model Capacity Results
- Recent Monitoring Locations Since 2016
- Recent and Anticipated Growth Areas
- Changes in Sewer Network Since 2016
- Maximizing Coverage in Common Time Frames
- Rainfall Data Availability
- Uncertainty Associated with COVID-19 Influence

The finalized **2021 Flow Monitoring Plan** is provided in **Appendix C**.

3.1 OBJECTIVE

A rainfall and flow monitoring program is required to enhance model confidence and to perform model recalibration with more recent data, for use in the Master Planning process. The Master Plan model will set the stage for future modeling activities; however, the focus of this exercise is to develop a tool for the purposes of long-term capital planning, considering the growth and capacity drivers of the City. Monitoring data will also be of use for characterizing the systems dry and wet weather responses, enabling relative comparison for elevated extraneous flow (dry weather groundwater infiltration, rainfall-induced infiltration and inflow).



APPENDICES

**CITY OF KITCHENER INTEGRATED SANITARY MASTER PLAN – TECHNICAL MEMO #1:
BACKGROUND REVIEW**

Appendix A Background Document Review
December 10, 2021

Appendix A BACKGROUND DOCUMENT REVIEW



CITY OF KITCHENER INTEGRATED SANITARY MASTER PLAN – TECHNICAL MEMO #1: BACKGROUND REVIEW

Appendix A Background Document Review
December 10, 2021

Report Title	Key Points / Summary / Purpose	ISAN-MP Application
Sanitary Sewer Related Documents		
City of Kitchener Sanitary Sewer System Model Update, December 12, 2019	<ul style="list-style-type: none"> • Provided an updated and calibrated existing City-wide sanitary sewer model. • Capacity assessments under current and future build-out conditions were completed. • Supported by a 15 site 3 month long monitoring program (5 rain gauges). • The existing sanitary sewer system generally demonstrated sufficient capacity to accommodate flows up to 100% of the Kitchener Growth Management Strategy (KGMS) anticipated growth scenario. • Recommendations included: (a) Manhole and pumping station survey programs to collect missing, incomplete, or inaccurate data (B) Permanent flow monitoring in the areas with high inflow and infiltration and limited capacity. (C) Model updating methodology (D) Accurate and reliable SCADA flow data was recommended for updated pumping capacity evaluations 	<ul style="list-style-type: none"> • Task 1: The existing model, available flow/rainfall monitoring data, Pump Station SCADA, GIS layers • Task 2b: Model review: InfoSWMM • Task 2c: Modeling validation with new flow monitoring data. • Task 3a – Existing and Future Population, Employment and Land Use and Servicing Implications/Analysis
City of Kitchener City-wide Sanitary Sewer System Capacity Study, February 14, 2011	<ul style="list-style-type: none"> • Evaluate available capacity within the existing sanitary sewer network • A hydraulic model (InfoSWMM) of the sanitary collection system was developed. • Calibration considered 17 temporary sewer flow monitors and the City’s SCADA data. • 18 specific locations were identified where capacity concerns may restrict future growth within the City. • The report recommended the City carry out a comprehensive program of asset surveys to gather missing information and additional flow monitoring to further recalibrate the model. 	<ul style="list-style-type: none"> • Task 1: the existing model, available flow/rainfall monitoring data, Pump Station SCADA, GIS layers • Task 2b: Model review- InfoSWMM • Task 2c: Modeling validation for new flow monitoring data. • Task 3a – Existing and Future Population, Employment and Land Use and Servicing Implications/Analysis
City of Kitchener Pumping Station Condition Assessments, 2013 and 2021	<ul style="list-style-type: none"> • Pump station assessment reports are available for 26 pump stations. The assessment reports for Breslau station, Freeport station and Old Mill station have not been provided. 	<ul style="list-style-type: none"> • TM2 pump station model input
Breslau Wet Well Upstream Analysis, 2020	<ul style="list-style-type: none"> • The Breslau WW was upgraded to allow an increase of flow from 96L/s to 189L/s. • The upgrade provides 28 minutes of basement flooding protection. 	<ul style="list-style-type: none"> • TM2 pump station model input
Field Verification Report Wastewater Pumping Facilities, 2005	<ul style="list-style-type: none"> • Consisted of an inventory and condition/status updates. • Would be superseded by the 2013 and/or 2021 condition assessments. 	<ul style="list-style-type: none"> • TM2 pump station model input (Possible – newer documents will be considered first)



CITY OF KITCHENER INTEGRATED SANITARY MASTER PLAN – TECHNICAL MEMO #1: BACKGROUND REVIEW

Appendix A Background Document Review
December 10, 2021

Report Title	Key Points / Summary / Purpose	ISAN-MP Application
Region of Waterloo 2018 Wastewater Treatment Master Plan	<ul style="list-style-type: none"> • The Kitchener existing (71,840m³/d) and 2051 (103,150m³/d) Average Day Flow are within the WWTPs rated capacity of 122,745m³/d. • A deviation from the Preston WWTP to the Kitchener WWTP is expected before 2041. • Details of the various regional WWTP and their interdependence are provided. 	<ul style="list-style-type: none"> • Task 2b: The Kitchener Wastewater Treatment plant has a rated capacity of 1227 m³/d which is adequate to beyond the year 2021 • Task 3a – East Site development population projection in 2051 is 14,297 • Task 3b – Potential infrastructure servicing
Master Plan Ottawa-Manchester-Montgomery Trunk Sanitary Sewer System, 2002	<ul style="list-style-type: none"> • The purpose was to identify wastewater servicing works, including: <ul style="list-style-type: none"> – Pumping station needs; – Wet weather storage needs; and – Collection system operation and monitoring needs. 	<ul style="list-style-type: none"> • Task 3a – Existing System condition and Future development: May be referenced if any questions pertaining to the specific study area arise. • Task 3b- Phase 1 and Phase 2 Improvement Works.
SCADA Needs Study (2016)	<ul style="list-style-type: none"> • The SCADA Needs Study guides budgeting and planning for future SCADA System additions and enhancements. • A major overhaul of the system was recommended, to be implement over 6 phases, <ul style="list-style-type: none"> – Program schedule indicated commencement in 2017 and completion by end of 2021. Capital cost and annual cash projection estimates provided to 2031. 	<ul style="list-style-type: none"> • TM4 - Integrate with capital planning priorities, phasing, and funding.
Region of Waterloo 2010 Water and Wastewater Monitoring Report, 2010	<ul style="list-style-type: none"> • The purpose of this report was: <ul style="list-style-type: none"> – to have records of actual water use and wastewater flows, and – to provide a basis of water and wastewater flow forecasts to prepare the capital budgets – to document water production and wastewater capacities – to provide comment on water and wastewater development applications. 	<ul style="list-style-type: none"> • Reference
Region of Waterloo East Side Lands Sanitary Servicing, 2018	<ul style="list-style-type: none"> • Developed a long-term sanitary servicing strategy to allow flows generated by future development within the East Side Lands to be conveyed to the Kitchener Wastewater Treatment Plant (WWTP). • The design and construction duration were estimated as requiring ~5 years. The implementation timeline was suggested to be in the ten-to-twenty-year time frame (i.e., 2028-2038) 	<ul style="list-style-type: none"> • Reference



CITY OF KITCHENER INTEGRATED SANITARY MASTER PLAN – TECHNICAL MEMO #1: BACKGROUND REVIEW

Appendix A Background Document Review
December 10, 2021

Report Title	Key Points / Summary / Purpose	ISAN-MP Application
Doon South Sanitary Pumping Station and Forcemain Schedule "B" Class Environmental Assessment Project File Final Draft, 2009	<ul style="list-style-type: none"> Developed a sanitary sewer strategy to serve the development of the Doon South planning area in the City of Kitchener. 	<ul style="list-style-type: none"> Reference
South Strasburg Gravity Trunk Sanitary Sewer: Schedule B Class Environmental Assessment Final Report, 2008	<p>The study reviewed the provisions of gravity trunk sanitary sewer servicing for future development lands in south-west Kitchener. Proposed and future development lands were found to be able to be serviced via a gravity trunk sanitary sewer outlet to the existing municipal gravity sanitary sewage collection system that is located within the Strasburg Road right of way.</p>	<ul style="list-style-type: none"> Reference
Sandrock Greenway Sanitary Trunk Sewer Flood Relief Study, 2004	<ul style="list-style-type: none"> Identified measures to control/ relieve basement flooding in the service area, and to prepare a functional design of the preferred solution. 	<ul style="list-style-type: none"> Reference
Ottawa Trunk Sanitary Sewer Capacity Evaluation Study, 1999	<ul style="list-style-type: none"> The purpose of this study was to confirm if developments east of Kitchener and in the Beslau area of Woolwich could be serviced by the Ottawa Trunk sewer. 	<ul style="list-style-type: none"> Reference
Upper Doon Sewage Pumping Station Doon South Community Phase 2 Service Area Expansion Study, 1998	<ul style="list-style-type: none"> The purpose of this study was to determine an appropriate design for the realignment of Doon Village Road. 	<ul style="list-style-type: none"> Reference
Middle Strasburg Creek Trunk Sanitary Sewer Huron Road to Bleams Road Class Environmental Assessment and Route Alignment Study, 1998	<ul style="list-style-type: none"> The purpose was to determinate the sewer capacity, alignment, and depth to serve the Huron Community Plan. 	<ul style="list-style-type: none"> Reference
Fischer Hallman Road Extension Ottawa Street to Bleams Road In The Laurentian West Community Kitchener Class Environmental Assessment and Preliminary, 1995	<ul style="list-style-type: none"> The purpose was to determinate a preferred route and completed a preliminary design for the selected roadway alignment, including horizontal and vertical geometric alignment based on Class Environment Assessment for Municipal Road Projects. . 	<ul style="list-style-type: none"> Reference



CITY OF KITCHENER INTEGRATED SANITARY MASTER PLAN – TECHNICAL MEMO #1: BACKGROUND REVIEW

Appendix A Background Document Review
December 10, 2021

Report Title	Key Points / Summary / Purpose	ISAN-MP Application
Final Study Report Schedule B Class EA Study Fairway Road Extension Alignment Study Regional Road 53 East of Lackner To Zeller, 1999	<ul style="list-style-type: none"> The purpose was to establish an alignment for Fairway Road east from its then right of way limit east of Lackner Boul to Zeller Drive. 	<ul style="list-style-type: none"> Reference
Doon Village Road Bechtel Drive to Tilt Drive Class Environmental Assessment and Alignment Location Study,1998	<ul style="list-style-type: none"> The purpose was to determine an appropriate design for the realignment of Doon Village Road. 	<ul style="list-style-type: none"> Reference
Pioneer Tower West Community Sanitary Sewage Facility Class Environmental Assessment Schedule B, 1995	<ul style="list-style-type: none"> The purpose was to summarize information developed in various reports from 1992-1995 with respect to a sanitary sewage facility to service the Pioneer Tower West Community, in a manner consistent with the Class Environmental Assessment process for Schedule "B" projects. 	<ul style="list-style-type: none"> Reference
Middle and South Branches Strasburg Creek Sanitary Trunk Sewer Alignment Study Schedule B Class Environmental Assessment Final Study, 1994	<ul style="list-style-type: none"> The purpose was to determine trunk sewer routes that will be compatible with the environmental characteristics of the study area including Strasburg Creek, one of the few remaining coldwater fisheries in the area, as well as the provincially significant Strasburg Creek Wetland Complex. 	Reference
Schneider Trunk Sanitary Sewer System Phase 4 And 5 Class Environmental Assessment Schedule B, 1990	<ul style="list-style-type: none"> The purpose was to evaluate alternative Schneider Trunk Sewer alignments for both Phase 4 and 5. 	<ul style="list-style-type: none"> Reference



CITY OF KITCHENER INTEGRATED SANITARY MASTER PLAN – TECHNICAL MEMO #1: BACKGROUND REVIEW

Appendix A Background Document Review
December 10, 2021

Report Title	Key Points / Summary / Purpose	ISAN-MP Application
Growth Related		
Region of Waterloo Growth Management Strategy, 2003	<ul style="list-style-type: none"> • Regional Growth Management Strategy and sets out actions to achieve a sustainable and livable Waterloo Region. • Growth Planning objectives were incorporated into the Region of Waterloo Official Plan. • Key goals of the strategy include: <ul style="list-style-type: none"> – Enhancing the natural environment – Building vibrant urban places – Providing transportation choices – Protecting the countryside – Fostering a strong economy – Coordination and communication 	<ul style="list-style-type: none"> • Satisfying the key goals of the growth strategy will be considered as they pertain to the development of servicing requirements • This will provide the current planning context for greenfield and intensification, secondary planning areas and related policies.
City of Kitchener Official Plan, 2014	<ul style="list-style-type: none"> • The Official Plan (OP) sets the goals and policies that help the City of Kitchener coordinate its future planning and development, and ensure both meet the specific needs of the community. • The plan is concerned with land use and physical development in the city, while aiming to balance the social, economic and environmental interests of the community. • The Official Plan must adhere to Regional Official Plan (ROP) policies, but also includes local considerations. • The OP provides: <ul style="list-style-type: none"> – The vision for growth and development to the year 2031 (greenfield and intensification) – A framework for urban structure within the City boundaries – Guidelines to evaluate the appropriateness of development as they relate to the goals/objectives and policies of the OP – A complimentary plan that aligns with provincial and regional plans. 	<ul style="list-style-type: none"> • Review mapping and policies to ensure alignment with the project • Municipal infrastructure and utilities are generally permitted in all land use areas. • While the policies do not always preclude development in these areas, they are intended to protect them from adverse impacts of development by allowing limited, compatible forms of development.
City of Kitchener Hidden Valley Land Use Master Plan, 2019	<ul style="list-style-type: none"> • Hidden Valley Land Use Master Plan to update land use type including low rise residential (estate and larger lot), medium rise residential, high rise residential, mixed use, commercial, business park employment, major infrastructure & utilities, natural heritage conservation and open space. 	<ul style="list-style-type: none"> • Review map of Hidden Valley Land Use Master Plan



CITY OF KITCHENER INTEGRATED SANITARY MASTER PLAN – TECHNICAL MEMO #1: BACKGROUND REVIEW

Appendix A Background Document Review
December 10, 2021

Report Title	Key Points / Summary / Purpose	ISAN-MP Application
Kitchener Growth Management Plan, 2019	<ul style="list-style-type: none"> • A relative priority for each growth area (intensification + greenfield) within the City is established. The philosophy of the plan is to maximize the use of existing infrastructure and the implementation of intensification is also high priority. • The recommended Priority A and B lands consist of 20 draft approved plans, 7 plans in circulation and 16 future plans (pending) for a total of 43 parcels. The Urban Growth Centre has the overall highest priority (A-1). One Priority C parcel is draft approved, one is in circulation and two are future plans, all of which require future works/applications. 	<ul style="list-style-type: none"> • Review draft map of Kitchener Growth Management plan to determine if sufficient capacity available and how these impact system operations.
Capital Planning Related		
2020 Capital Budget & 10-Year Forecast	<ul style="list-style-type: none"> • The proposed Capital Budget includes over 500 projects with a total cost of \$1.4B. • 10 Year Capital Investments for Water, sanitary and stormwater is \$182 million. 	<ul style="list-style-type: none"> • Task 4: Capital Infrastructure: Develop a long-term financial management plan, including the assessment of projected annual revenue.
City of Kitchener Development Charge Studies, 2019	<ul style="list-style-type: none"> • Development forecast from 2019-2036 considered. • The gross cost of the City's capital forecast is estimated to be \$276.25 million. • The gross cost of the City engineered service capital forecast is estimated to be \$155.73 million • The development-related capital program for Sanitary Servicing includes \$56.92 million of capital works, including \$42.76 million of trunk sewer extensions, pumping stations and pumping station upgrades, and storage facilities, and \$14.16 million of development charge credit and/or refund repayment commitments. 	<ul style="list-style-type: none"> • Task 4: Capital Infrastructure: Develop a long-term financial management plan, including the assessment of projected annual revenue.
Policy Related		
City of Kitchener Asset Management Program Policy, 2018	<ul style="list-style-type: none"> • The policy outlines the City's Asset Management program, roles, responsibilities, and definitions. • Preparing for climate change is identified as a priority activity within the asset management practice • Sustainability/lifecycle cost performance indicators are emphasized 	<ul style="list-style-type: none"> • Task 3: Sanitary Servicing Analysis: informs assessment of sewer infrastructure. • Task 4: Capital Infrastructure: Definitions of asset management
Region of Waterloo Discharge By-Law Number 1-90,	<ul style="list-style-type: none"> • A By-law that prohibits, regulates, and controls the discharge of water and waste into bodies of water within the Region or into the Regional sanitary sewer system or sewage treatment works. 	<ul style="list-style-type: none"> • Task 3: Sanitary Servicing Analysis:
Region of Waterloo By-Law Number 21-036	<ul style="list-style-type: none"> • Regional staff completed an extensive review process, in consultation with local municipal staff, to develop a new Sewer Use By-law to replace By-law 1-90 (effective January 1, 2022), concerning operation of, and connection to, Regional sanitary sewers. 	<ul style="list-style-type: none"> • Task 3: Sanitary Servicing Analysis: A by-law that identifies requirements for consideration.



CITY OF KITCHENER INTEGRATED SANITARY MASTER PLAN – TECHNICAL MEMO #1: BACKGROUND REVIEW

Appendix A Background Document Review
December 10, 2021

Report Title	Key Points / Summary / Purpose	ISAN-MP Application
City of Kitchener Utility & Services Chapter 930 - Sewage System	<ul style="list-style-type: none"> • Includes articles providing interpretations and specifics relating to: <ul style="list-style-type: none"> – Drains and connections – Sewage works – Waste treatment agreements – Industrial waste – Storm sewers – Damage to structures – Commissioner power and authority – Enforcement – Severability 	<ul style="list-style-type: none"> • Task 3: Sanitary Servicing Analysis: A by-law that identifies requirements for consideration.
Criteria Related		
City of Kitchener Design Standards and Procedures Manual: Wastewater Pumping Facilities, 2003 / revised 2013	<ul style="list-style-type: none"> • Establishes the City's standards and general design preferences for wastewater pumping facilities. 	<ul style="list-style-type: none"> • Task 3: Sanitary Servicing Analysis: Provides the basis for assessing PS performance for the target events. • Task 5: Design Criteria, Level of Service & Sensitivity Analysis: Existing City guidelines will be reviewed as part of this task.
Region of Waterloo and Area Municipalities Design Guidelines and Supplemental Specifications for Municipal Services, 2018 (DGSSMS)	<ul style="list-style-type: none"> • Provides a common set of design guidelines amongst the Regional member municipalities. • This document provides the member municipalities' design preferences under normal circumstances. • The document is to be used in conjunction with the member municipalities' related guidelines and related documents. 	<ul style="list-style-type: none"> • Task 3: Sanitary Servicing Analysis: Provides the basis for assessing PS performance for the target events. • Task 5: Design Criteria, Level of Service & Sensitivity Analysis: Existing City guidelines will be reviewed as part of this task.
City of Kitchener Standard Specifications, revised 2020	<ul style="list-style-type: none"> • These specifications are <u>supplemental and take precedence over</u> the Ontario Provincial Standard Specifications, the Ministry of Transportation of Ontario, the Regional Municipality of Waterloo Standard Specifications and Special Provisions, the Region of Waterloo and area municipalities Design Guidelines and Supplemental Specifications for Municipal Services, and the City of Kitchener Development Manual. 	<ul style="list-style-type: none"> • General – can be referenced if for construction related documentation.
City of Kitchener Development Manual, Updated 2021	<ul style="list-style-type: none"> • Outlines the City's current engineering requirements, guidelines, specifications and standards, which guide the design and construction of public infrastructure. It also outlines the expectations and requirements for obtaining engineering approvals associated with development applications (Site Plans and Plans of Subdivision). 	<ul style="list-style-type: none"> • Task 5: Design Criteria, Level of Service & Sensitivity Analysis: Existing City guidelines will be reviewed as part of this task.



CITY OF KITCHENER INTEGRATED SANITARY MASTER PLAN – TECHNICAL MEMO #1: BACKGROUND REVIEW

Appendix A Background Document Review
 December 10, 2021

Report Title	Key Points / Summary / Purpose	ISAN-MP Application
	<ul style="list-style-type: none"> • 2021 update involved internal and external stakeholder recommended modifications. • Reaffirms the use of the DGSSMS except where overridden by the guide. • Section E covers sanitary sewers. Kitchener residential per capita is 305 L/c/d, with 0.15 L/s/ha infiltration allowance. Identifies trunk sewers as 375mm and larger. Local to be sized to <95% pipe full capacity; trunk to 85% full. 	<ul style="list-style-type: none"> • Task 6: Growth Management & Implementation Plan: Will be reviewed from a subdivision application perspective.
Engagement Related		
Community Engagement Policy	<ul style="list-style-type: none"> • The City of Kitchener recognizes the importance of community and stakeholder involvement in planning and decision making to help the city better meet citizen needs. The City policy also commits to promoting ongoing meaningful public engagement. • The goal of the communication plan is to recognize how the project will consult, collaborate and/or entrust the community. 	<ul style="list-style-type: none"> • Guides the Communications and Community Engagement Plan. • Key stakeholders and potential concerns are listed in the Plan to determine an appropriate level of engagement.
Community Engagement Review Report	<ul style="list-style-type: none"> • Principles of community engagement are listed, along with the City Community Engagement Framework. • The vision of the City of Kitchener is for citizens to have a meaningful role in the decisions that impact the quality of their life. 	<ul style="list-style-type: none"> • Public notification will identify opportunities for individuals and stakeholders to meaningfully participate, share two-way dialogue, provide accessible forms of communication.



**CITY OF KITCHENER INTEGRATED SANITARY MASTER PLAN – TECHNICAL MEMO #1:
BACKGROUND REVIEW**

Appendix B Select Maps from the City of Kitchener and the Region of Waterloo Official Plans
December 10, 2021

**Appendix B SELECT MAPS FROM THE CITY OF KITCHENER
AND THE REGION OF WATERLOO OFFICIAL
PLANS**





Map 3 Land Use

City of Kitchener Official Plan A complete and healthy Kitchener

Legend

- Refer to Secondary Plan For Detail
- Urban Growth Centre (Downtown)
Refer to Map 4
- Area Under Deferral
- Low Rise Residential
- Medium Rise Residential
- High Rise Residential
- Mixed Use
- Commercial Campus
- Commercial
- Heavy Industrial Employment
- General Industrial Employment
- Business Park Employment
- Institutional
- Prime Agriculture
- Rural
- Natural Heritage Conservation
- Open Space
- Major Infrastructure and Utilities

Railway

Major and Minor Roads

— Existing

- - - Planned

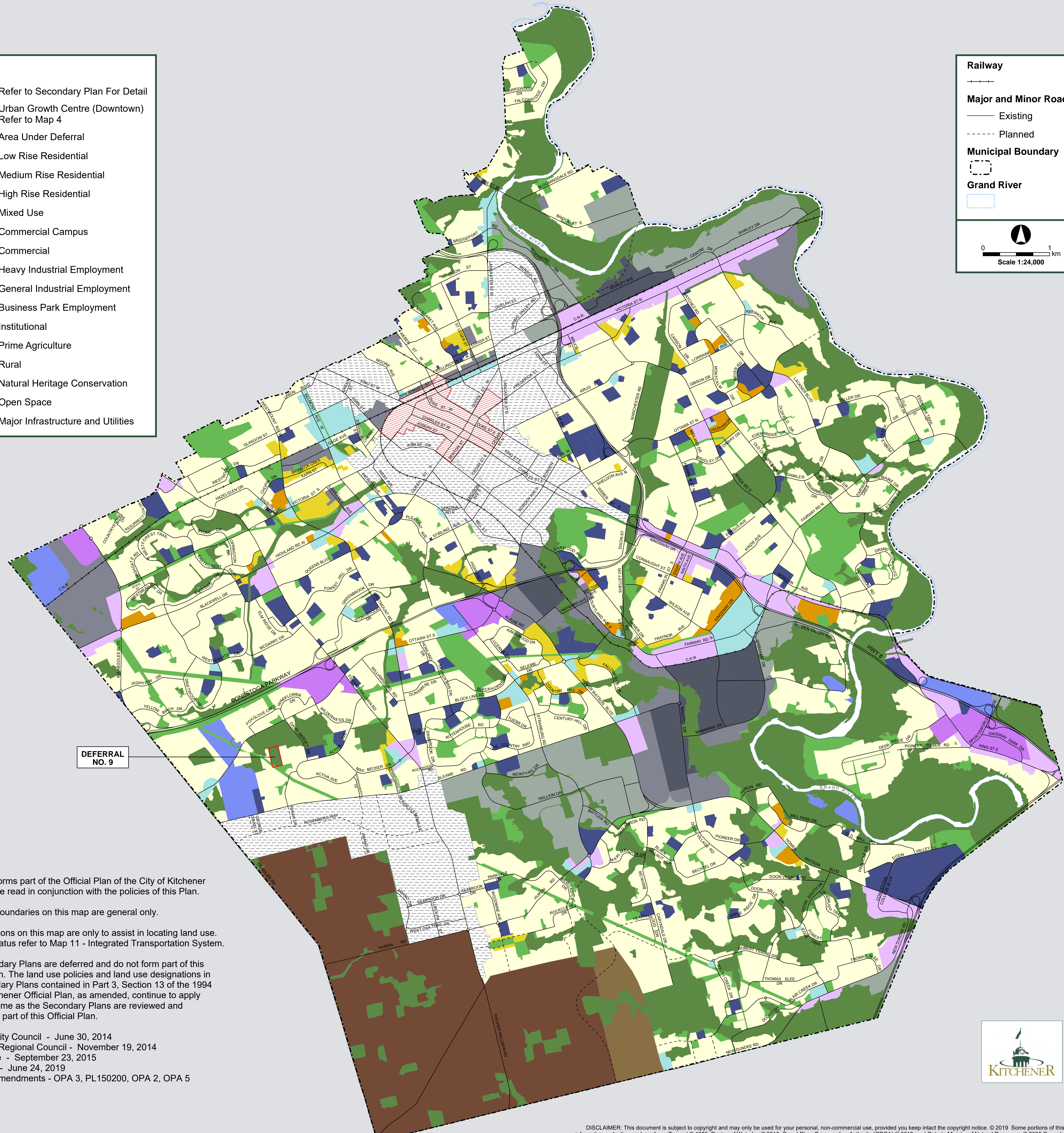
Municipal Boundary

- - -

Grand River

[]

0 1 km
Scale 1:24,000

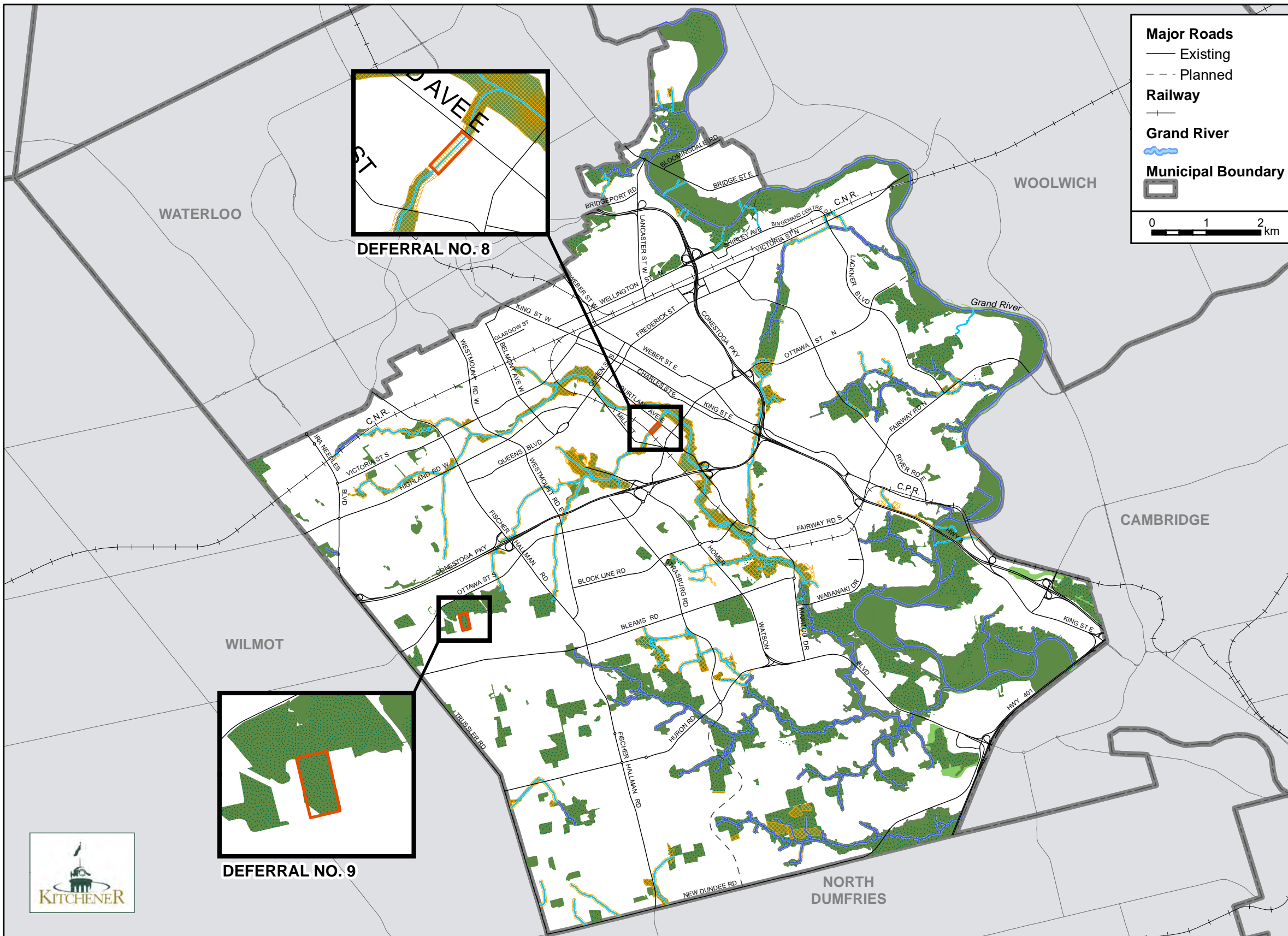


DEFERRAL
NO. 9

- Notes:
1. This map forms part of the Official Plan of the City of Kitchener and must be read in conjunction with the policies of this Plan.
 2. Land use boundaries on this map are general only.
 3. Road locations on this map are only to assist in locating land use. For road status refer to Map 11 - Integrated Transportation System.
 4. The Secondary Plans are deferred and do not form part of this Official Plan. The land use policies and land use designations in the Secondary Plans contained in Part 3, Section 13 of the 1994 City of Kitchener Official Plan, as amended, continue to apply until such time as the Secondary Plans are reviewed and adopted as part of this Official Plan.

Adopted by City Council - June 30, 2014
 Approved by Regional Council - November 19, 2014
 Effective Date - September 23, 2015
 Last Revised - June 24, 2019
 Revised by Amendments - OPA 3, PL150200, OPA 2, OPA 5





Major Roads
 — Existing
 - - - Planned

Railway
 —

Grand River

Municipal Boundary

0 1 2 km

Legend

Natural Heritage System

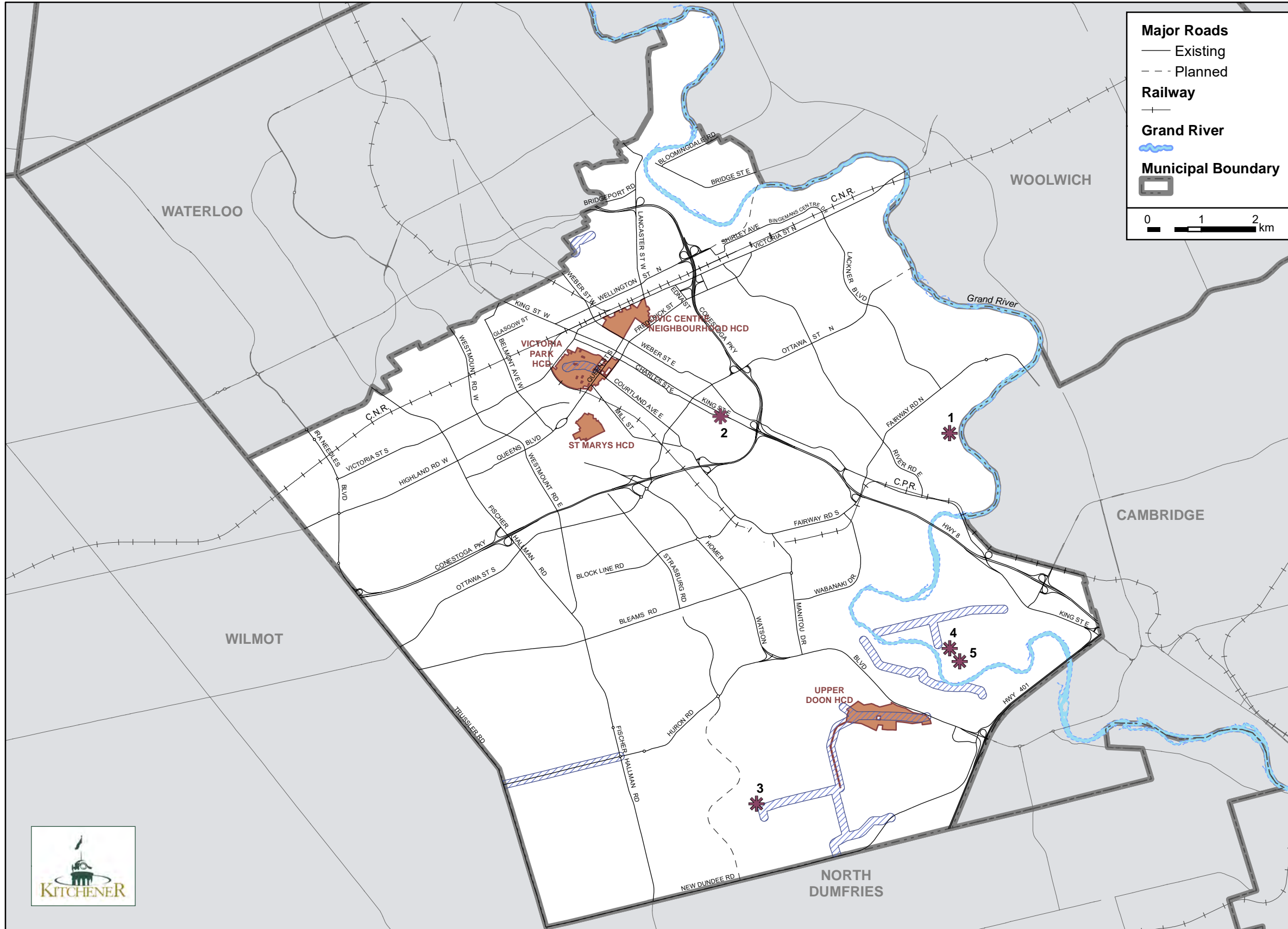
- Kitchener Core
- Significant Wildlife Habitat and Significant Landforms
- Ecological Restoration Areas
- Region Core Environmental Features
- Stream - Ecological Restoration
- Stream
- Area Under Deferral

Notes:

- This map forms part of the Official Plan of the City of Kitchener and must be read in conjunction with the policies of this Plan.
- The detailed mapping and criteria for identifying individual natural heritage features are included in the City of Kitchener Natural Heritage System Technical Background Report.
- Kitchener Natural Heritage System includes Provincially and Locally Significant Wetlands, Regionally and Locally Significant Woodlands, Regionally Significant Valley and Valleyland Features, Locally Significant Valleylands, Significant Habitat of Endangered and Threatened Species (Refer to Note 4), Significant Wildlife Habitat, Significant Landforms, Fish Habitat, other Regional Core Environmental Features, and Ecological Restoration Areas.
- Significant Habitat of Endangered and Threatened Species is not shown on Map 6 of this Plan but forms part of the Kitchener Natural Heritage System. This is in accordance with common practices to protect the species and associated habitat from disturbance.

Adopted by City Council - June 30, 2014
 Approved by Regional Council - November 19, 2014
 Effective Date - September 23, 2015
 Last Revised - March 21, 2019
 Revised by Amendments - PL150200





Major Roads
 — Existing
 - - - Planned

Railway
 + + +

Grand River

Municipal Boundary

0 1 2 km

Legend

Heritage Conservation District



Heritage Corridor



Canadian Heritage River



Cultural Heritage Landscape



1. 501-545 Morrison Road & 10 Sims Estate Place (Sims Estate)
2. 7 Floral Crescent (Rockway Gardens)
3. 500 Stauffer Drive
4. 300 Joseph Schoerg Crescent (Betzner Farmstead)
5. Joseph Schoerg Crescent 58R-10533 Pts 2 & 3

Notes:

1. This map forms part of the Official Plan of the City of Kitchener and must be read in conjunction with the policies of this Plan.
2. Please note that not all Cultural Heritage Resources identified in accordance with Policy 12.C.1.3 of this Plan are shown on Map 9.

Adopted by City Council - June 30, 2014
 Approved by Regional Council - November 19, 2014
 Effective Date - September 23, 2015
 Last Revised - December 13, 2016
 Revised by Amendments -





Region of Waterloo

Regional Official Plan SHAPING OUR FUTURE

MAP 3a

URBAN AREA

LEGEND

- Built-Up Area*
- Urban Designated Greenfield Areas
- Prime Industrial/Strategic Reserve (Served)
- Urban Growth Centres
- Reurbanization Corridors **
- Major Transit Station Areas **
- Central Transit Corridor Environmental Assessment Study Area
- Planned Highway 7
- Region of Waterloo International Airport
- Urban Area Boundary

LEGEND

- Provincial Highway
- Regional Road
- River
- Region of Waterloo International Airport
- Municipal Boundary
- Railway

0 0.5 1 2 Km



Sources: Region of Waterloo, Ministry of Energy and Infrastructure

2015

* Built-Up Area includes all lands within the built boundary, as established by the Province.

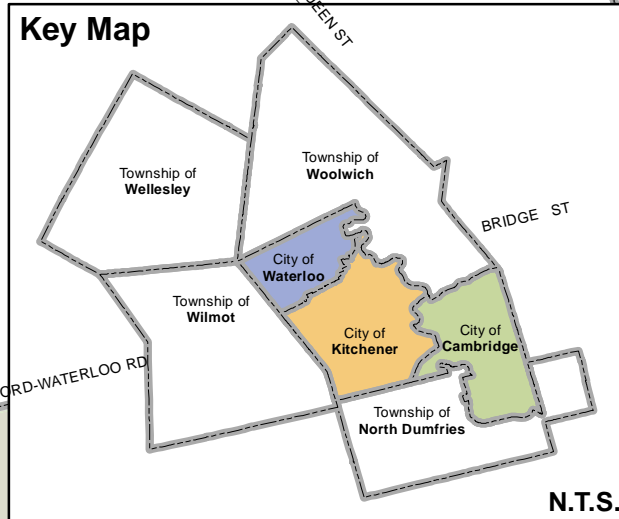
** Map 3a will be amended to designate Reurbanization Corridors and Major Transit Station Areas following the completion of the Rapid Transit Environmental Assessment.

Note: This map forms part of the Official Plan of the Regional Municipality of Waterloo and must be read in conjunction with the policies of this Plan.

Township of Woolwich

Township of North Dumfries

Key Map



N.T.S.



Region of Waterloo


Regional Official Plan SHAPING OUR FUTURE

MAP 4


GREENLANDS NETWORK

LEGEND


Landscape Level Systems

-  Significant Valleys
-  Environmentally Sensitive Landscape
 - 1. Laurel Creek Headwaters
 - 2. Blair-Bechtel-Cruikston
 - 3. Dumfries Carolinian
 - 4. Beverly
-  Provincial Greenbelt Natural Heritage System
-  Regional Recharge Areas (also shown on Map 6g)
-  Southwest Kitchener Policy Area

Core Environmental Features

-  Core Environmental Features include: Provincially Significant Wetlands; Environmentally Sensitive Policy Areas; Regional Forests; Forests greater than 4 ha; and Significant Valley Features

LEGEND

-  Provincial Highway
-  Regional Road
-  River
-  Region of Waterloo International Airport
-  Municipal Boundary
-  Railway

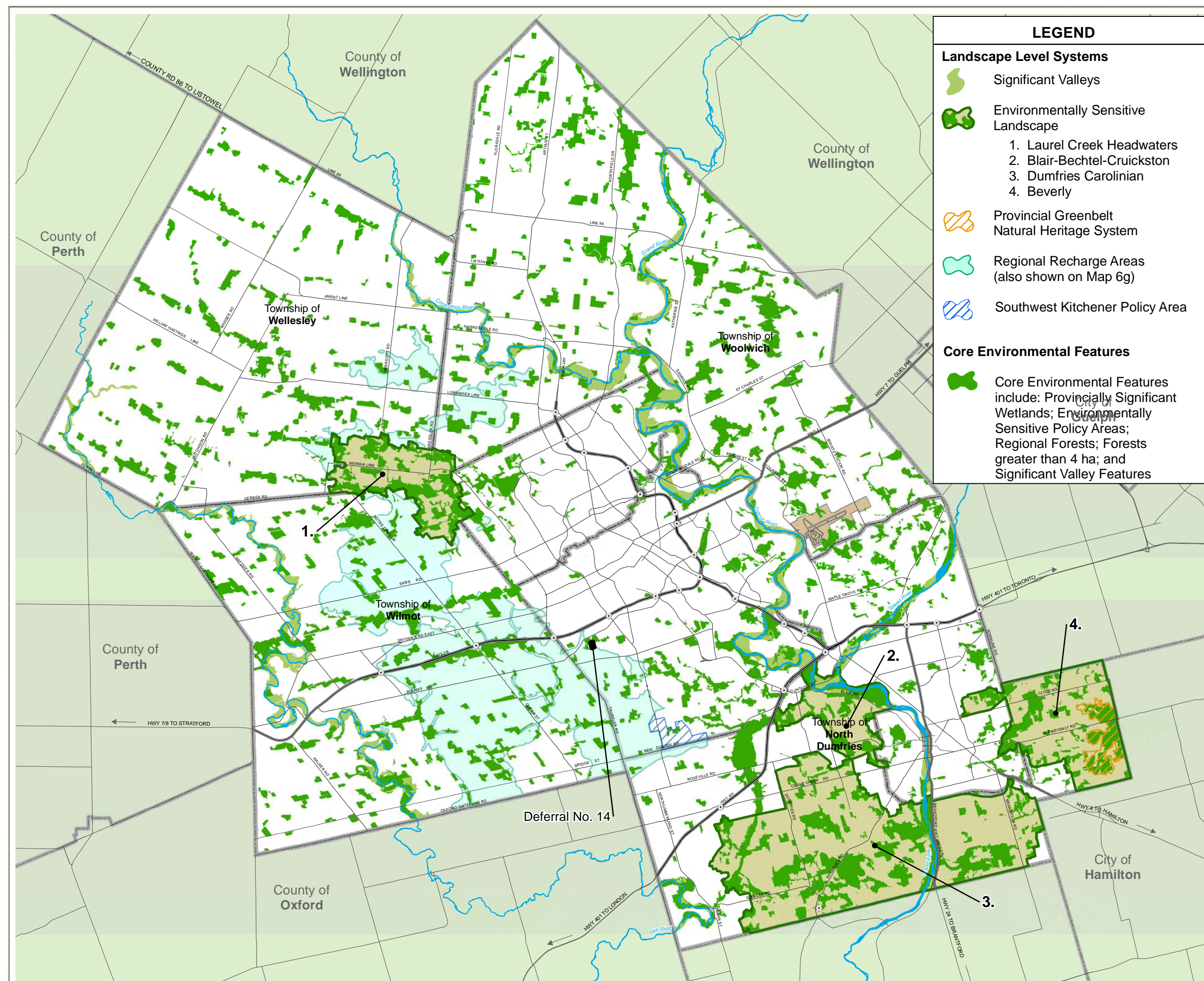


Sources: Region of Waterloo, Ministry of Natural Resources

2015

Note: Permanent and intermittent watercourses are identified in the Technical Appendix for Landscape Level Systems and Core Environmental Features

Note: This map forms part of the Official Plan of the Regional Municipality of Waterloo and must be read in conjunction with the policies of this Plan.



Deferral No. 14



Region of Waterloo

Regional Official Plan SHAPING OUR FUTURE

MAP 6a

URBAN AREA SOURCE WATER PROTECTION AREAS

LEGEND

Wellhead Protection Areas

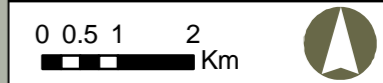
- WPSA-1
- WPSA-2
- WPSA-3
- WPSA-4
- WPSA-5
- WPSA-6
- WPSA-7
- WPSA-8

Municipal Wellhead

- Municipal Wellheads
- Groundwater Under Direct Influence (GUDI)

LEGEND

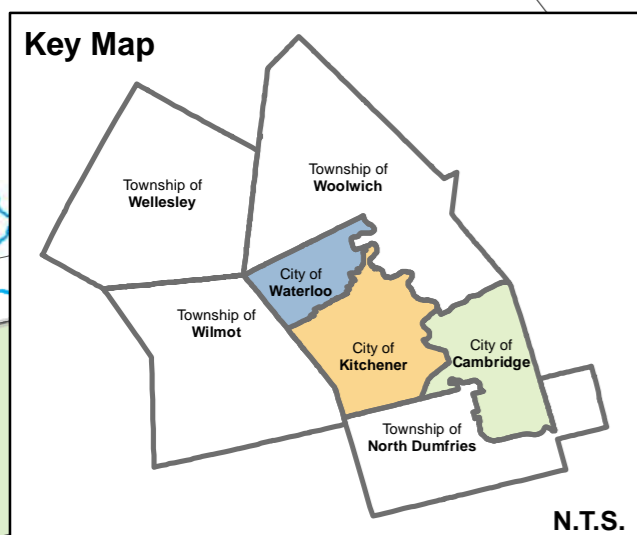
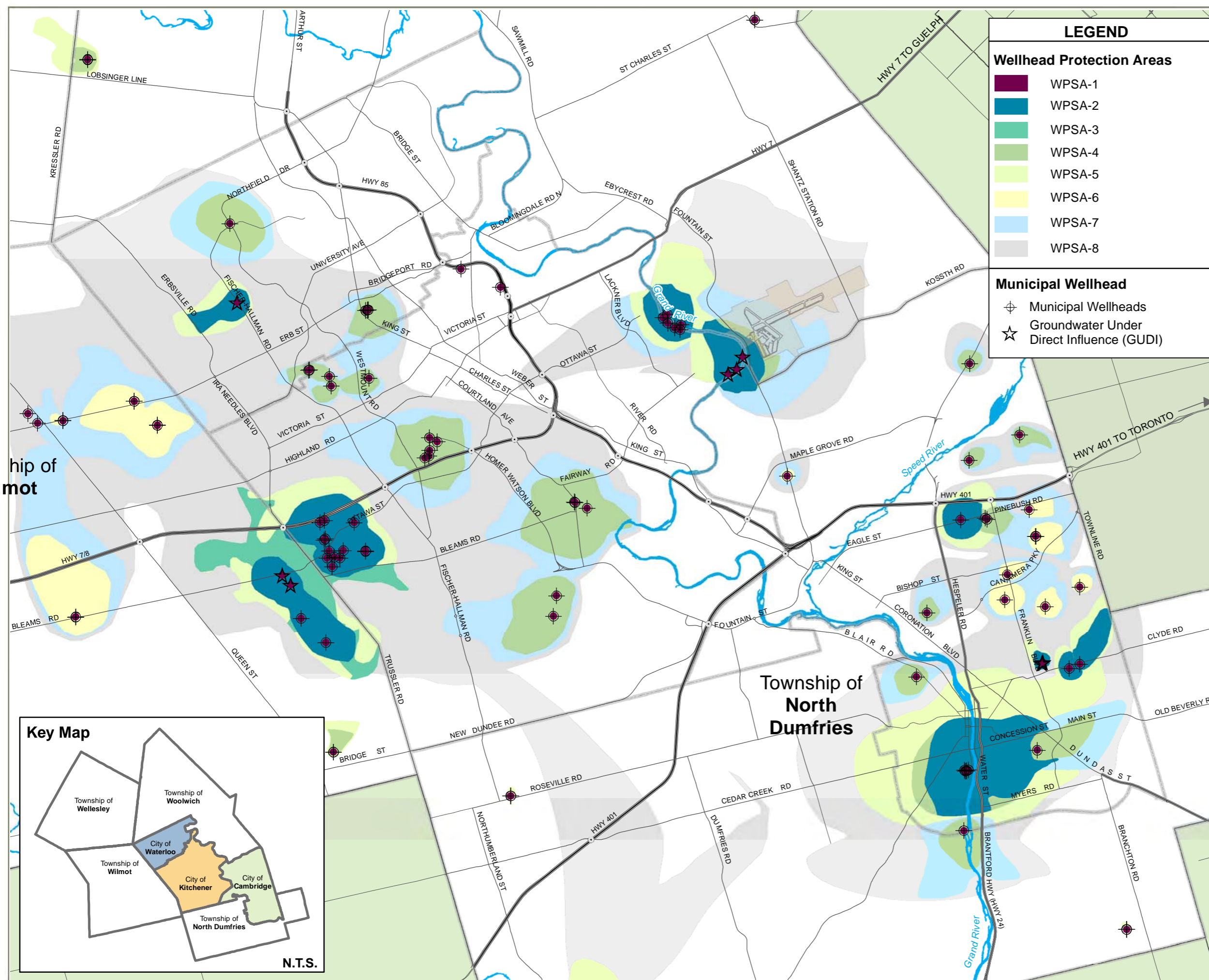
- Provincial Highway
- Regional Road
- River
- Region of Waterloo International Airport
- Municipal Boundary
- Railway



Sources: Region of Waterloo

2015

Note: This map forms part of the Official Plan of the Regional Municipality of Waterloo and must be read in conjunction with the policies of this Plan.



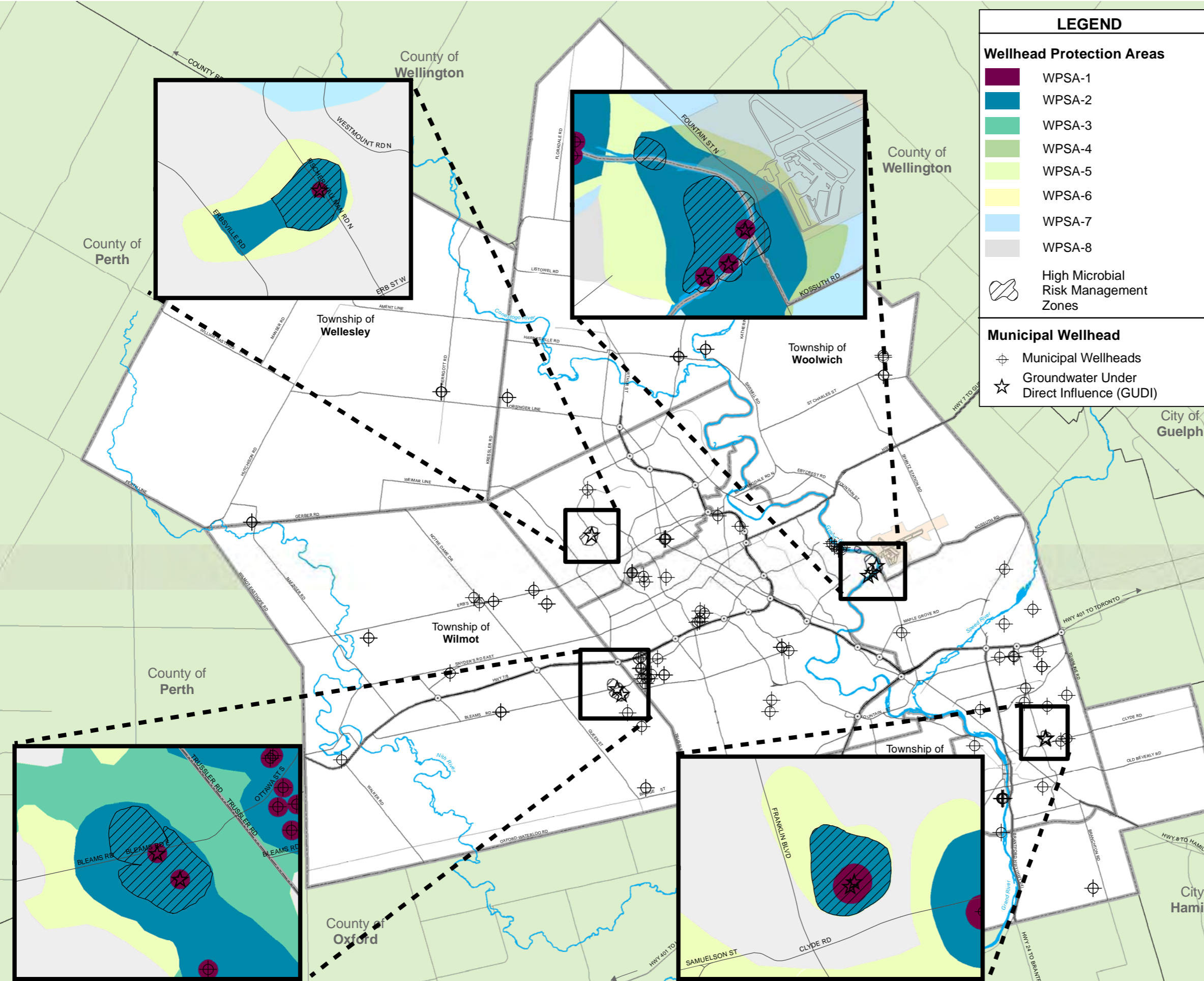


Region of Waterloo

Regional Official Plan SHAPING OUR FUTURE

MAP 6f

OTHER SOURCE WATER PROTECTION AREAS - HIGH MICROBIAL RISK MANAGEMENT ZONES



LEGEND

Wellhead Protection Areas

- WPSA-1
- WPSA-2
- WPSA-3
- WPSA-4
- WPSA-5
- WPSA-6
- WPSA-7
- WPSA-8

Municipal Wellhead

- + Municipal Wellheads
- ☆ Groundwater Under Direct Influence (GUDI)

High Microbial Risk Management Zones

LEGEND

- Provincial Highway
- Regional Road
- River
- Region of Waterloo International Airport
- Municipal Boundary
- Railway

0 0.5 1 Km

Sources: Region of Waterloo

2015

Note: This map forms part of the Official Plan of the Regional Municipality of Waterloo and must be read in conjunction with the policies of this Plan.



Region of Waterloo

Regional Official Plan SHAPING OUR FUTURE

MAP 6g

OTHER SOURCE WATER PROTECTION AREAS

LEGEND

- Regional Recharge Areas (also shown on Map 4)
- Southwest Kitchener Policy Area

Surface Water Intake Protection Zones

- Zone 1
- Zone 2

LEGEND

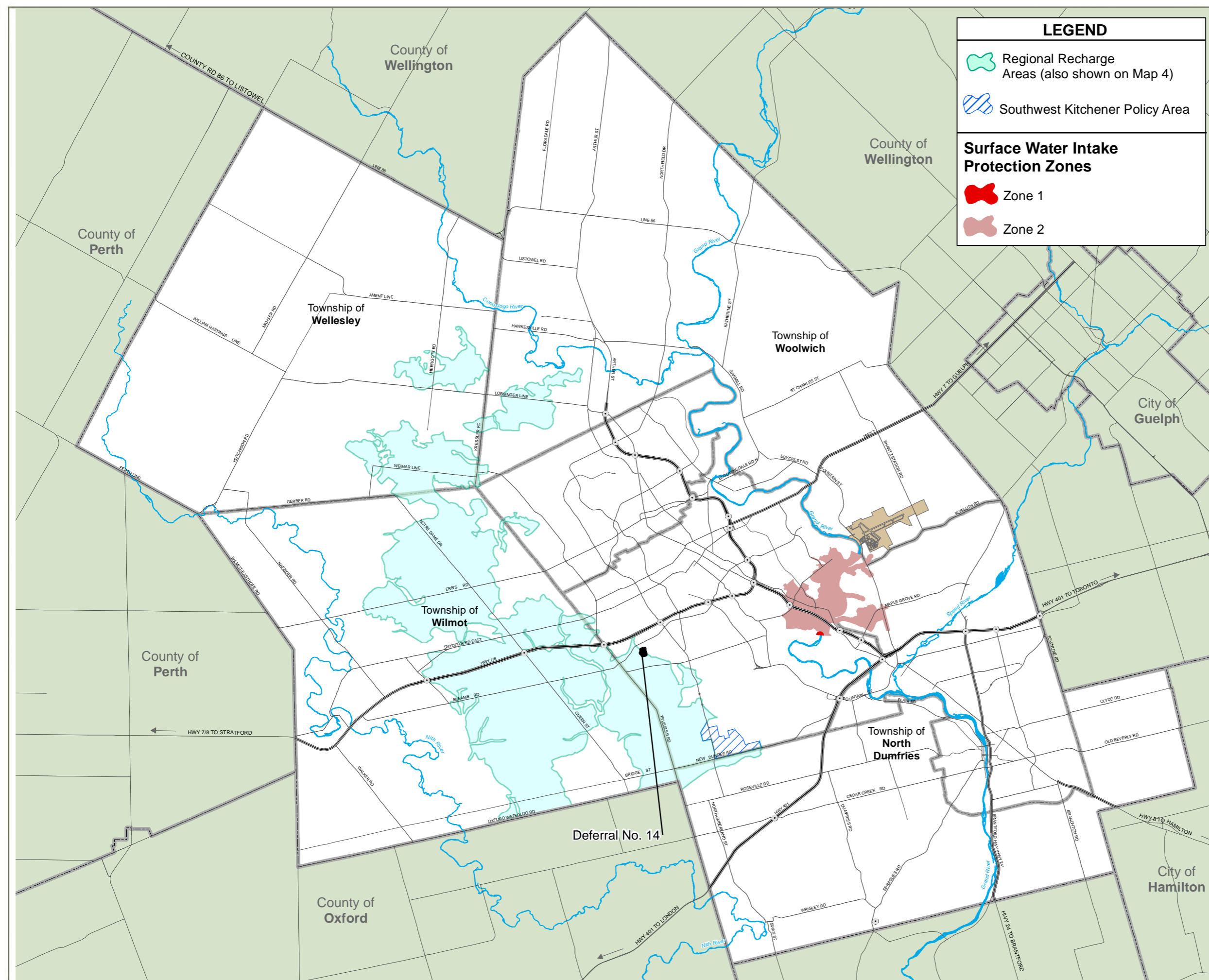
- Provincial Highway
- Regional Road
- River
- Region of Waterloo International Airport
- Municipal Boundary
- Railway

0 1 2 4 Km

Sources: Region of Waterloo

2015

Note: This map forms part of the Official Plan of the Regional Municipality of Waterloo and must be read in conjunction with the policies of this Plan.





Region of Waterloo

Regional Official Plan SHAPING OUR FUTURE

MAP 7a

THE COUNTRYSIDE

LEGEND

- Protected Countryside
- Prime Agricultural Area
- Rural Areas
- Area subject to Policy 6.H.1 (Municipal Park)
- Southwest Kitchener Policy Area
- Countryside Line
- Exact location of Countryside Line yet to be determined

LEGEND

- Provincial Highway
- Regional Road
- River
- Region of Waterloo International Airport
- Municipal Boundary
- Railway

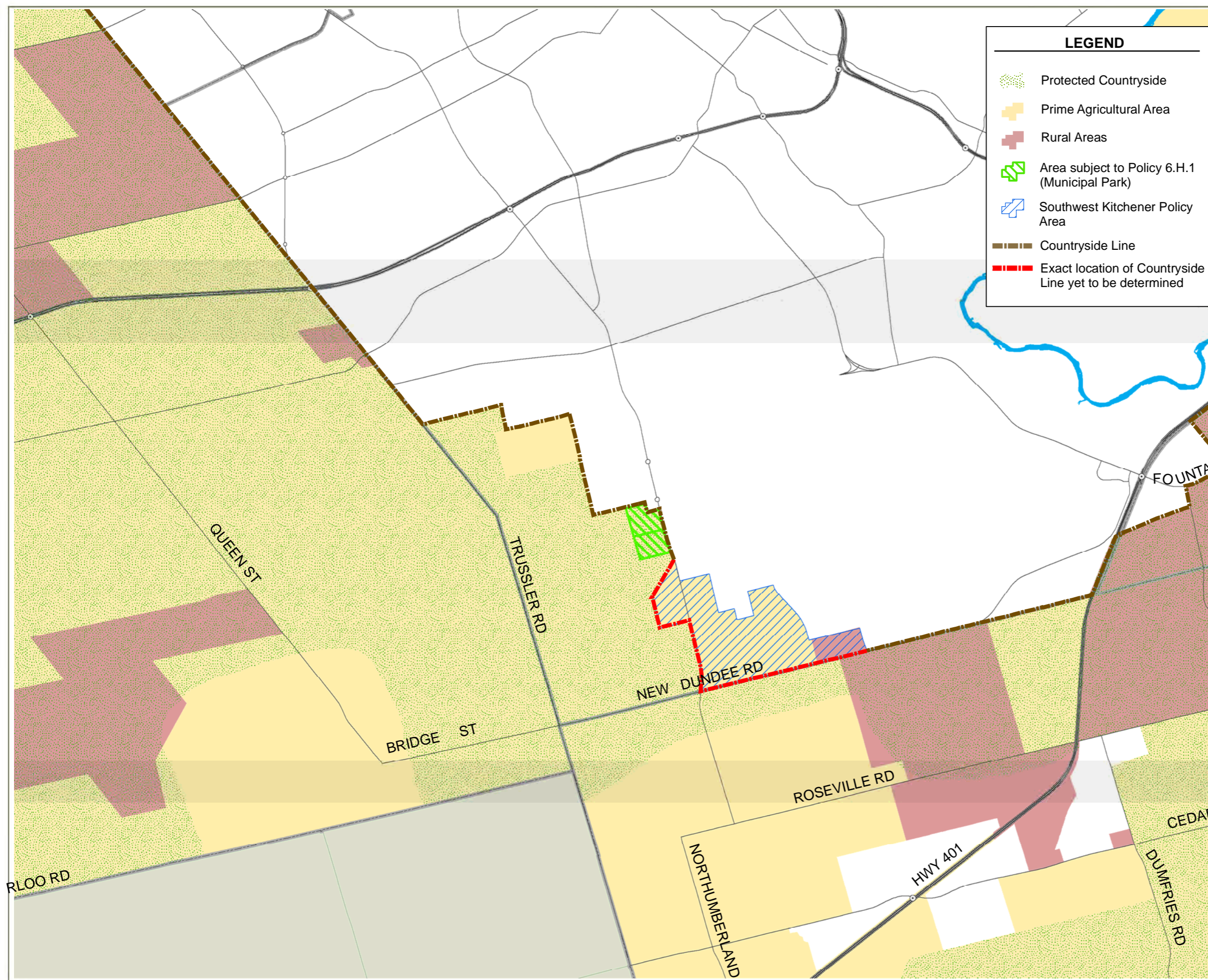
0 0.5 1 Km



Sources: Region of Waterloo

2015

Note: This map forms part of the Official Plan of the Regional Municipality of Waterloo and must be read in conjunction with the policies of this Plan.



**CITY OF KITCHENER INTEGRATED SANITARY MASTER PLAN – TECHNICAL MEMO #1:
BACKGROUND REVIEW**

Appendix C 2021 Flow Monitoring Plan
December 10, 2021

Appendix C 2021 FLOW MONITORING PLAN



To:	Jean Hao, P.Eng., PMP City of Kitchener	From:	Dave Eadie, P.Eng. Stantec
File:	1656-40334	Date:	August 5, 2021

Reference: Kitchener Integrated Sanitary Master Plan – 2021 Final Flow Monitoring Plan

Stantec is pleased to present the following update to the recommended flow monitoring plan to support the City of Kitchener's (City) Integrated Sanitary Master Plan (ISAN-MP). The initial plan of July 5, 2021 was circulated for review and implementation by AMG Environmental. This memo has been updated with input from the field reconnaissance efforts and presents the final site locations installed.

OBJECTIVE

A rainfall and flow monitoring program is required to enhance model confidence and to perform model recalibration with more recent data, for use in the Master Planning process. The Master Plan model will set the stage for future modeling activities; however, the focus of this exercise is to develop a tool for the purposes of long-term capital planning, considering the growth and capacity drivers of the City.

CONSIDERATIONS

There are several considerations that were factored into the development of the 2021 monitoring plan:

- Previous Model Calibration Monitor Locations
- Previous Model Calibration Performance
- Existing Model Capacity Results
- Recent Monitoring Locations Since 2016
- Recent and Anticipated Growth Areas
- Changes in Sewer Network Since 2016
- Maximizing Coverage in Common Time Frames
- Rainfall Data Availability
- Uncertainty Associated with COVID-19 Influence

Each are discussed in the following sections.

Previous Model Calibration Monitor Locations

The previous monitoring program was completed in 2016 over 3 months, with the coverage as presented in **Figure 1**. Upon review of the report materials, there was a discrepancy on the location of monitor F6, which was cited as located on MH301115 (on a 600mm sewer) but the pipe was listed as 101268, a 1350 mm downstream. It is also noted that F2 represents two (2) monitors in both the incoming pipes to MH311154.

Reference: **Kitchener Integrated Sanitary Master Plan – 2021 Final Flow Monitoring Plan**

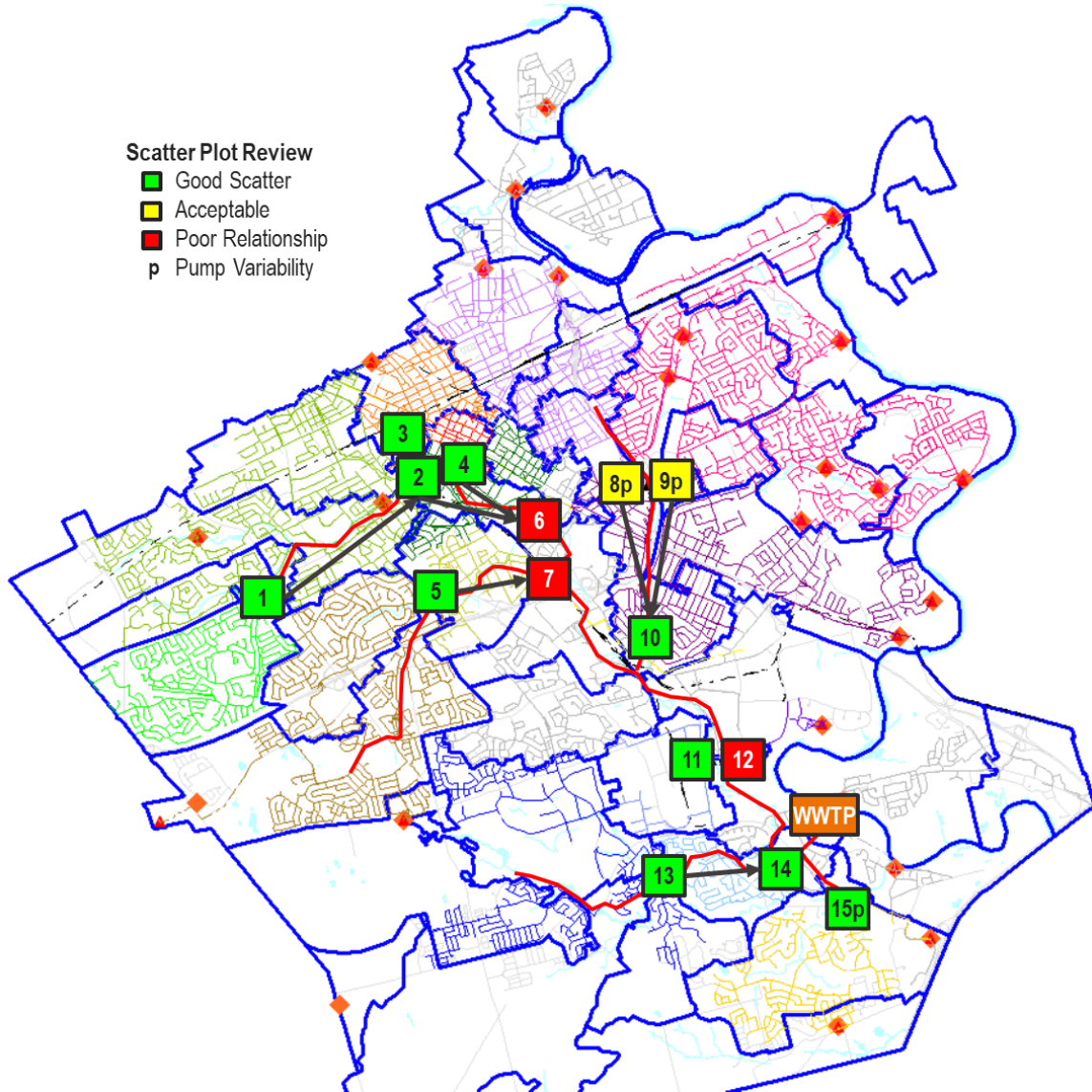


Figure 1: 2016 Flow Monitoring Locations and General Data Quality

The monitor data quality was fairly good with the following exceptions:

- F6: the scatterplot indicated a large deviation from the theoretical Mannings equation, which might be a result of the confusion between location and diameter
- F7: backwater conditions indicated
- F12: variable velocity of a low depth band – unusable
- F8 & F9: data quality was sufficient, with a variable influence of the upstream pump stations

Reference: **Kitchener Integrated Sanitary Master Plan – 2021 Final Flow Monitoring Plan**

Previous Model Calibration Performance

The calibration summaries as presented in the Sanitary Sewer System Model Update Final Report (AECOM, 2019), were reviewed to identify any locations with less than satisfactory observed-vs-predicted response (**Figure 2**). Poor locations were cross-referenced against the underlying monitor data quality to determine the source of the poor correlation. Those sites with good quality and poor calibration results were targeted for repeat monitoring. Sites with good calibration metrics could be avoided in 2021, unless there are other factors such as growth potential or significant pipe changes that warrant repeat monitoring.

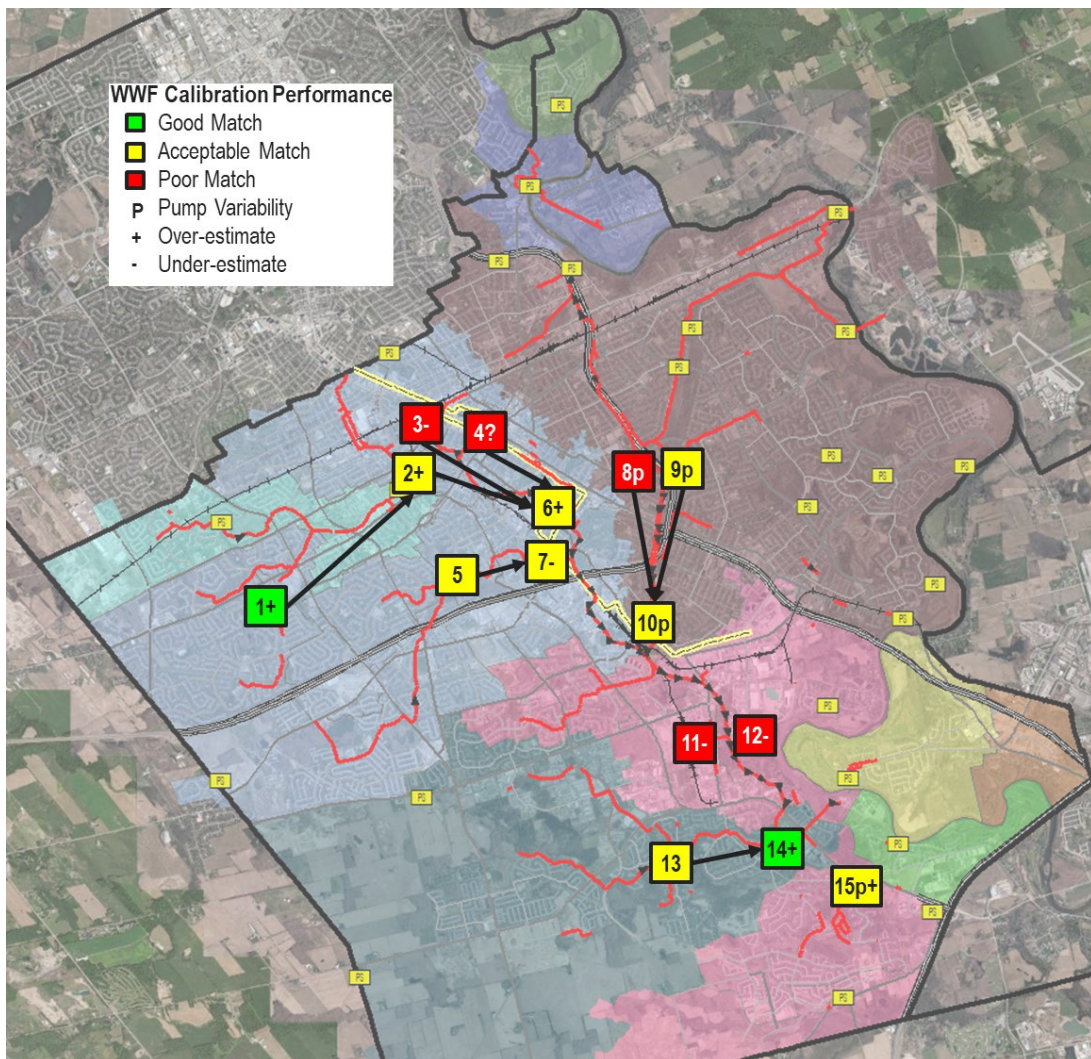


Figure 2: 2016 Model Wet Weather Calibration General Performance

Reference: **Kitchener Integrated Sanitary Master Plan – 2021 Final Flow Monitoring Plan**

F3 consistently underestimated wet weather response. F4 appears to have been abandoned during the wet weather calibration, as no results were provided in the tables or the appendices. The two smaller sites F11 and F12 did not perform well, likely attributed to the small drainage area and predominant ICI land use. F8 did not capture the pumped data well in the Montgomery sewershed, suggesting more upstream meters would be beneficial to confirm pump station performance. F13 had meter failure therefore only 1 event was captured.

Existing Model Capacity Results

Results as presented in the Sanitary Sewer System Model Update Final Report (AECOM, 2019), were reviewed for existing and future capacity constraints to help inform the model locations. **Figure 3** repeats **Figure 5-3** from the report with depth to diameter ratio (d/D).

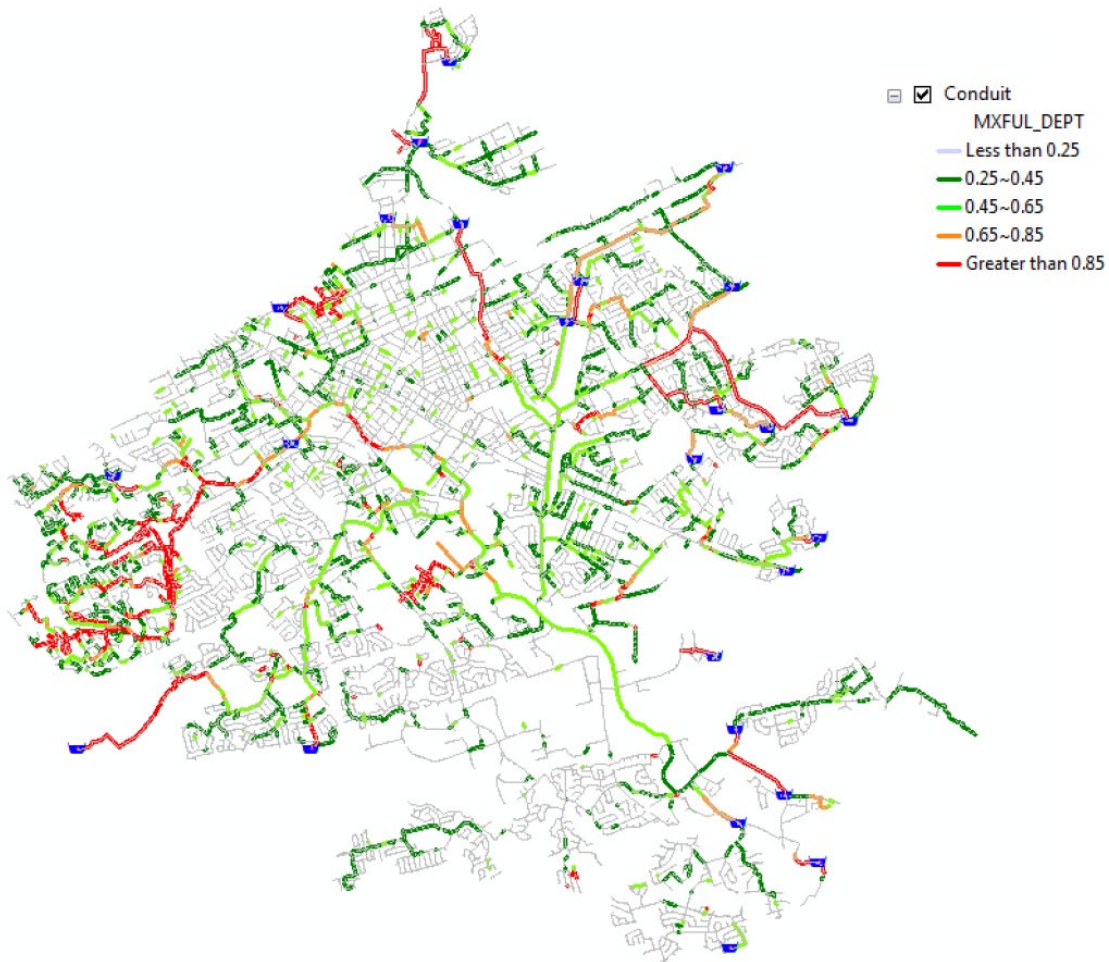


Figure 3: 2016 Wet Weather System Performance (d/D) (AECOM, 2019)

Reference: **Kitchener Integrated Sanitary Master Plan – 2021 Final Flow Monitoring Plan**

The high rainfall-derived inflow and infiltration (RDII) area of Upper Schneider upstream of monitor 2 indicates existing capacity risk, along with other pockets including the previously unmonitored Lower -Schneider – Balzer sewershed, and the area tributary to the Moore Pump Station.

Recent Monitoring Locations Since 2016

Monitoring has taken place since 2016 by AMG Environmental, under contract with the City of Kitchener. AMG provided access to their online data management platform which was used to assess the temporary and spatial coverage of recent monitoring campaigns, for assessment of potential use in model calibration and in lieu of repeat monitoring. **Figure 4** presents the locations per year. Note the coverage in 2020 was isolated to small drainage areas.

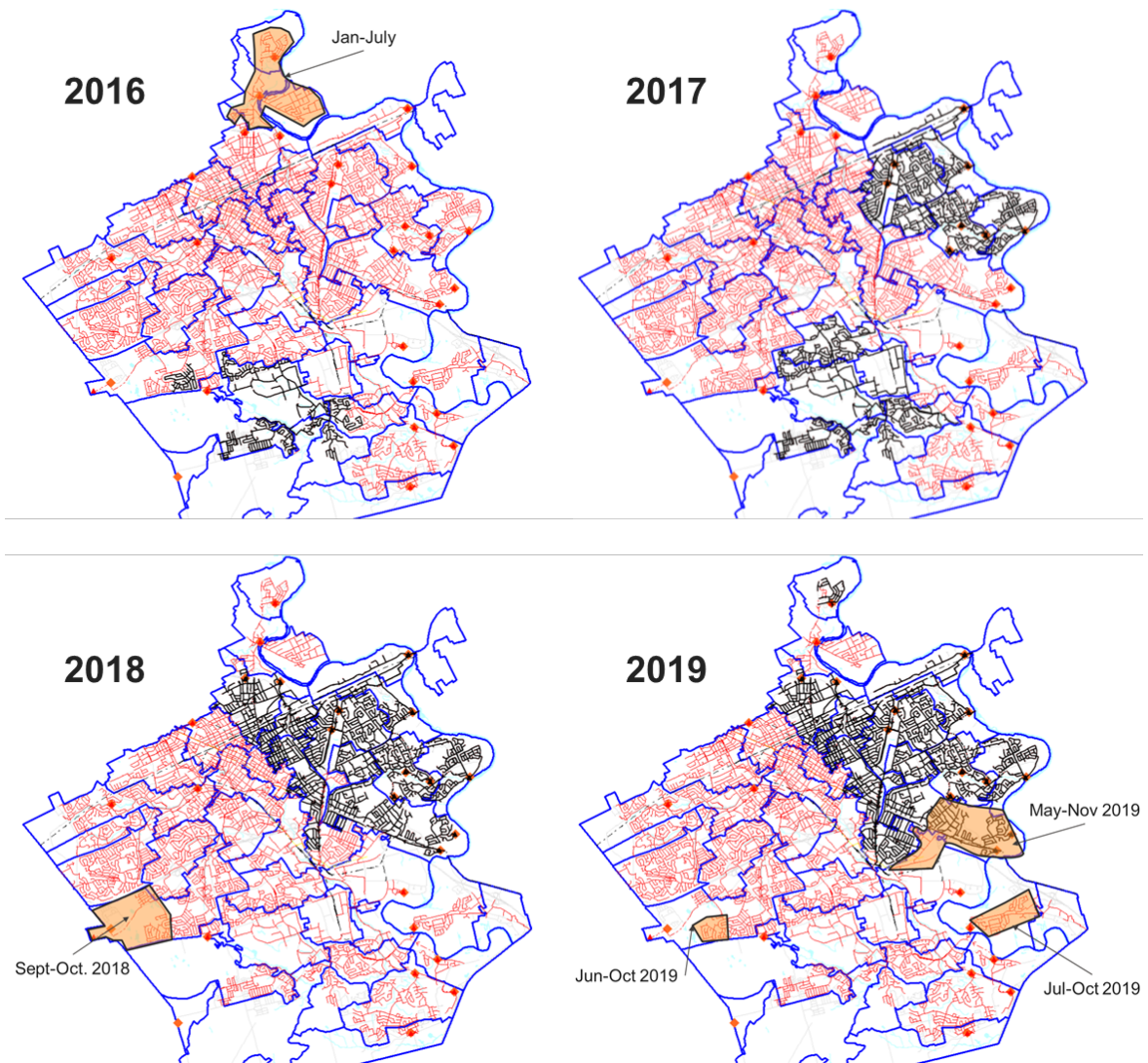


Figure 4: AMG Flow Monitoring Since 2016

Reference: Kitchener Integrated Sanitary Master Plan – 2021 Final Flow Monitoring Plan

Recent and Anticipated Growth Areas

The model will have been impacted by major changes in growth since 2016, affecting the sewage generation rate and potential state of capacity. The Annual Monitoring Reports for the Kitchener Growth Management Strategy between 2016 and 2020 were reviewed, with a depiction of the major areas of growth as shown in **Figure 5**, overlain against the major sanitary sewersheds and trunk infrastructure. The intensification growth appears to have been concentrated in the Upper Schneider (Downtown, Dietwieler, Westmount areas) and Montgomery (Weber/Hwy 8) sewersheds, while greenfield development has occurred in the Strasburg, Lower Schneider (Doon) and Montgomery (Grand R. South) trunks.

Monitoring should be placed in downstream locations of these major growth pockets to confirm current flow generation. Additionally, having monitors strategically located downstream of anticipated growth areas will provide the basis for current assessment of capacity concerns along with trend comparison to future monitoring data.

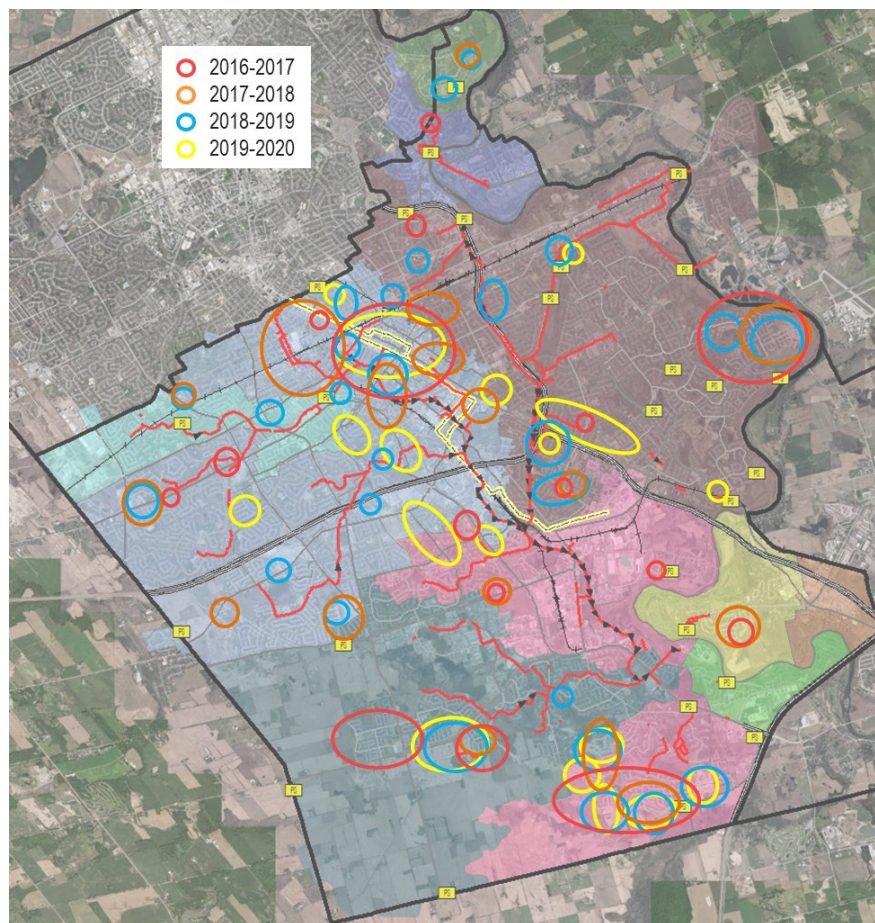


Figure 5: General Areas of Growth Since 2016

Reference: Kitchener Integrated Sanitary Master Plan – 2021 Final Flow Monitoring Plan

Changes in Sewer Network Since 2016

The original model was built with data from a May 2016 release of the City's GIS data. Comparing against the June 2021 download of sewer asset data from the City's Open Data portal, **Figure 6** presents the sewers identified with an Installation Date of 2016 onwards. Several sewers associated with new development now exist in the greenfield areas, while a significant degree of sewer replacement occurred with the Ion light rail construction in the Upper Schneider sewershed, and portions of western Montgomery. Monitoring should be conducted in the vicinity and downstream of these areas to confirm current flow conditions.

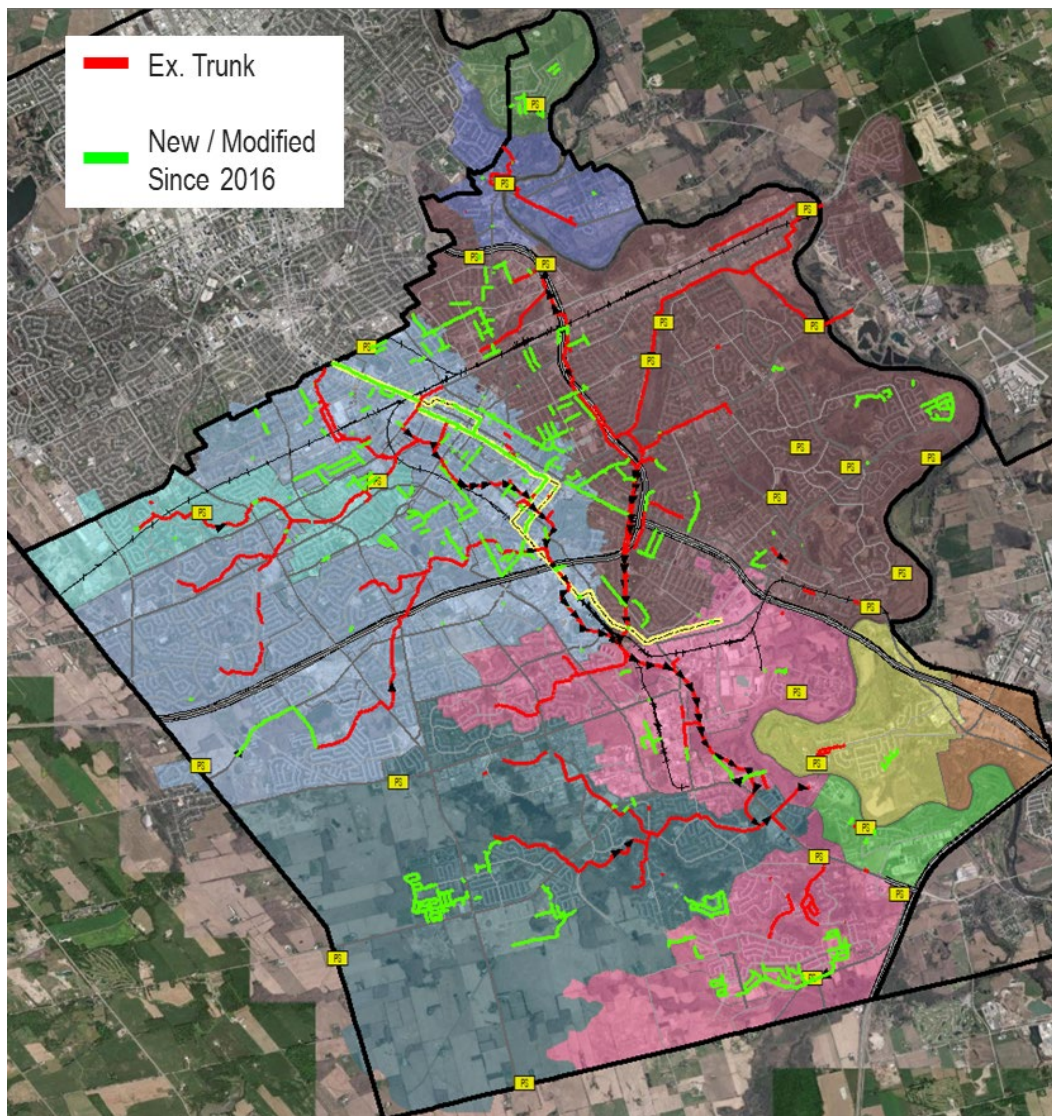


Figure 6: New/Replaced Sewers Since 2016

Reference: Kitchener Integrated Sanitary Master Plan – 2021 Final Flow Monitoring Plan

Maximizing Coverage in Common Time Frames

It is preferred to have data coverage in a common time frame, to better understand the specific conditions that exist within a system and reduce uncertainty associated with changes between time periods such as antecedent moisture conditions, population, and existing sewers. Therefore, while previous monitoring data does exist since 2016, it is recommended that calibration be performed only with 2021 data, reserving the recent historic data for supplemental validation.

Rainfall Data Availability

The City maintains two permanent rain gauges with locations at City Hall and the Kitchener Operations Facility. While data is available from 2016 for each year, there are some outages as specified in **Table 1**.

Table 1: Permanent Rain Gauge Coverage

Gauge	Start	End	Missing Periods	Total Days Missing
City Hall	2016/01/01	2021/06/10	2018: May 8 2020: Jan 15-16, Aug 28-Jan 2021	134
Operations Facility	2016/01/01	2021/06/10	2018: May 2-8 2020: Jan 16 2021: Jan 5	9

For model calibration purposes, the above dataset is of good temporal coverage. However, the spatial coverage is too broad for model calibration, especially given the propensity for summer storm cells to be isolated over a City the size of Kitchener. The 2016 model was calibrated to these two gauges plus 5 others, providing a larger network to distinguish variable rainfall patterns and intensities, using a series of virtual rain gauges to interpolate between physical rain gauges. It is not recommended to interpolate between too few gauge locations, as this assumes a degree of linear uniformity that is highly unlikely in practice.

The Chartered Institute of Water and Environmental Management (CIWEM) Urban Drainage Group produced a document entitled “Rainfall Modelling Guide 2015” which recommends that best practice for rain gauge density is between 1 per 2 to 4 km² (200 - 400 ha) for average terrain. This ideal value translates over the entire area of Kitchener (13,800 ha) to between 34 to over 60 rain gauges, which is not practical from an available location and/or budgetary standpoint. It is noted that guidance does vary for rain gauge density, with values as high as 1 per 25 km². Obviously, the more locations, the better resolution on rainfall distribution. Use of radar data can also be used to help interpret how rainstorms actually occurred between rain gauges.

It is recommended that at minimum, the same number of temporary additional gauges be installed, as was completed in the 2016 model calibration (5), if budget allows.

Uncertainty Associated with COVID-19 Influence

The COVID-19 pandemic influenced the way in which people and industry operated through 2020 into 2021, and has potentially shifted the daily water use patterns from that experienced pre-pandemic moving forward due to increasing flexible working arrangements. While that pattern and impact remains uncertain, the use of data from early and late 2020 when lockdowns were in place should not be used for assessing model

Reference: **Kitchener Integrated Sanitary Master Plan – 2021 Final Flow Monitoring Plan**

parameterization. Data collected post 2020 should be used with a comparison to historic data trends to evaluate if there are any major shifts that can be attributed to the change in daily routine, versus other variables such as seasonal base flow or growth.

FINAL MONITORING PROGRAM

Table 2 presents a summary of the final 2021 monitoring plan, with locations shown on **Figure 7**.

Table 2: Installed 2021 Flow Monitoring Network

ID	Type	Associated Monitors	Manhole (Pipe)	Dia. (mm)	Drainage Area (ha)	Justification
1	Repeat	F1	308300 (108884)	675	190.6 (298.2)	<ul style="list-style-type: none"> Identified capacity constraints in model Elevated RDII
1b	New	Upstream of F1 (2016)	309484 (110043)	300	26.8 (42.3)	<ul style="list-style-type: none"> Identified capacity constraints in model; downstream of FM1
2	New	US of F1 and F2 (2016)	304470 (104814)	1050	532.3 (787.4)	<ul style="list-style-type: none"> Downstream of FM1 in high RDII area, with identified capacity issues and changes since 2016. Upstream from previous site F2 to avoid twin monitors
2b	New	US of F2	304819 (105326)	675	173.8 (326.4)	<ul style="list-style-type: none"> Downtown/Belmont/Glasgow intensification area
3	Repeat	F3	311165 (118573)	900	149.9 (223.3)	<ul style="list-style-type: none"> Previously monitored (2016) with moderate RDII rate, poor wet weather calibration, and identified capacity issues. Changes resulting from lon.
3b	New	US of F3 (2016)	2091740 (2091730)	225	29.5 (51.4)	<ul style="list-style-type: none"> Tributary to Moore PS that indicated performance issues in model. Pipes changes since 2016 and contributes to intensification area downstream. Previous F3 under-predicted wet weather response.
4	New	US of F4 (2016)	303786 (2012068)	600	41.4 (50.3)	<ul style="list-style-type: none"> Downstream of anticipated Downtown (Northern Portion) growth area, and growth since 2016
5b	New	2018, 2019, US of F5 (2016)	311440 (118906)	525	79.4 (127.5)	<ul style="list-style-type: none"> Identified capacity constraints in model Laurentian West Ph3b development.
6	Repeat	F6	301110 (101256)	600	79.6 (139.4)	<ul style="list-style-type: none"> Wet weather calibration was outside the acceptable range in the previous (2016) modeling exercise

Reference: Kitchener Integrated Sanitary Master Plan – 2021 Final Flow Monitoring Plan

ID	Type	Associated Monitors	Manhole (Pipe)	Dia. (mm)	Drainage Area (ha)	Justification
7	New	US of F7 (2016)	306584 (107031)	900	579.3 (888.2)	<ul style="list-style-type: none"> Relocation of F7 that experienced backwater in 2016
9	New	US of F9 (2016)	301182 (101366)	675	300.6 (461.6)	<ul style="list-style-type: none"> Growth since 2016 and future growth Downstream of pump station forcemains (Zeller Dr, and Otterbein)
10	Repeat	F10	300305 (100348)	1200	1433.9 (2,199.7)	<ul style="list-style-type: none"> Continuity with 2016 and minor growth upstream
11	New	2020	302989 (103242)	450	270.6* (392.4)	<ul style="list-style-type: none"> Fairway Rd Intensification area and ICI land use Uncertainty in upstream contribution from King St
12	New	Previously Unmonitored	300575 (107270)	750	129.4 (207.8)	<ul style="list-style-type: none"> Poor model validation to post 2016 events Growth since 2016
13	Repeat	F13	303564 (103861)	1050	332.8 (621.3)	<ul style="list-style-type: none"> Improve data capture from 2016 monitoring (1 event only) Growth since 2016 and future growth
13b	New	2016-2017, US of F13	2001421 (2001424)	675	82.9 (230.6)	<ul style="list-style-type: none"> Downstream of anticipated growth areas (Huron, Rosenberg), and growth since 2016
15	Repeat	US of F15 (2016)	303238 (103074)	600	169.5 (307.6)	<ul style="list-style-type: none"> Growth since 2016 and downstream of anticipated growth area (Doon South) Inflow into Homer Watson PS
18	New	None	306550 (107153)	300	71.5 (86.9)	<ul style="list-style-type: none"> Previously uncalibrated; identified capacity constraints in model Minor growth since 2016
19	New	2016, 2019	311719 (119379)	450	33.7 (52.0)	<ul style="list-style-type: none"> Identified to have capacity constraints in 2016 model Upstream of Falconridge PS to confirm inflow hydrograph against SCADA. Discharge to Waterloo
20	New	NA	303424 (103751)	375	30.9 (35.8)	<ul style="list-style-type: none"> Previously Unmonitored. Contributes to Cambridge system.
<p>Drainage Areas estimated from upstream trace in model, including bifurcation contributions, and are subject to change upon model update. "Effective" Area shown with Total Parcel-based Area in brackets.</p>						

Reference: Kitchener Integrated Sanitary Master Plan – 2021 Final Flow Monitoring Plan

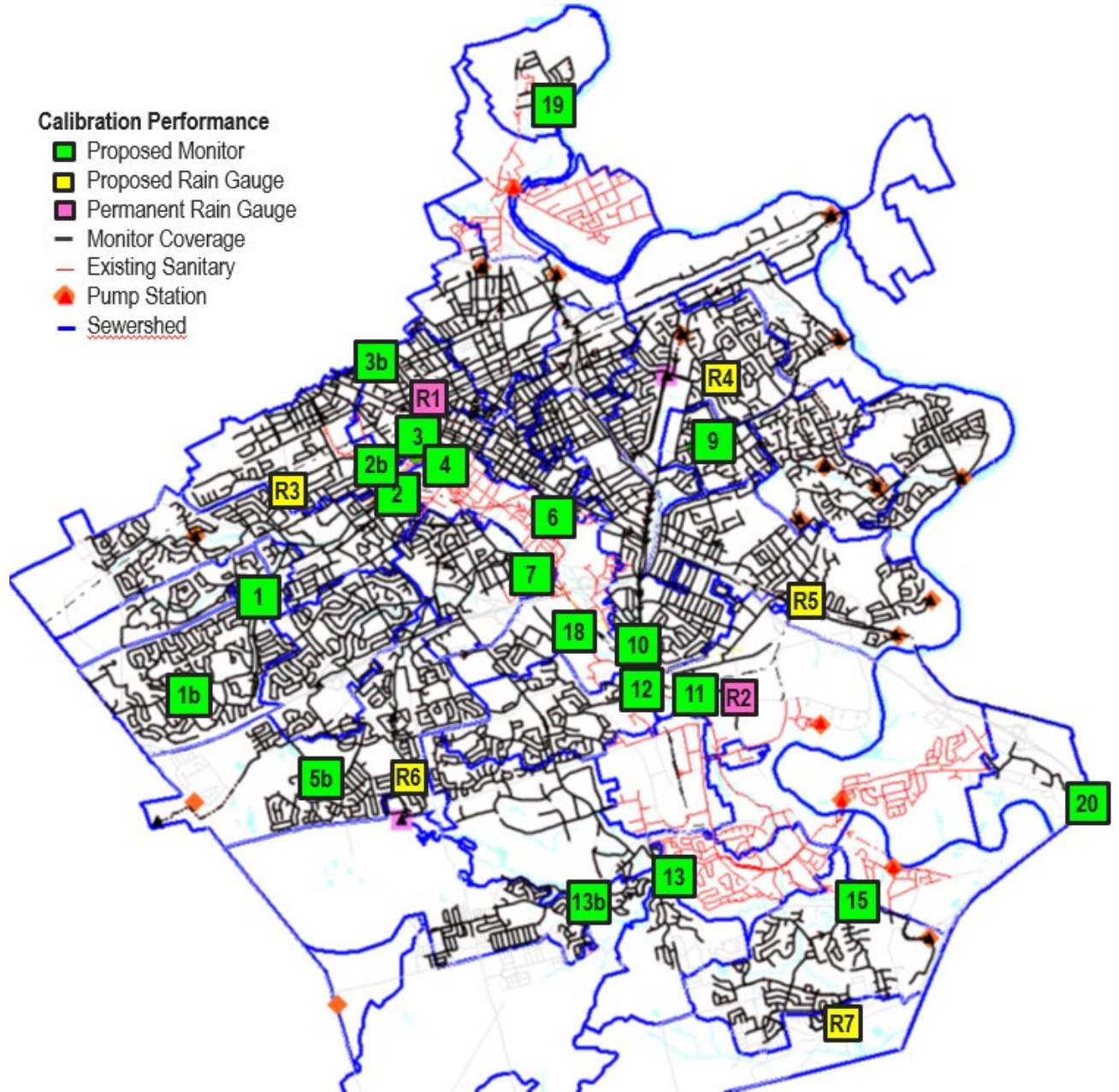


Figure 7: Final 2021 Monitoring Program

Reference: Kitchener Integrated Sanitary Master Plan – 2021 Final Flow Monitoring Plan

Table 3: Proposed 2021 Rain Gauge Network

ID	Location	Type
R1	City Hall	Existing Permanent
R2	Kitchener Operations Facility	Existing Permanent
R3	Victoria Hill Community Centre	Temporary
R4	Grand River Arena	Temporary
R5	Centreville Chicopee Community Centre	Temporary
R6	Williamsburg	Temporary
R7	New Dundee Pump Station	Temporary

The City agreed that all 5 temporary rain gauges should be installed.

STATUS AND NEXT STEPS

The flow monitors and rain gauges were installed by AMG between July 20th and July 28th, 2021, and are now active on the AMG-Live online platform (see attached AMG installation report as provided via email on August 4, 2021). AMG is conducting field verifications in early August and a meeting will be set shortly thereafter to review the early data quality and make any last adjustments to site locations based on data capture / quality concerns (some debris has been identified).

The intention is to maintain the meters in the ground for at least 3 months, with potential extension if required to capture sufficient wet weather flow events. However, events of significance are not historically captured in the late fall or winter months. Therefore, monitoring needs for maximization of beneficial use for model calibration / validation will be reviewed and discussed with the City throughout August, September and October via Project Management and Progress Meetings.

All of which is respectfully submitted.

Stantec Consulting Ltd.



Dave Eadie P.Eng.
Senior Associate, Engineering Discipline Lead – Urban Water Resources

Phone: 647 986 0254
Dave.Eadie@stantec.com

Attachment: AMG Install Report List

c. Shailesh Shah/Steve Allen/Nick Gollan, City of Kitchener
Jeff Paul/Faiz Bhatia, Stantec Consulting
Michelle Ward, AMG Environmental

Attachments

From: [Michelle Ward](#)
To: [Jean Hao](#); [Shailesh Shah](#)
Cc: [Eadie, Dave](#); [Zach Leslie](#)
Subject: Update on Flow Monitoring Program
Date: Wednesday, August 4, 2021 2:21:24 PM
Attachments: [image001.png](#)
[image003.png](#)
[Site Install Report Kitchener 2021_UPDATEDv2.xlsx](#)

Good Afternoon,

I have attached the final list of installs. To date, all twenty (20) flow monitors and (5) rain gauges are installed. We are dealing with two flow monitor connectivity sites and one rain gauge connectivity site. The monitors are collecting data and will be uploaded during the next field visit. We will try to change the sim cards and antennas at these sites to improve connectivity.

304470-KW-West Ave – has a large amount of debris, this site is not connecting so we are unsure if it is affecting the data. (see photos below)



311165-KW-Victoria St S – after inspecting the primary (MH311163) site that was located by City staff we determined that the alternative was a better monitoring site. Monitor was installed in alternative site MH 311165. Silt and debris are an issue at this location.

Follow up verifications should be completed by the end of next week. Once the follow up verifications are completed, I will set up a meeting to review the collected data and access to AMG Live.

Thank you

Michelle



Michelle Ward

President

494 Veterans Drive, Unit 12
Barrie, ON, Canada L4N 9J5

TF: 866-212-6717 ext. 2001

Fax: (705) 812-1645

Cell: (647) 377-8730

www.amgenvironmental.com



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AMG ENVIRONMENTAL SITE INSTALL REPORT

8/4/2021

Project: Kitchener

MONITOR ID	SITE NAME	M.H. NUMBER	GROUND TO INVERT	INFLOW PIPE SIZE (mm)	OUTFLOW PIPE	RECOMMENDED PIPE TO	AMG RECOMMENDED	COMMENTS AND CONCERNS	POST INSTALLATION COMMENTS
308300-KW-Highland Rd W	1	308300	<6000	675	675	Inflow	Inflow		Good
309484-KW-Highview Dr	1b	309484	>6000	300	300	Inflow	Inflow		Follow-up completed (repositioned sensors)
304470-KW-West Ave	2	304470	<6000	1050	1050	Outflow	Inflow		No connectivity since install. Large Rocks & Debris
304819-KW-Sandrock Creek	2b	304819	<6000	675	675	Inflow	Inflow		Good
311165-KW-Victoria St S	3 Alt	311165	>6000	900	900	inflow	Inflow	2 AV in 900mm inflow. Silt and rocks.	Significant debris (silt & rocks). Data looks ok. Silt equation applied.
2091740-KW-Moore Ave PS	3b	2091740	<6000	225	225	Inflow	Inflow	Map says 225mm pipe. GIS shows 450mm pipe. 2 AV in inflow.	Lost connection shortly after installation. Pipe measured as 450mm, review to confirm as 250mm was the pipe size provided.
303786-KW-David St	4	303786	>6000	600	600	Inflow	Inflow	2 AV sensors in 600mm inflow. Requires extensions.	Good, change in flow (D and V as well) July 29th. (rain event)
311440-KW-Activa Ave	5b	311440	>6000	525	525	Inflow	Inflow	Installed in outflow due to drop structure.	Field technicians unable to install in inflow due to drop structure. Sensors installed in OUTFLOW. (monitored outflow in 2018)
301110-KW-Borden Ave S	6 Alt	301110	>6000	600	600	Outflow	Inflow	2 AV in 600mm inflow. Lateral dry at the time of inspection. Will miss small section.	High gas levels (must ventilate). Significant silt/debris issues (150mm). Silt equation applied.
306584-KW-Hoffman St	7 Alt	306584	>6000	900	900	Outflow	Inflow	2 AV in 900mm inflow. Extensions required.	Good
301182-KW-Ottawa St N	9 Alt	301182	<6000	675	675	Inflow	Inflow	2 AV in 675mm inflow. Heavy traffic TL-23.	No connectivity since install
300305-KW-Shelley Dr	10	300305	<6000	1200	1200	inflow	Inflow	2 AV in 1200mm inflow.	High velocity coefficients (1.4 on both). Follow-up not completed yet, may push band further in pipe. Data ok.
302989-KW-Manitou Dr	11	302989	<6000	450	450	inflow	Inflow	2 AV in 450mm inflow.	Small amount of silt (20mm). Data ok, no silt equation
300575-KW-Balzer Creek Trail	N/A	300575	<6000	750	750	inflow	Inflow	2 AV in 750mm inflow. Previously monitored by AMG.	Follow-up already completed. Lost connectivity after install, but data was recovered
303564-KW-Black Walnut Dr	13	303564	>6000	1050	1050	inflow	Inflow	2 AV in 1050mm inflow. Extensions required.	No connectivity since install (ProSiren) but still recording data. Requires new monitor or modem.
2001421-KW-Huron Rd	13b Alt	2001421	>6000	675	675	inflow	Inflow	2 AV in 675mm inflow. Requires extensions.	Dead-spot (stagnant) flow on left side of profile. Velocity average skewed (affecting coefficients)
303238-KW-Homer Watson PS	15	303238	>6000	600	600	inflow	Inflow	2 AV in 600mm inflow. Requires extensions. Located inside pump station that has a gate. Arrange access to ensure that the gate is open when visiting.	Pump station gate at outflow pipe. When gate closes, pipe surcharges. Check if float in functioning
306550-KW-Hanson Ave	18 Alt	306550	<6000	300	300	inflow	Inflow	2 AV in 300mm inflow with 1 at the invert. Or 1 AV 1 Ultrasonic.	Follow-up completed (repositioned sensors)
311719-KW-Falconridge PS	19	311719	>6000	450	450	inflow	Inflow	2 AV in 450mm inflow. Extensions required. Previously monitored.	Bend in pipe, flow is turbulent. Data quality is fair.
303424-KW-King St E	20	303424	<6000	375	375	inflow	Inflow	1 AV 1 Ultrasonic in 375mm inflow. Heavy traffic TL-23.	US sensor not working (spikes). Tracking AV and depth is low, so data quality is fair

RAIN GAUGE LOCATIONS	INSTALLATION TYPE	POST INSTALLATION COMMENTS
RG3	Victoria Hill Community Center	Rooftop
RG4	Williamsburg	tripod (on roof)
RG5	Centerville Chicopee Community Center	rooftop
RG6	Grand River Arena	rooftop
RG5	New Dundee PS	tripod