City of Brantford

2014 Master Servicing Plan (MSP) for Water, Sanitary and Stormwater Services





Volume IV - Wastewater Master Plan

Final Report

July, 2014

Prepared by:

BluePlan Engineering Consultants Limited

In Association With:

Associated Engineering

GeoAdvice

Watson & Associates Economists Ltd.

McLeod Wood Associates Inc.

Table of Contents – Volume IV – Wastewater Master Plan

Page

List of Figures

List of Tables

Appendices

1 Introduction and Background

1.1 Background

Brantford is a city located in southwestern Ontario, bordering with the County of Brant and in close proximity with the City of Hamilton, and the Greater Golden Horseshoe Area. The City of Brantford is responsible for: water treatment, transmission and distribution mains, storage facilities and pumping stations; wastewater treatment, sewers, forcemains and sewage pumping stations; as well as, stormwater sewers, drainage ditches, culverts, and stormwater management ponds.

The City of Brantford owns and operate its water system, which draws water from the Grand River and distributes treated water to its residents. The City employs the Ontario Clean Water Agency (OCWA) to operate, maintain and manage the Brantford Water Pollution Control Plant and nine sewage pump stations. The entirety of the City is located within the Grand River Watershed. The majority of the City drains directly to the Grand River or Grand River tributaries, Mohawk Lake and D'Aubigny Creek, via City owned stormwater infrastructure; however, a significant portion of the northeastern segment of the City discharges to local creeks along the City's north and east boundaries.

The City of Brantford is part of the Greater Golden Horseshoe (GGH) area situated on the Grand River in the heart of Southern Ontario. The Government of Ontario's legislative growth plan, *Places to Grow Act, 2005*, and its *Amendment 2, 2013*, identifies substantial population and employment growth for the City to 2031.

Readily available and accessible public infrastructure is essential to the viability of existing and growing communities. Infrastructure planning, land use planning and infrastructure investment require close integration to ensure efficient, safe and economically achievable solutions to provide the required water, wastewater and stormwater infrastructure.

To balance the needs of growth with the protection and preservation of natural, environmental and heritage resources, the City of Brantford initiated the preparation of a Master Servicing Plan for water, wastewater and stormwater services under the Municipal Engineers Association (MEA) Master Plan Class Environmental Assessment process.

As the study proponent, the City of Brantford retained BluePlan Engineering Limited as lead consultant, in association with Associated Engineering, GeoAdvice, Watson & Associates and McLeod Wood, to complete the Master Plan through an integrated process with City Staff, stakeholders and the public.

The 2014 Master Servicing Plan provides a review, evaluation and development of water, wastewater and stormwater servicing strategies to support existing needs and projected growth within the City. The Master Plan uses updated population and employment growth forecasts based on a 2031 planning horizon.

The 2014 Master Servicing Plan is being completed concurrently with the City's Transportation Master Plan Update to enable, where advantageous, alignment of recommended work or capital projects, minimizing potential impacts and disruptions to the public. The 2014 Master Servicing Plan is a critical component of the City's planning for growth and will provide the framework and vision for the management, expansion and funding of the water, sanitary and storm systems for the entire City to 2031 and beyond.

1.2 Master Servicing Plan Objectives

The Master Servicing Plan for Water, Sanitary and Stormwater Services comprehensively documents the development, evaluation and selection of the preferred water, wastewater and stormwater servicing strategies to meet the servicing needs of existing and future development to 2031.

The 2014 Master Servicing Plan evaluates the ability of existing and planned water, wastewater and stormwater infrastructure in the City of Brantford to efficiently and effectively service the City's existing and anticipated growth, and to evaluate and develop recommended servicing strategies.

The key objectives of the 2014 Master Servicing Plan are as follows:

- Review planning forecasts to 2031 and determine the impacts on servicing needs for the City's water, wastewater and stormwater infrastructure;
- Consider and incorporate proposed water, wastewater and stormwater infrastructure needs beyond 2031;
- Undertake a comprehensive review and analysis for the water, wastewater and stormwater servicing requirements;
- Complete the Master Servicing Plan in accordance with the MEA Class EA process (further described in Volume II)
- Address key servicing considerations as part of the development and evaluation of servicing strategies including:
  - Level of service to existing users and approved growth
  - Operational flexibility and security of supply
  - Mitigation of impacts to natural, social and economic environments
  - Opportunity to meet policy, policy statements, regulations and technical criteria
  - Opportunity to optimize existing infrastructure and servicing strategies
  - Ensuring the strategies are cost effective
- Consider and develop sustainable servicing solutions;
- Utilize updated industry trends and more detailed information from relevant City studies and projects to provide better capital cost estimates;
- Utilize recently completed and on-going projects to update infrastructure status, capacity and cost estimates;
- Utilize the updated water, wastewater and stormwater hydraulic models for the analysis of servicing alternatives;
- Establish a complete and implementable water, wastewater and stormwater capital program; and
- Extensive consultation with the public and stakeholders.

1.3 Master Servicing Plan Documentation Layout

The 2014 Master Servicing Plan Report, including all supporting volumes, is the documentation placed on public record for the prescribed review period. The documentation, in its entirety, describes all required phases of the planning process and incorporates the procedure considered essential for compliance with the *Environmental Assessment Act*.

The Master Servicing Plan Report is organized into six volumes as illustrated in Figure 4.1 and as described below:

Figure 4.1 - Master Servicing Plan Document Layout

Volume I – Executive Summary

Volume I provides a brief overview of the 2014 Master Servicing Plan. It summarizes the information contained in Volumes II, III, IV, V and VI, including problem statement, purpose of the study, significant planning, environmental and technical considerations, description of the analysis performed and final solutions and recommendations.

Volume II – Background and Planning Context

Volume II details the master planning process including the Master Plan Class EA process, related studies, legislative and policy planning context, water, wastewater and stormwater servicing principles and policies, population and employment growth forecasts, existing environmental and servicing conditions and future considerations. This volume also introduces the existing infrastructure conditions for the water, wastewater and stormwater systems. The appendices in this volume contain relevant baseline and planning information including:

- Appendix 2A – Water and Wastewater Servicing Principles and Policies Paper
- Appendix 2B – Planning Data and Memo
- Appendix 2C – Environmental Mapping

Volume III – Water Master Plan

Volume III consists of the principal document summarizing the study objectives, approach, methodologies, technical analyses, evaluation and selection of the preferred water servicing strategy. This volume outlines the water policies, design criteria and level of service needed to be achieved by the water network. In addition, Volume III identifies the existing water network and describes the hydraulic modelling tool used for the analysis. Further in Volume III is the detailed evaluation and decision-making as well as the preferred servicing strategy and associated capital program.

A significant amount of technical background information has been compiled, which is critical to the development of the Water Master Servicing Plan. This information is included as appendices of Volume III. The technical appendices contain relevant project, implementation and technical analysis information, including:

- Appendix 3A – Water Demand Projections
- Appendix 3B – Historical Water Demand
- Appendix 3C – Water Evaluation Tables
- Appendix 3D – Unit Costs
- Appendix 3E – Preliminary Water Model Results

Volume IV – Wastewater Master Plan

Volume IV consists of the principal document summarizing the study objectives, approach, methodologies, technical analyses, and evaluation and selection of the preferred wastewater servicing strategy. This volume outlines the wastewater policies, design criteria and level of service needed to be achieved by the wastewater network. In addition, Volume IV identifies the existing wastewater network and describes the hydraulic modelling tool used for the analysis. Further in Volume IV is the detailed evaluation and decision-making as well as the preferred servicing strategy and associated capital program.

A significant amount of technical background information has been compiled, which is critical to the development of the Wastewater Master Servicing Plan. This information is included as appendices of Volume IV. The technical appendices contain relevant project, implementation and technical analysis information, including:

- Appendix 4A – Wastewater Flow Projections
- Appendix 4B – Historical Wastewater Flows
- Appendix 4C – Wastewater Evaluation Tables
- Appendix 4D – Unit Costs
- Appendix 4E – Preliminary Wastewater Model Results

Volume V – Stormwater Master Plan

Volume V consists of the principal document summarizing the study objectives, approach, methodologies, technical analyses, evaluation and selection of the preferred stormwater servicing strategy. This volume outlines the stormwater policies, design criteria and level of service needed to be achieved by the stormwater network. In addition, Volume V identifies the existing stormwater network and describes the hydraulic modelling tool used for the analysis. Further in Volume V is the detailed evaluation and decision-making as well as the preferred servicing strategy and associated capital program.

Background information is included as appendices of Volume V. The technical appendices contain relevant project, implementation and technical analysis information, including:

- Appendix 5A – Introduction to Stormwater Management
- Appendix 5B - Stormwater Evaluation Tables
- Appendix 5C – Unit Costs

Volume VI – Public and Agency Consultation

Volume VI contains all relevant documentation of the public consultation process including notices, comments and responses, and distribution information. Presentation material from all Public Information Centres (PICs) held during the process is included. Other presentation material and discussion information from workshops held with relevant agencies, approval bodies and other stakeholders are also included.

1.4 Master Plan Report Volume IV

This current volume provides the analysis and summary of the preferred wastewater servicing strategy for the City of Brantford. It also provides the background support for satisfying Phase I and II of the Class EA process.

Volume IV is organized into the following sections:

1. Introduction
2. Wastewater System Policy and Criteria
3. Existing Wastewater Collection System
4. Assessment of Existing and Future Wastewater Infrastructure
5. Evaluation of Strategies
6. Preferred Wastewater Servicing Strategies
7. Post 2031 Vision

Volume IV is one of six volumes that make up the complete Master Servicing Plan Class EA Study Report and should be read in conjunction with the other volumes.

2 Wastewater System Policy and Criteria

2.1 Design Criteria

A guiding principle of design criteria is to ensure that the flow projections are adequately predicted with an appropriate factor of safety and risk management. This overall principle also ensures that infrastructure has sufficient capacity to meet the growing needs of the City and does not impede the approved/planned growth.

The design criteria was reviewed as part of this Master Servicing Plan to ensure wastewater flows are accurate and will support sizing and timing of future infrastructure such as pipes and facilities.

2.1.1 Dry Weather Flow

The Dry Weather Flow (DWF) is the portion of sanitary flow that is generated by residential, industrial, commercial and institutional water consumption. It may also contain a portion of base infiltration. The amount of base infiltration during dry weather flow periods is usually judged to be the minimum night time flow or a certain proportion of it.

For analysis of the wastewater system and for use with the City of Brantford's wastewater hydraulic model, the Dry Weather Flow (DWF) was estimated based on water meter data received from the City of Brantford for 2013. This meter data was then adjusted based on a comparison of the water production at Holmedale Water Treatment Facility for the year 2013 versus treated sanitary flow at the Brantford Wastewater Treatment Plant (WWTP). The wastewater generation figure for the same time period at the WWTP was calculated to be 90 percent of the water consumption figure, therefore the individual metered flows were reduced by 10% to establish the sanitary dry weather flow.

This methodology was confirmed through workshops with City Staff and a final per capita dry weather flow was established.

Table 4.1 summarizes the final sanitary DWF design criteria for the City of Brantford based on the above analysis.

Table 4.1 – Wastewater Design Criteria

Type of Development	Average Day Flow	Peaking Factor
Residential	270 L/person/day	Harmon (min 2.0, max 4.0)
Employment	300 L/employee/day	2.0

2.1.2 Wet Weather Flow

Wet Weather Flow is comprised of the aforementioned dry weather flow component and rainfall derived inflow and infiltration (RDII or I/I). The rainfall can either enter the system as runoff or as groundwater infiltration.

The RDII used for the analysis and within the Wastewater Hydraulic Model was applied based on the MOE design criteria of **0.2 L/s/ha.**

- ***Peak wet weather infiltration allowance: 0.2 L/s/ha based on gross catchment area; minimum MOE guidelines***

Based on the above Criteria, the total Peak Wet Weather flow is then calculated as follows

Peak Wet Weather Flow = (Dry Weather Flow x Peaking Factor) + RDII Allowance

The capacity of the sewage pumping stations and trunk sewers are assessed based on peak wet weather flow, which is the combination of peak dry weather flow plus infiltration allowance as identified above.

A high-level comparison of this criteria has been completed, evaluating the suitability of the per capita flow and assumptions used for the Brantford Master Servicing Plan as compared to other larger municipalities within the Greater Golden Horseshoe. This comparison is shown below in Table 4.2

Table 4.2 – Per Capita Wastewater Flow Comparison Table

Municipality	Approximate Service Population	Avg Dry Weather Flow Criteria (L/cap/day)	Peaking Factor	Sewer Design Basis
City of Brantford	94,000	270 – 300	Harmon	PWWF = DWF*PF + I/I
York Region	1,062,000	285-369	Harmon	PWWF = DWF*PF + I/I
Peel Region	1,290,000	303	Harmon	PWWF = DWF*PF + I/I
Halton Region	476,000	275	Harmon	PWWF = DWF*PF + I/I
City of Hamilton	500,600	360	Babbitt	PWWF = DWF*PF + I/I
Durham Region	490,000	364	Harmon	PWWF = DWF*PF + I/I
City of London	355,000	250	Harmon	PWWF = DWF*PF + I/I (factor of 1.1 applies to parcels <200 ha)
Halifax Water	300,000	330	Harmon	PWWF = 2.5 x (DWF*PF + I/I)

2.1.3 Sewage Pumping Station Capacity Assessment

City of Brantford design standards define the sewage pumping station (SPS) firm capacity as well as the maximum SPS inflow limits. Eight sewage pumping stations of varying sizes lie within the Brantford City

Limits, none of which have incoming flow monitoring. Some stations contain varying degrees of Supervisory Control and Data Acquisition (SCADA) systems that monitor station operations.

The level of service standards used for the Brantford Master Servicing Plan require that sewage pumping station capacity to be based on full capacity redundancy (i.e. full 100%) based on maintaining adequate emergency level of service. This approach ensures an elevated level of safety within the pumping stations. For example, within this study a sewage pumping station that houses four pumps rated at 100 L/s will have a firm capacity for this Master Servicing Plan Analysis of 200 L/s.

2.2 Costing Methodology

2.2.1 Unit Rates

Unit cost rates were used as a baseline approach in determining estimated linear project costs. The linear unit rates used for this Master Servicing Plan are based in 2014 dollars and take into consideration southern Ontario prices of labour and availability of materials. The unit rates are the result of preparing multiple Master Planning Studies and have undergone independent peer reviews in order to further refine and ensure overall accuracy of the cost estimates. Estimates were favorably compared to costs of recent capital projects within Brantford, the GTA and southern Ontario to support validation of the unit rates. A summary of the linear unit water costs for the Master Servicing Plan is provided in Appendix 4D.

2.2.2 Operation and Maintenance Costs

Operation and Maintenance Costs (O & M) have been qualitatively considered during the evaluation of servicing alternatives. The development of alternatives has strived to reduce O & M costs wherever possible. For example, the ongoing operation and maintenance costs of a sewage pumping station will have a larger financial impact on a servicing strategy, therefore the evaluation has shown a preference of a gravity solutions instead of pumping stations, where possible.

2.2.3 Final Project Costs

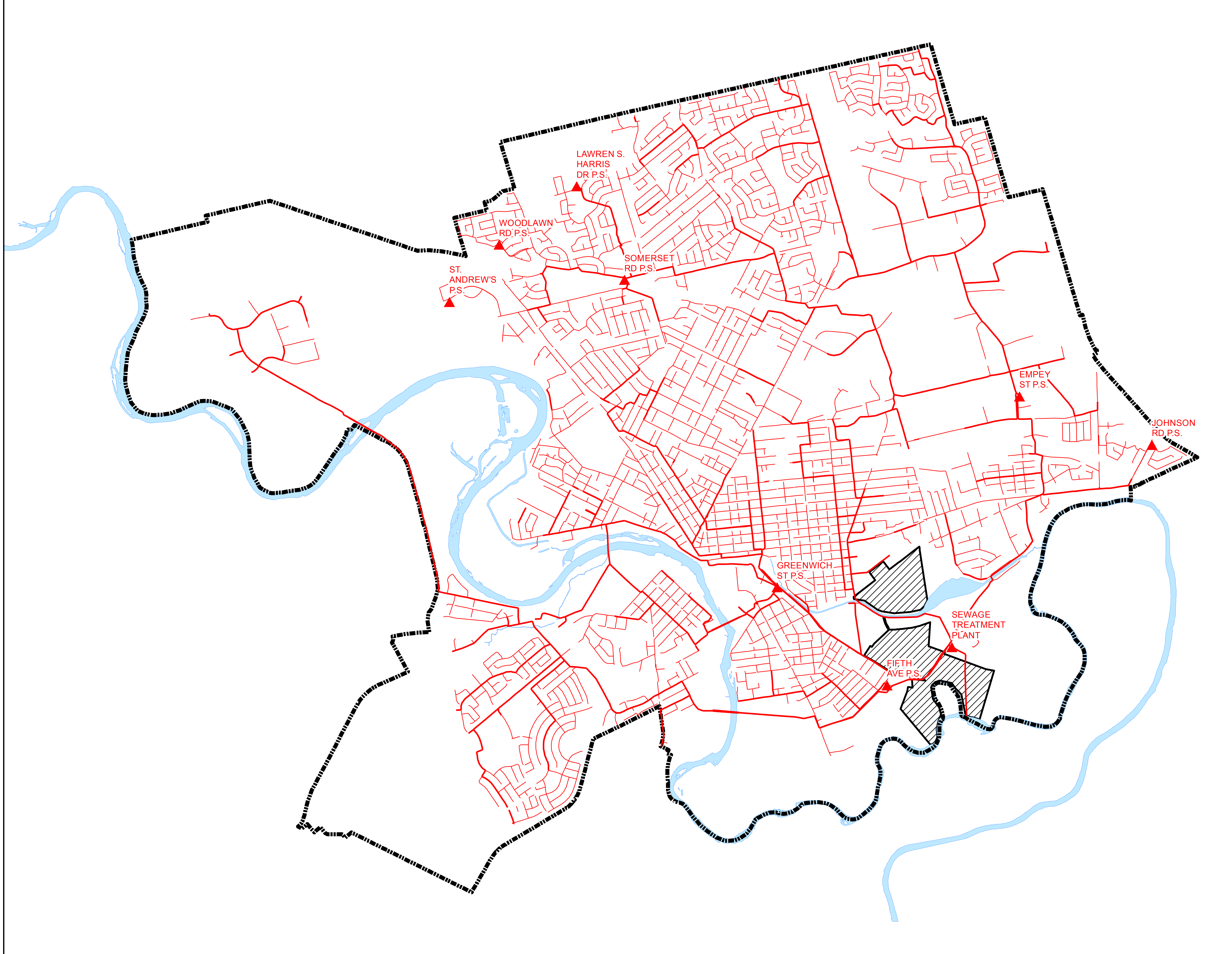
The 2014 Master Servicing Plan includes the calculation of capital costs for all proposed projects. These costs were calculated using a combination of methods. For the majority of the wastewater projects, a base construction cost was obtained using either unit rate construction cost based on pipe diameter or unique project analysis. The base construction cost considers several factors unique to each project such as approximate depth of installation, creek, railway and highway crossings, tunneling requirements, Greenfield versus urban construction and various other construction challenges. Design, administration, contingency and non-recoverable HST costs were added to arrive at a final project cost. Detailed costing sheets were developed to support the financial evaluation for each linear and facility projects. The final project costs are shown in the Capital Program within Section 6.2.

3 Existing Wastewater Collection System

3.1 Existing Infrastructure

The City of Brantford employs a stream-based wastewater collection and treatment system that collects wastewater from the east and west sides of the Grand River. The collection system generally drains from the north to the south and from west of the Grand River to the East. In areas where gravity servicing is not possible due to topographic constraints, sewage pumping stations pump flows to the gravity network. The existing network also includes siphons which convey flow under the Grand River in four locations. Wastewater flow is sent to the Brantford Water Pollution Control Plant, located in southeast Brantford where flow undergoes preliminary, primary and secondary treatment before the treated effluent is discharged to the Grand River.

The wastewater collection system is summarized within this section and is shown in Figure 4.2.



City of Brantford
2014 Master Servicing Plan (MSP)
for Water, Sanitary and Stormwater Services

Figure 4.2 - Existing Wastewater System

EXISTING WASTEWATER INFRASTRUCTURE

- <=250
- >250
- Pumping Stations
- Municipal Boundary
- Rivers
- Six Nations of the Grand River Territory

June 2014
1:44,000 | UTM83-17n

3.1.1 Water Pollution Control Plant

The Brantford Water Pollution Control Plant (WPCP) is located at 385 Mohawk Street adjacent to the Grand River in southeast Brantford. The plant is operated by the Ontario Clean Water Agency (OCWA).

The WPCP is a Class III conventional activated sludge (CAS) facility with rated capacity of 81,800 m^3/day and final effluent discharging to the Grand River.

Wastewater flow from the City of Brantford is conveyed to the WPCP via 1,200 mm and 1,350 mm diameter trunk sewers on Mohawk Road. The influent sewers first drain to a raw sewage lift station which is equipped with four dry pit submersible pumps, each rated at 675 L/s, and twin forcemains that discharge to the preliminary treatment building.

Preliminary treatment is achieved using two mechanically raked bar screens within two screening channels plus two vortex grit chambers. Peak flow rate capacity of the preliminary treatment works is 116,000 m^3/d (116 MLD).

Primary and Secondary treatment is carried out within two process modules. Process Module 1 has an Average Daily Flow capacity of 54,500 m^3/d (54.5 MLD). The treatment works consist of four primary clarifiers equipped with raw sludge pumps, two aeration tanks and six secondary clarifiers. Process Module 1 uses four return/waste activated sludge pumps to pump return activated sludge to the aeration tanks and waste activated sludge back to the headworks.

Process Module 2 has an Average Daily Flow capacity of 27,300 m^3/d (27.3 MLD). The treatment works consist of two primary clarifiers equipped with raw sludge pumps, two aeration tanks and two secondary clarifiers. Process Module 2 uses two return/waste activated sludge pumps to pump return activated sludge to the aeration tanks and waste activated sludge to the inlet Pumping Station.

The treatment process includes phosphorous removal, disinfection and dechlorination, prior to discharge via a 2,000 m, 1,200 mm diameter outfall to the Grand River. The raw sludge is pumped to an anaerobic digester tank and one secondary digester tank. Digested sludge is pumped and stored in 1 of 3 biosolids storage tanks (8,000 m^3 each) located across from the Brantford WPCP and land applied during the timeframe of April to November.

3.1.2 Sanitary Trunk Sewers

The City of Brantford operates a separated sanitary sewer system generally extending to the northwest and northeast from the WPCP located on Mohawk St.

A larger trunk sewer network and catchment area collects most areas northeast of the Grand River. A 975 mm – 1200 mm trunk sewer extends along the east side of Brantford, generally Mohawk Street, Empey Street, Roy Boulevard and Wayne Gretzky Parkway, a 675 mm – 750 mm sewer extends north through the centre of Brantford just west of Wayne Gretzky Parkway and a 900 mm sewer services the majority of the downtown core and follows Greenwich Street.

A smaller collection system drains the area southwest of the Grand River towards Colborne Street. The trunk sewer network crosses the Grand River via siphons from southwest to northeast at two locations;

south of Colborne Street and south of Baldwin Street along the Dike Trail. In addition, flow from smaller catchments crosses the Grand River from northeast to southwest from Grand River Ave to Spalding Drive and along the Oak Hill Trail south of Hardy Road.

There are currently no CSOs within the Brantford sanitary collection network.

3.1.3 Sewage Pumping Stations

There are eight sewage pumping stations of varying capacity that are owned by the City of Brantford and operated by the Ontario Clean Water Agency (OCWA). Table 4.3 below summarizes the station pumps and theoretical firm capacity based on the City requirement to have full 100% redundancy. The SPS locations are identified in Figure 4.2.

Table 4.3 – Sewage Pumping Station Summary

Station	Pumps	Pump Capacity (L/s)	Installed Capacity (L/s)	Theoretical Firm Capacity (100% Redundancy) (L/s)
Empey SPS	1	268	1292	646
	2	268		
	3	378		
	4	378		
Woodlawn SPS	1	50	150	50
	2	50		
	3	50		
Somerset SPS	1	108	432	216
	2	108		
	3	108		
	4	108		
Greenwich SPS	1	95.2	381	190
	2	95.2		
	3	95.2		
	4	95.2		

Station	Pumps	Pump Capacity (L/s)	Installed Capacity (L/s)	Theoretical Firm Capacity (100% Redundancy) (L/s)
Fifth Ave SPS	1	50	150	50
	2	50		
	3	50		
St Andrews SPS	1	25	50	25
	2	25		
Northridge SPS	1	53.7	161	54
	2	53.7		
	3	53.7		
Johnson SPS	1	53	159	53
	2	53		
	3	53		

3.2 Hydraulic Wastewater Model

Analysis of the current and future wastewater collection system capacity was undertaken using a hydraulic simulation model. The City of Brantford maintains an all pipe model of its wastewater collection system based in InfoWorks CS (Innovyze). The wastewater model was used to analyze existing and future capacity and expansion needs in the City of Brantford's wastewater collection system up to the year 2031.

Dry Weather Flow

Dry Weather Flow (DWF) is the portion of sanitary flow that is generated by residential, industrial, commercial and institutional water consumption. It may also contain a portion of base infiltration. The amount of base infiltration during dry weather flow periods is usually judged to be the minimum night time flow or a certain proportion of it.

For the City of Brantford's wastewater hydraulic model, the DWF was estimated based on water meter data received from the City of Brantford for 2013. This meter data was then adjusted based on a comparison of the water production at Holmedale Water Treatment Facility for the year 2013 versus treated sanitary flow at the Brantford Wastewater Treatment Plant (WWTP). The wastewater generation figure for the same time period at the WWTP was calculated to be 90 percent of the water consumption figure, therefore the individual metered flows were reduced by 10% to establish the sanitary dry weather flow.

Wet Weather Flow

Wet Weather Flow is comprised of the aforementioned dry weather flow component and rainfall derived inflow and infiltration (RDII). The rainfall can either enter the system as runoff or as groundwater infiltration.

The RDII in the model was applied based on the MOE design criteria of 0.2L/s/ha.

Model Validation

The scope of work for the master plan did not include flow monitoring for the purposes of calibrating the model. However, the model was validated for accuracy using a number of different benchmarks. Average daily flow at each pumping station was supplied by the City and the dry weather flow in the model was measured against this to ensure that flow was realistic.

Harmon peak factor was calculated using data obtained from the treatment works and then a generic diurnal profile was generated which used the peaking factor calculated at the treatment works. This diurnal profile was applied across the whole model.

Growth Scenario Modelling

For the analysis of the City of Brantford model, a future growth scenario was developed for the year 2031. This meant allocating dry weather flows to Greenfield and intensification development areas and also incorporating an allowance for Inflow and Infiltration (I & I) of 0.2 L/s/ha (based on the MOE design criteria) for the Greenfield development area. The flow projections and Traffic Survey Zone analysis is described in Section 4.2

4 Assessment of Existing and Future Wastewater Infrastructure

The first step in the detailed analysis of the Master Servicing Plan is assessment of the existing infrastructure capacity and conditions. Establishing accurate existing conditions will ensure further accuracy of the future recommendations. Once the existing system conditions are established, the impacts of future growth flows on the collection system were analyzed to develop and evaluate servicing alternatives.

The following sections describe the current infrastructure constraints, future wastewater flow and capacity deficiencies within the wastewater collection system to the 2031 planning horizon.

4.1 Opportunities and Constraints

Existing opportunities and constraints were identified through preliminary infrastructure review and discussions with City staff. In addition, the opportunities and constraints were further validated through preliminary modelling results, which can be found in Appendix 4E. The opportunities and constraints are shown in Figure 4.3 and are further outlined in the following sections.

4.1.1 Water Pollution Control Plant

The Brantford Water Pollution Control Plant currently has adequate capacity to treat existing flows and does not currently experience overflows under high flows. Further assessment of the capacity with respect to future flows can be found in Section 4.2.1.

4.1.2 Collection System

In general, the collection system has adequate capacity for existing peak wet weather flow. The hydraulic model was used to identify locations of constraints as well as input from City staff. This review identified some isolated locations within the older areas of Brantford that experience capacity issues and surcharging under peak flow conditions. The following Opportunities and Constraints were identified:

General

- Oak Hill Road sewer diameter decrease within steep trunk sewer
- Several sewers cross Grand River – siphons and pipe bridges
- Northwest Brantford growth flows through single pipe – limited flexibility
- Downtown University campus to be included in analysis

Capacity

- Insufficient sewer capacity upstream of Greenwich SPS
- Insufficient sewer capacity (surcharging) downstream of Wayne Gretzky Pkwy/Henry Street
- Capacity constraints along Hardy Road
- Trunk sewer capacity in trunk sewer south of Hardy Road (northwest Brantford)
- Greenfield growth in southwest Brantford focuses on the Shellard Lane sewer
- Sunset Avenue/Alexander Drive Area sewer capacity issues.

- Future Intensification within downtown core requires accommodating growth while maintaining level of service
- Brantford Water Pollution Control Plant has adequate hydraulic capacity for existing service area plus growth, based on average daily flow. Treatment/loading concentration capacity is under review
- Some Sewage Pumping Stations may approach capacity under growth scenarios

All flow through a single, long sewer crossing the Grand River.

North West Growth

Several areas have been identified as experiencing existing capacity constraints

Capacity

Exploring ways to minimize new infrastructure needs in busy urban areas whilst maintaining levels of service will be a focus for intensification areas.

Intensification Areas

Significant growth flow through trunk sewers and river crossing via siphon. Flow through Fifth Ave Sewage Pumping Station.

West Conklin Growth

Servicing the downtown core will require integration with rehabilitation programs for old assets as well as complementing the transportation master plan.

Downtown Core

Several sewers crossing the Grand River. These locations require particular attention due to the environmental importance and difficulty in modifying them.

River Crossing: siphons and pipe bridges

The growth to the Uuniversity campus has been included to ensure that the final servicing strategy is comprehensive.

University

Some of the City's pumping stations are predicted to become close to capacity under growth conditions if current levels of service are to be maintained.

Pumping Stations

Based on average daily flow the hydraulic capacity of the treatment plant is adequate. Treatment/loading concentration capacity under review.

Treatment Plant

Several environmental constraints and environmentally sensitive areas throughout Brantford.

Environmental

N

THE CORPORATION OF THE CITY OF BRANTFORD

City of Brantford
2014 Master Servicing Plan (MSP)
for Water, Sanitary and Stormwater Services

Figure 4.3 - Opportunities and Constraints

EXISTING WASTEWATER INFRASTRUCTURE

- <=250
- >250
- Pumping Stations
- Municipal Boundary
- Rivers
- Six Nations of the Grand River Territory

BluePlan ENGINEERING CONSULTANTS LIMITED

July 2014
1:44,000 | UTM83-17n

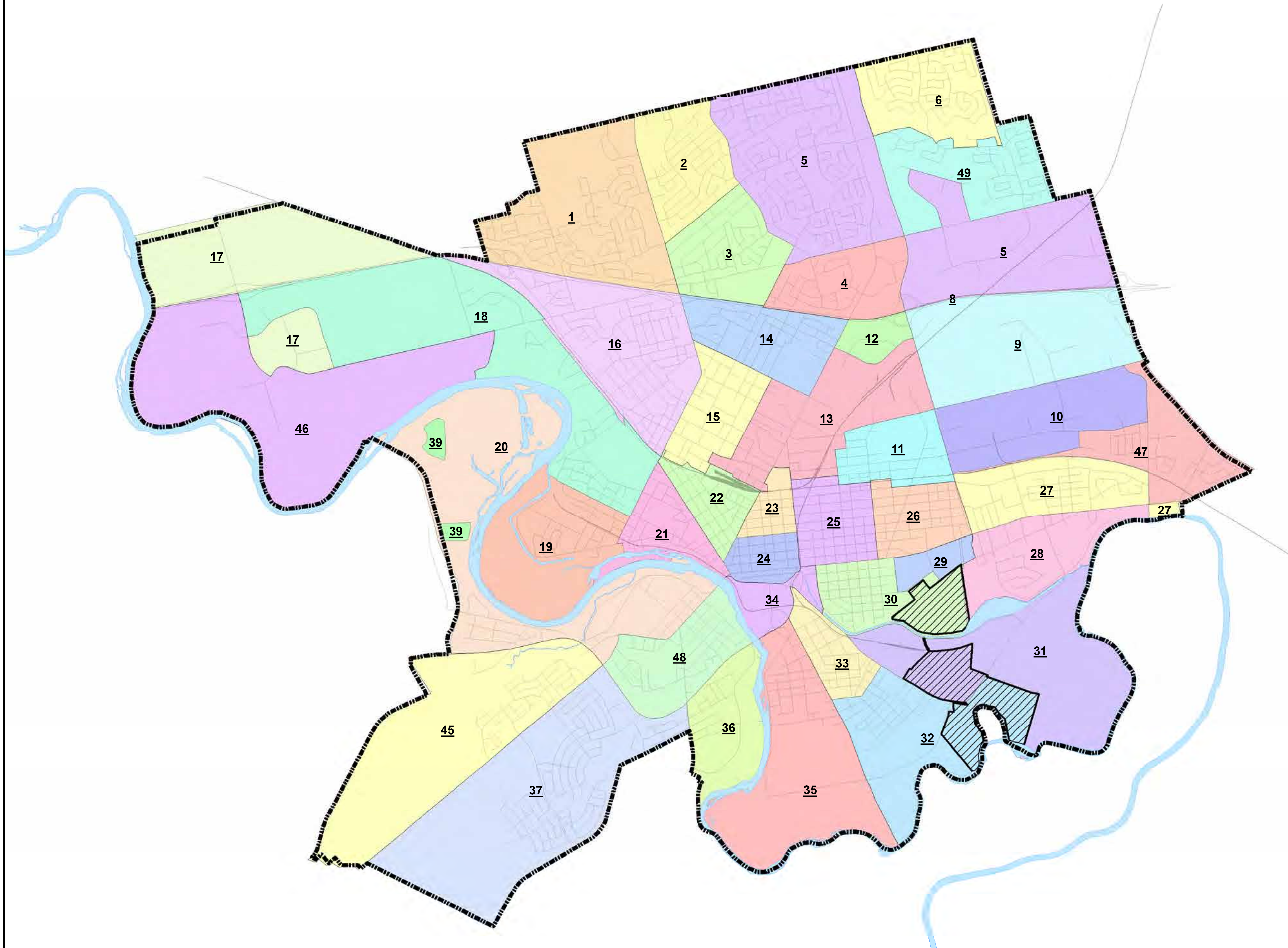
4.2 Hydraulic Analysis

Analysis and wastewater flow from existing and future population and employment growth is based on the City's Traffic Zones. These Traffic Zone polygons containing growth data were supplied by the City as shown in Figure 4.4. Once the population had been calculated for each Traffic Zone and Intensification Zone, an average daily wastewater flow was calculated using the design criteria methodology described in 2.1. For wastewater flow projection, the wastewater per capita design criteria was 270 L/person/day and 300 L/employee/day.

Table 4.4 shows the average daily water demand and Table 4.5 shows the average daily flow for wastewater.

Table 4.4 - 2031 Water Average Daily Flow for Traffic Zones and Intensification Zones

Intensification Zones	Water Consumption Figure (L/person/d)	Avg Daily Flow Per Zone (L/s)	Avg Daily Flow Per Node (L/s)
1	300	4.832	4.832
2	300	2.484	0.131
3	300	9.787	0.652
4	300	3.726	0.081
4a	300	4.068	0.097
4b	300	6.708	6.708
5	300	28.456	0.199
5a	300	3.336	0.257
6	300	30.411	0.428
6a	300	6.378	3.189
6b	300	4.777	0.177
7	300	4.425	0.277
8	300	2.980	0.298
Traffic Zones	**Water Consumption Figure (L/person/d)**	**Avg Daily Flow Per Zone (L/s)**	**Avg Daily Flow Per Node (L/s)**
6	300	0.318	0.008
17	300	15.723	3.145
19	300	1.665	0.023
22	300	1.564	0.015
27	300	1.382	0.021
28	300	0.056	0.001
30	300	1.379	0.019
31	300	5.526	0.461
36	300	0.298	0.013



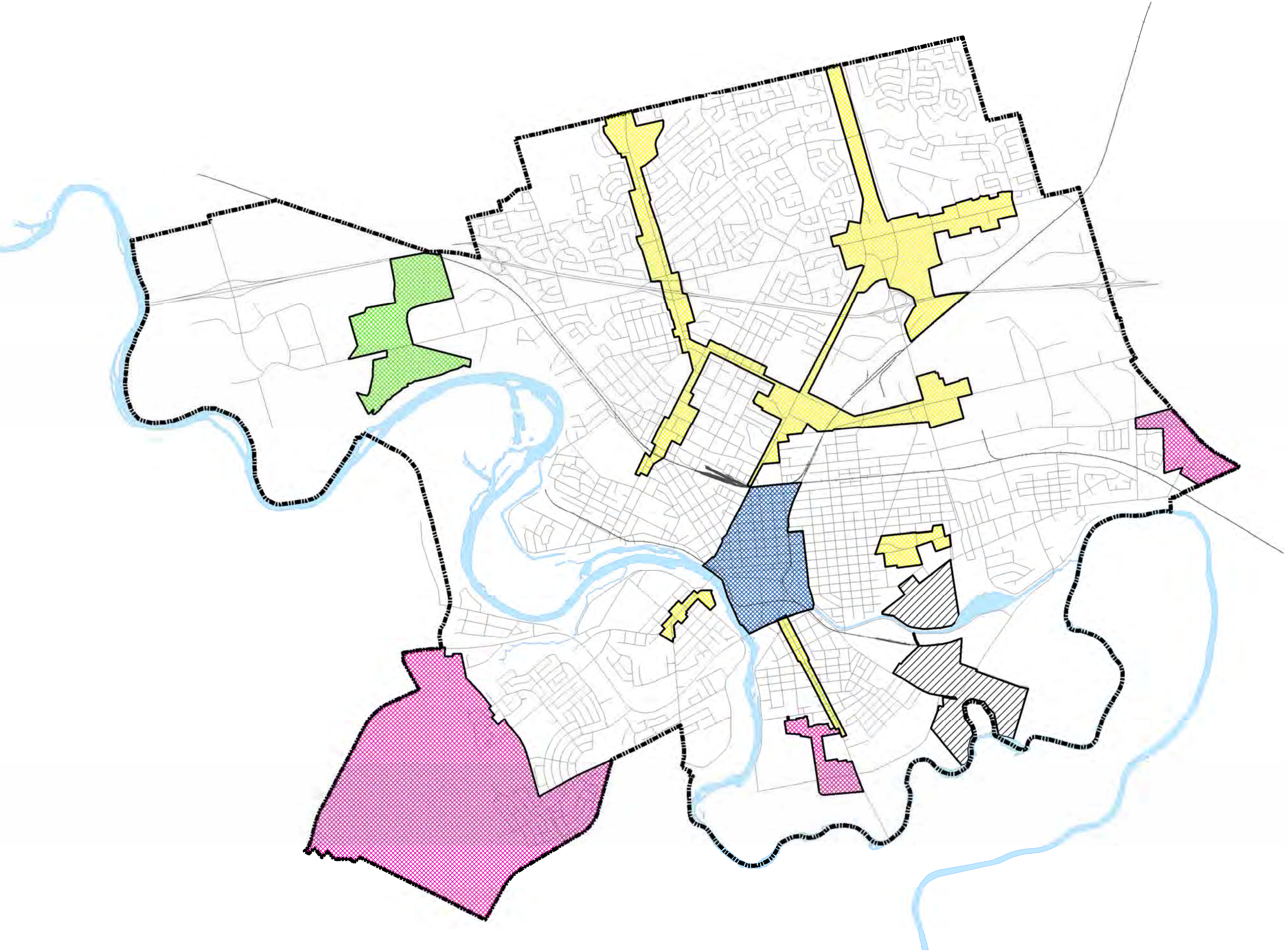
THE CORPORATION OF THE CITY OF BRANTFORD

City of Brantford
2014 Master Servicing Plan (MSP)
for Water, Sanitary and Stormwater Services

Figure 4.4 - Traffic Zones

BluePlan ENGINEERING CONSULTANTS LIMITED

June 2014
1:44,000 | UTM83-17n



City of Brantford
2014 Master Servicing Plan (MSP)
for Water, Sanitary and Stormwater Services

Figure 4.5 - Intensification Zones

GROWTH AREAS

- Greenfield Area
- Intensification Area
- Under OMB Review
- Urban Growth Centre
- Rail
- Roads
- Municipal Boundary
- Rivers
- Six Nations of the Grand River Territory

June 2014
1:44,000 | UTM83-17n

Table 4.5 - 2031 Wastewater Average Daily Flow for Traffic Zones and Intensification Zones

Intensification Zones	Wastewater Generator Figure (L/employee/d)	Wastewater Generator Figure (L/person/d)	Avg Daily Flow Per Zone (L/s)	Avg Daily Flow Per Node (L/s)
1	300	270	4.355	4.355
2	300	270	2.318	0.063
3	300	270	9.289	0.113
4	300	270	3.457	0.038
4a	300	270	3.773	0.042
4b	300	270	6.740	0.518
5	300	270	26.568	0.111
5a	300	270	3.054	0.180
6	300	270	27.569	0.163
6a	300	270	5.748	1.150
6b	300	270	4.315	0.108
7	300	270	4.014	0.098
8	300	270	2.721	0.088
Traffic Zones	**Per Capita Flow (L/employee/d)**	**Per Capita Flow (L/person/d)**	**Avg Daily Flow Per Zone (L/s)**	**Avg Daily Flow Per Node (L/s)**
6	300	270	0.309	0.002
17	300	270	15.723	0.403
19	300	270	1.503	0.014
22	300	270	1.433	0.011
27	300	270	1.255	0.008
28	300	270	0.055	0.000
30	300	270	1.248	0.009
31	300	270	4.974	0.094
36	300	270	0.270	0.006

The average daily flow was distributed evenly across the nodes in each Traffic Zone and Intensification polygon. To achieve this, the number of nodes in each polygon was summed and the flow per node was established. Where there was growth but no nodes, the loading was allocated to a suitable node outside of the polygon. The suitability of the node was established by looking at the diameter of the incoming and outgoing pipes and, for wastewater, the natural drainage path of the flow. It should be noted that the flow generated in the model differed from manual calculations undertaken as the polygons for the intensification zones used in the model were, in some cases, a combination of smaller intensification zones used for the manual calculations.

The inflow and infiltration allowance for the Greenfield zones in the City of Brantford is shown in Table 4.6. This flow was point loaded into the model at locations that were considered to be the most suitable location for the new development.

Table 4.6 - Inflow and Infiltration Allowance for Greenfield Zones

Intensification Zones	Area (ha)	I/I Allowance (0.2 L/s/ha)	Node Loading Point (Manhole ID)
1	113.5	22.7	NW052
6	555.0	111.0	Flow split between nodes ED130 & ED515
6a	30.4	6.1	ED073
7	43.2	8.6	EC339

The model analysis revealed capacity issues at several locations within sanitary network. Surcharged pipes were observed upstream of Greenwich SPS from the incoming sewer to the Northwest. Upgrades were recommended upstream of this location to Water Street. In addition, the discharge point from St Andrew's SPS forcemain was showing some surcharging and an upgrade is recommended at this point.

Due to anticipated intensification development to the northeast upstream of Empey SPS and known operational issues around Arrowdale Golf Course, the Master Servicing Plan recommended a pump upgrade at the Empey SPS.

4.2.1 Water Pollution Control Plant

The population and employment projections outlined in Volume II and the Design Criteria within Section 2 of Volume IV were utilized to calculate the average day wastewater flow projections. The total flow for the City of Brantford catchment to the Brantford Water Pollution Control Plant is shown in Table 4.7.

Table 4.7 - Brantford WPCP Average Day Wastewater Flow Projection (MLD)

	2013	2031
Brantford WPCP Capacity (MLD)*	81.8	81.8
Average Day WW Flow (MLD)	32.9	52.5

**Treatment Capacity based on combined Process Module 1 & 2 Average Daily Flow from City of Brantford C of A 0954-8AGKDD*

Current hydraulic treatment capacity of the Brantford Water Pollution Control Plant is 81.8 MLD (946 L/s). As per the flow projections outlined in Table 4.7 and graphically represented in Figure 4.6, there is adequate hydraulic treatment capacity to satisfy the projected growth to 2031 without upgrades.

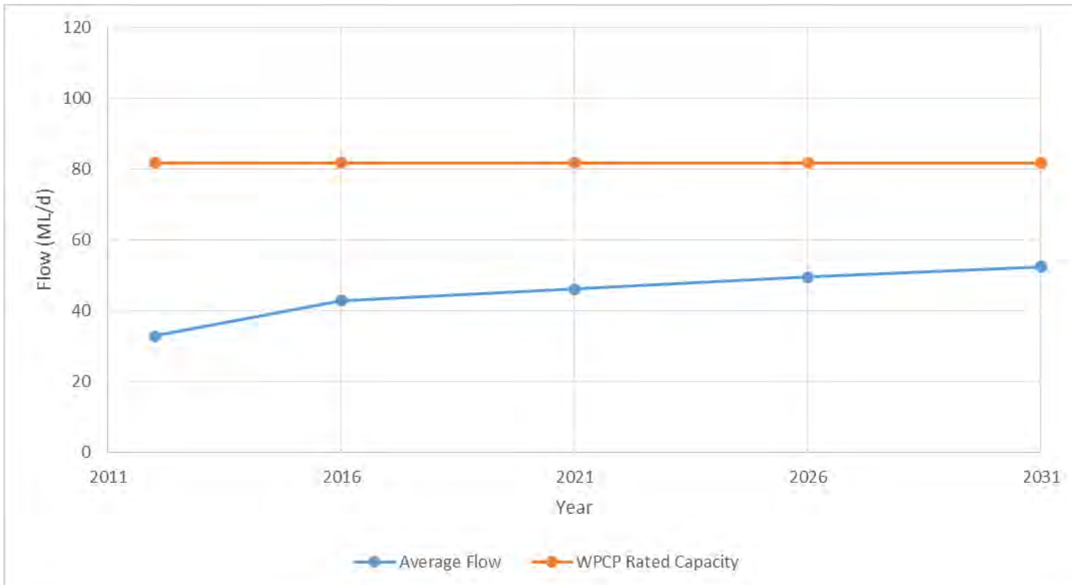


Figure 4.6 – Wastewater Flow Projections and Treatment Capacity

4.2.2 Sewage Pumping Stations

Modelled flows to the Sewage Pumping Stations (SPS) were assessed against firm capacity to satisfy design criteria outlined in Section 2.1.3. Table 4.8 lists the SPS firm capacity and projected peak wet weather flow according to the existing SPS catchments and existing operational conditions.

Table 4.8 – SPS Capacity and Peak Wet Weather Flow

		Peak Wet Weather Flow (L/s)	
Station	Theoretical Firm Capacity (L/s)	2013	2031
Empey SPS	646	632	639[1]
Woodlawn SPS	50	53	52
Somerset SPS	216	74	82
Greenwich SPS	190	179	192
Fifth Ave SPS	50	39	46
St Andrews SPS	25	19	19
Northridge SPS	54	21	21
Johnson SPS	53	17	31

[1]Empey SPS has adequate capacity under existing and 2031 model runs. Diversion scenarios further described in Section 5 increase the peak wet weather flow to Empey SPS and trigger capacity upgrades

4.2.3 Sanitary Trunk Sewers

The InfoWorks CS all pipe model was used to identify potential issues in the City's sanitary trunk sewers. Sanitary trunk sewers generally have sufficient capacity for existing as well as 2031 peak wet weather flow, however, potential capacity issues under future peak wet weather flows were identified for sewers in the following areas:

- Upstream of Greenwich SPS
- Downstream of Wayne Gretzky Parkway/Henry Street
- Hardy Road

In addition to the upgrades to the existing network, extension of trunk sewers into Greenfield growth areas will be required and is further outline in Section 5.

5 Evaluation of Strategies

The identification and evaluation of servicing options is a critical component of the master planning process because it enables a comprehensive review of a reasonable range of alternatives while documenting the process in a transparent manner. The evaluation process that has been undertaken is described in the following sections.

5.1 Objectives

The identification and evaluation of servicing options is the comprehensive review of a reasonable range of alternatives while documenting the process in a transparent manner.

The 2014 Master Servicing Plan sets out to meet the Approach 2 requirements under the Municipal Engineers Association (MEA) Class EA process. Under Approach 2, a Master Plan document is prepared at the conclusion of Phases 1 and 2 of the Class EA process. This approach allows for all Schedule A, A+ and selected Schedule B projects identified in the Master Plan to move forward to implementation. To achieve this result, systematic evaluation and documentation is required to support selected Schedule B project Class EA requirements along with applicable review agency commitments prior to implementation. Select Schedule B and all identified Schedule C projects will require additional supporting information and decision making to proceed onto separate studies and continue to Phases 3 and 4 of the Class EA process.

The evaluation approach has been designed to ensure a logical and transparent process that can document the evaluation and decision making that will ultimately develop a defensible capital program. Sustainability principles were also considered in the development of the 2014 Master Servicing Plan and have been integrated within the five-point evaluation. Examples of such principles are:

- making best use of existing infrastructure;
- minimizing the cost of new infrastructure;
- considering operation and maintenance costs to ensure financial sustainability and;
- ensuring the long-term reliability and security of the water, wastewater and stormwater systems.

5.2 Description of the Evaluation Process

The Evaluation Process undertaken for development and selection of a preferred servicing strategy is described in this section and is graphically depicted in Figure 4.7.

A broad range of wastewater serving concepts were established based on high level feasibility to meet the servicing requirements for the growth within the City of Brantford. These high level concepts included but were not limited to Expand Existing Network, Inflow Infiltration Reduction and Wastewater Storage. These concepts also included Do Nothing and Limit Growth as required for the Class EA Process.

To evaluate the Servicing Concepts, the advantages and disadvantages for each were established based on several evaluation criteria. This preliminary evaluation examined the concepts from an ability to meet the servicing needs as well as a high level examination based on the 5-point criteria outlined in Section

5.3. Each concept was given a Low, Medium or High rating with concepts receiving a Low rating being screened out and not carried further to detailed evaluation.

The Servicing Concepts that were carried forward were then combined in order to build overall Servicing Strategies that would alleviate any existing constraints and satisfy the projected growth within Brantford to 2031. The Servicing Strategies were evaluated using a detailed 5-point strategy evaluation described in Section 5.3. The result of this evaluation was the selection of the Preferred Servicing Strategy.

The Preferred Servicing Strategy consists of several Concepts and, while an Overall Preferred Strategy was selected, additional details for extension of sanitary servicing for the Northwest Growth Area was required. This gave rise to an additional evaluation of five potential servicing 'sub-options' within the area and subsequent selection of a Preferred Strategy for the Northwest Growth Area.

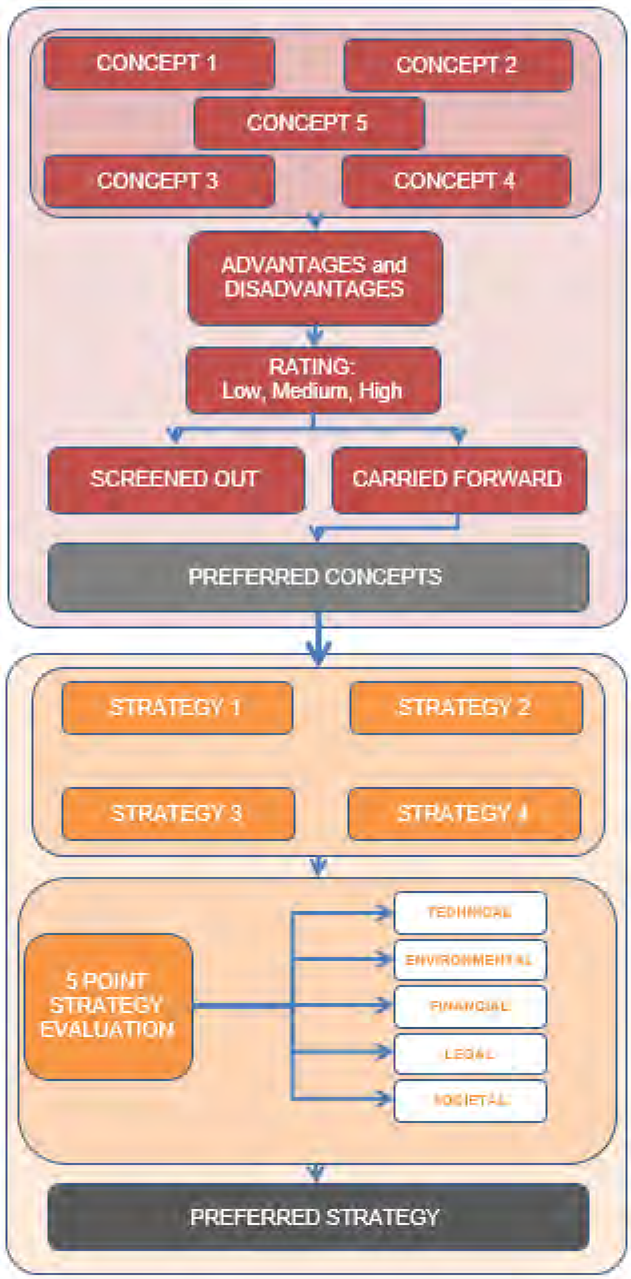


Figure 4.7 – Servicing Option Evaluation Flow Diagram

5.3 Evaluation Criteria

Detailed evaluation matrices supporting the evaluation of servicing options within the localized areas were developed and used for selection of preferred servicing for the 2014 Master Servicing Plan. The complete evaluation matrices are included in Appendix 4C. The servicing strategies were subject to a 5-point evaluation which includes five major areas of impact: Technical, Environmental, Financial, Legal/Jurisdictional and Socio-Cultural. The 5-point criteria and the evaluation considerations are described further in Table 4.9.

Table 4.9 – Evaluation Criteria

CRITERIA	DESCRIPTION

Technical Impact	• Describes overall technical advantages and disadvantages to an option related to:
	  ○ capacity requirements and level of service
	  ○ performance under power outage conditions
	  ○ alignments that can maximize a service area
	  ○ utilization of existing infrastructure
	• Describes difficulty of construction (e.g., construction in limited areas, crossings, protection of utilities, trees or structures)
	• Assesses whether existing infrastructure upgrades are required
	• Describes risk considerations:
	  ○ Level of security of water supply/transmission or wastewater treatment/conveyance
	  ○ Considers impact of deep sewers versus sewage pumping stations
	• Describes the ability for phasing:
	  ○ staged growth and maximizing the use of existing or planned infrastructure
	  ○ incremental extensions of infrastructure as growth progresses
	  ○ balanced infrastructure costs with staged level of growth (high-level comment)
	• Describes impact on the sizing of planned and existing infrastructure
	• Highlights trunk infrastructure that potentially should be oversized to benefit future growth
	• Comments on whether growth areas will need to be serviced by existing or new infrastructure
	• Compares relative sizing differences between alternatives
	• Describes the technical consideration required for construction:
	  ○ Highlights need for deep pipe construction, creek/highway/railway crossings, alignment changes, and potential challenges during construction
	  ○ Where applicable, comments on construction of projects that can be coordinated with road improvements or construction
	• Describes potential opportunities/constraints to servicing build out
	• Notes flexibility of servicing the mature state growth (post Places to Grow)

CRITERIA	DESCRIPTION
Environmental Impact	• Describes the potential impacts of the option on the natural environment, proximity to existing natural features and designations including, but not limited to: ESAs, ANSIs, conservation authority regulation limits, vegetation, woodlands, wildlife, aquatic resources and fisheries • Highlights requirements for major environmental crossings, deep sewers, development through environmental designated areas, and requirements for mitigative action
Financial Impact	• Describes the capital cost relative to other options • Considers construction costs for new infrastructure and for upgrades to existing system • Highlights major projects that differ from other options that significantly contribute to the capital costs • Describes large up-front costs required for phasing of growth • Comments on post-construction impacts such as operation and maintenance costs and requirements, and compares to other options
Legal/Jurisdictional Impact	• Notes any land requirement issues and agency concerns that may arise related to project alignments, land acquisition, planning permits, crossings etc. • Comments on compliance with Guidelines and Policies • Describes the potential impacts related to opportunity or requirements for integrated planning, design, construction with other servicing such as bridge, road construction etc. • Notes if coordination with involved parties is required
Socio-Cultural Impact	• Describes the potential impacts to residents, archaeological/heritage resources, and visual aesthetics • Describes any potential noise, dust, vibrations, traffic disruptions to residents and businesses during and following construction

5.4 Servicing Concepts

The wastewater network, along with the previously identified Opportunities and Constraints, were examined within the larger, City-wide context as well as at a local level. A long list of high level Servicing Concepts were introduced early in the analysis and were investigated. The Concepts are listed below and were evaluated to determine which concepts are feasible to carry forward to make up City-Wide Servicing Strategies.

1. Do Nothing & Limit Community Growth
2. Increase Conveyance Capacity
3. Wastewater Storage
4. Inflow & Infiltration Reduction
5. Regulation/by-law to reduce and limit Inflow & Infiltration
6. Optimize System Operation
7. New West Brantford Water Pollution Control Plant
8. Satellite Treatment (multiple micro treatment plants)
9. High Flow Rate Treatment
10. Deep Tunnel

5.4.1 Servicing Concept Evaluation

A preliminary evaluation process for the servicing concepts was undertaken to determine which high level concepts should be carried forward or screened out.

The results of the screening evaluation process is provided in Appendix 4C and is summarized below.

1. Do Nothing & Limit Community Growth – *Screened Out*
2. Increase Conveyance Capacity – *Carried Forward*
3. Wastewater Storage – *Carried Forward*
4. Inflow & Infiltration Reduction - *Carried Forward*
5. Regulation/by-law to reduce and limit Inflow & Infiltration – *Carried Forward*
6. Optimize System Operation – *Carried Forward*
7. New West Brantford Water Pollution Control Plant – *Screened Out*
8. Satellite Treatment (multiple micro treatment plants) – *Screened Out*
9. High Flow Rate Treatment – *Screened Out*
10. Deep Tunnel – *Screened Out*

The advantages and disadvantages for each of the concepts is outlined in Appendix 4C. For the Do Nothing and Limit Community Growth options, it is recognized that these alternatives are required for evaluation under the Class EA process. It essentially identifies the existing conditions, and helps to define the extent of the problem. In this case the “Do Nothing” alternative does not address the problem and needs of the study. The Do nothing alternative would not alleviate existing wastewater servicing deficiencies or meet the servicing needs of population and employment growth mandated through the Province’s Places to Grow Act and the City’s growth conformity. For this reason the Do Nothing Alternative is not considered a viable alternative and has been screened out. Similarly, the Limit Growth alternative does not meet growth conformity and has also been screened out as a viable alternative

5.5 Servicing Strategies

The following servicing concepts were carried forward through the preliminary evaluation and were combined to create City-wide Servicing Strategies.

1. Water Conservation and Efficiency – *Common to all Strategies*
2. Increase Conveyance Capacity - *Common to all Strategies*
3. Wastewater Storage
4. Inflow & Infiltration Reduction – *Common to all Strategies*
5. Regulation/by-law to reduce and limit Inflow & Infiltration
6. Optimize System Operation

While each of these concepts on their own may not satisfy all growth and capacity constraints within the system, they have been combined to generate the Servicing Strategies. In addition, the concept of Inflow/Infiltration reduction represents good management of wastewater systems and as such, is encouraged to be carried forward in all Servicing Strategies.

At the servicing strategy level of detail, additional development of infrastructure location, capacity and purpose has been undertaken. The application of the servicing concepts as they related to the unique service areas across the City, including Greenfield and intensification areas, has been completed to determine the proposed infrastructure requirements.

Four Servicing Strategies were developed and evaluated. The descriptions for the Strategies are shown below and are depicted in Figure 4.8 to Figure 4.11.

Strategy 1 – Increased Conveyance

- Select system-wide conveyance capacity increases and extension to Greenfield service areas
- Capacity upgrades to alleviate surcharging downstream of the Wayne Gretzky Parkway/Hardy Road flow split

Strategy 2 – Increased Conveyance + Storage

- Select system-wide conveyance capacity increases and extension to Greenfield service areas
- Select wet weather storage to attenuate peak flows

Strategy 3 – Increased Conveyance + Diversion from Empey SPS

- Select system-wide conveyance capacity increases and extension to Greenfield service areas
- Capacity upgrades to alleviate surcharging downstream of the Wayne Gretzky Parkway/Hardy Road flow split.
- Diversion of flow from Empey SPS catchment to maximize capacity of upgrade downstream of flow split

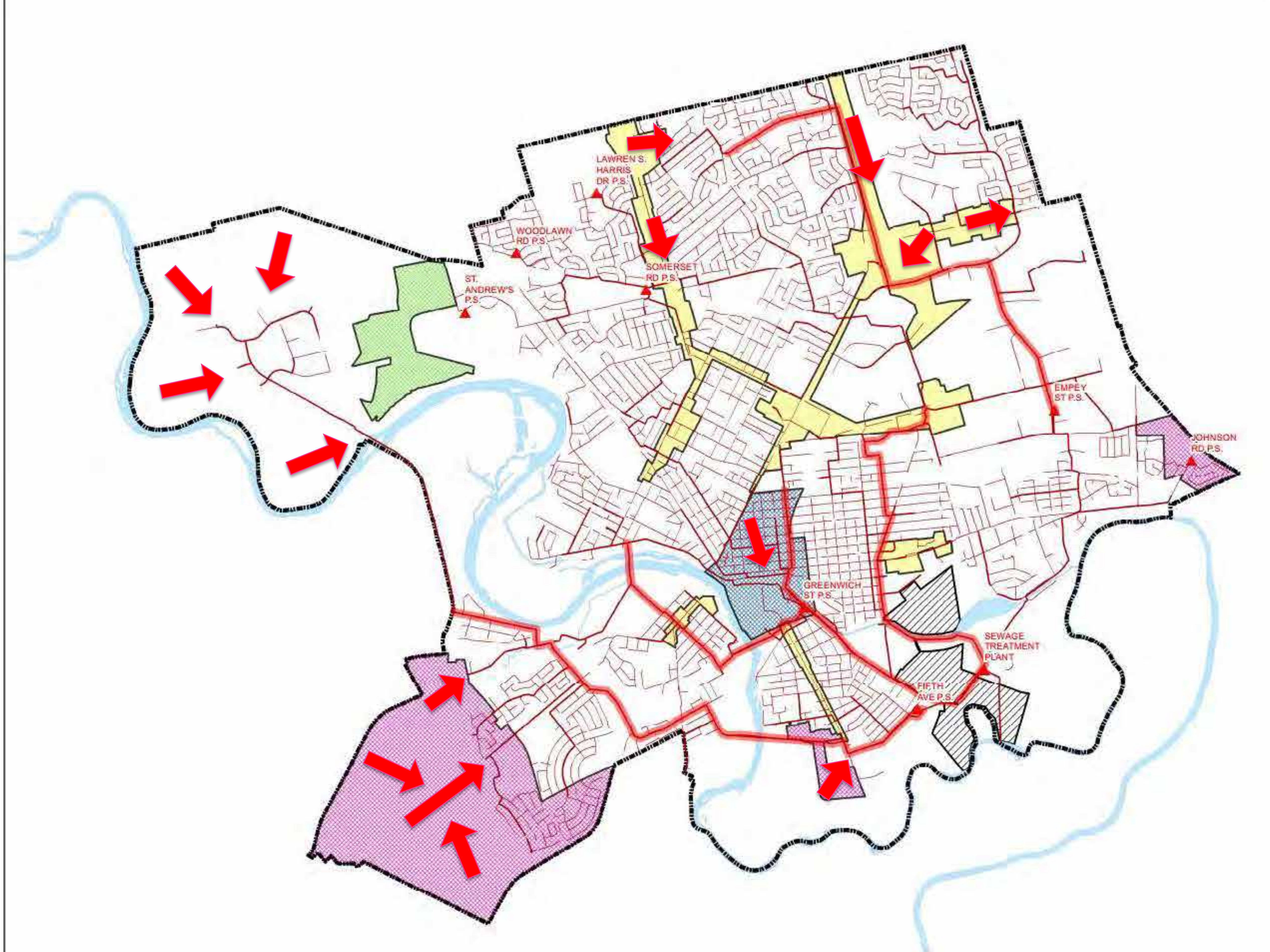
Strategy 4 – Increased Conveyance + Diversion to Empey SPS

- Select system-wide conveyance capacity increases and extension to Greenfield service areas

- Diversion of flow to Empey SPS via Wayne Gretzky Parkway/Hard Road split.
- Capacity upgrades at Empey SPS

Common Elements:

Common to all Servicing Strategies is the requirement for capacity upgrades within the existing system. Several existing sanitary sewers experience surcharging under future peak wet weather flows and have been identified for upgrades in all Strategies. In addition, to service Greenfield growth in the Northwest and Southeast Brantford, extension of the sanitary sewer network is required. This extension is also common to all Strategies, however separate “sub-options” for the Northwest Service area have also been identified.



BRANTFORD
THE CORPORATION OF THE CITY OF

City of Brantford
2014 Master Servicing Plan (MSP)
for Water, Sanitary and Stormwater Services

Figure 4.8 - Servicing Strategy 1
Increased Conveyance

UPGRADES

- Storage
- Sanitary Pipe

EXISTING WASTEWATER INFRASTRUCTURE

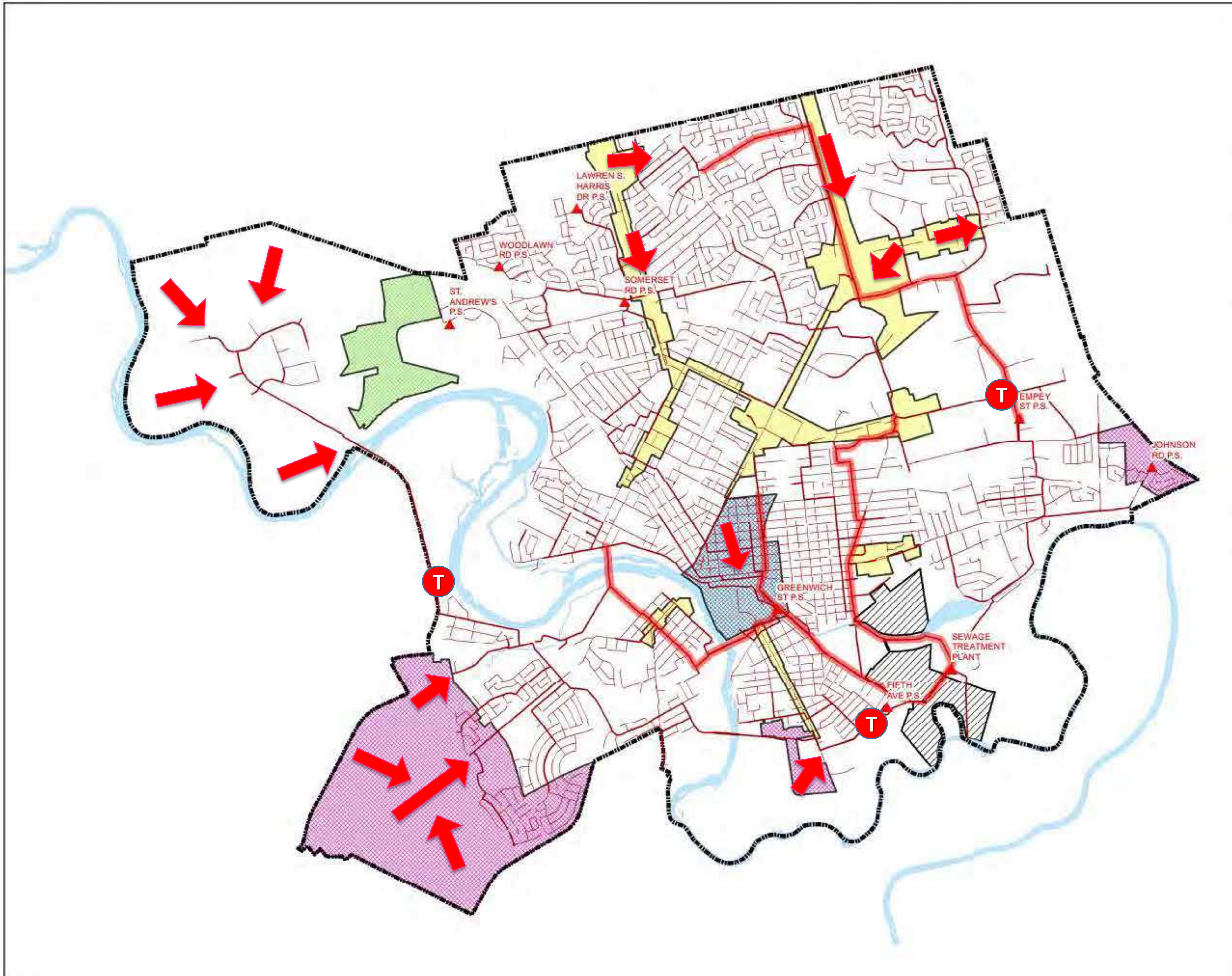
- <=250
- >250
- Pumping Stations
- Schematic Wastewater Servicing

GROWTH AREAS

- Greenfield Area
- Intensification Area
- Under OMB Review
- Urban Growth Centre
- Municipal Boundary
- Rivers
- Six Nations of the Grand River Territory
- Schematic Wastewater Servicing

BluePlan

June 2014
1:44,000 | UTM83-17n



N

THE CORPORATION OF THE CITY OF BRANTFORD

City of Brantford
2014 Master Servicing Plan (MSP)
for Water, Sanitary and Stormwater Services

Figure 4.9 - Servicing Strategy 2
Increased Conveyance + Storage

UPGRADES

- Storage
- Sanitary Pipe

EXISTING WASTEWATER INFRASTRUCTURE

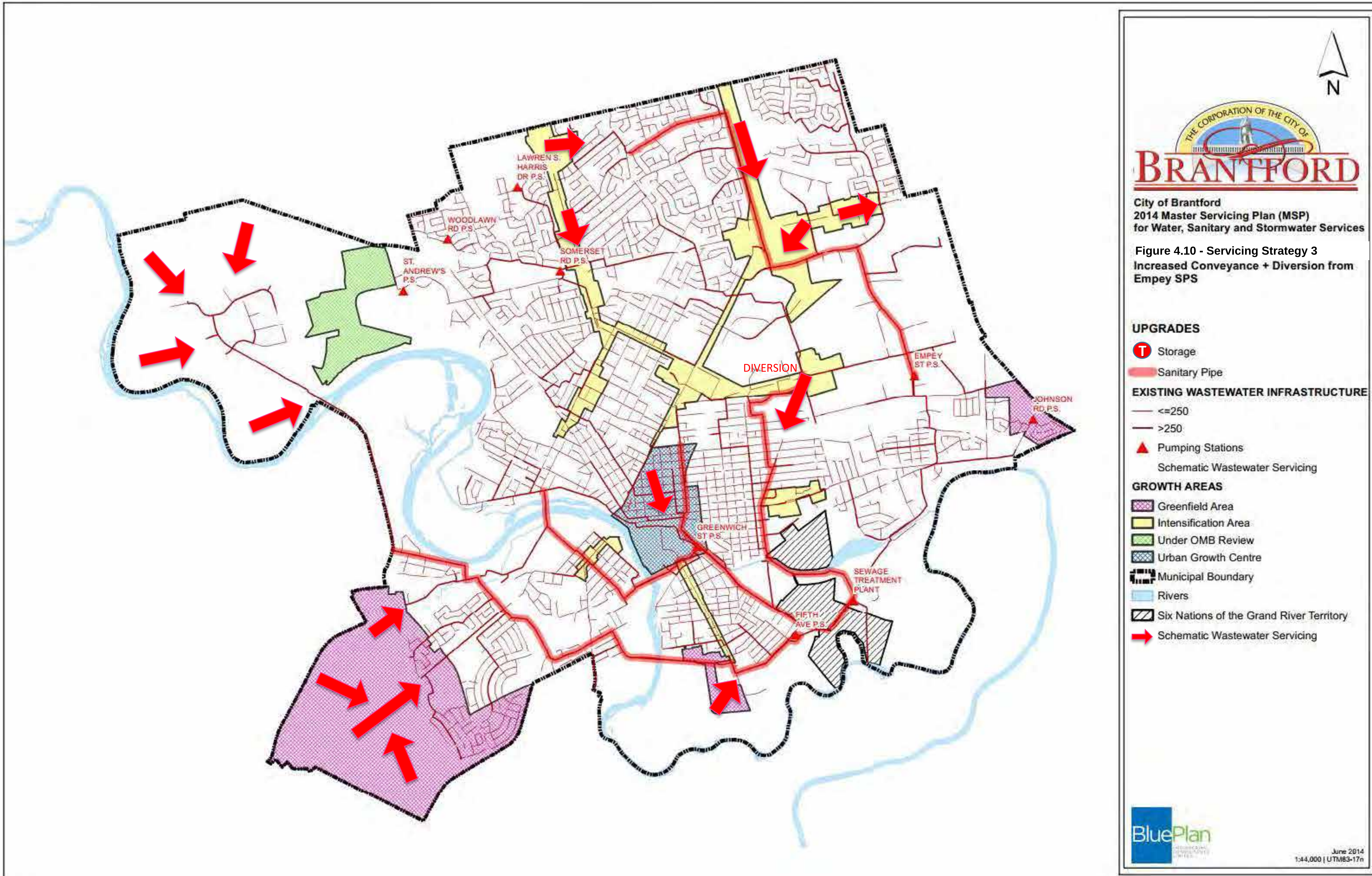
- <=250
- >250
- Pumping Stations
- Schematic Wastewater Servicing

GROWTH AREAS

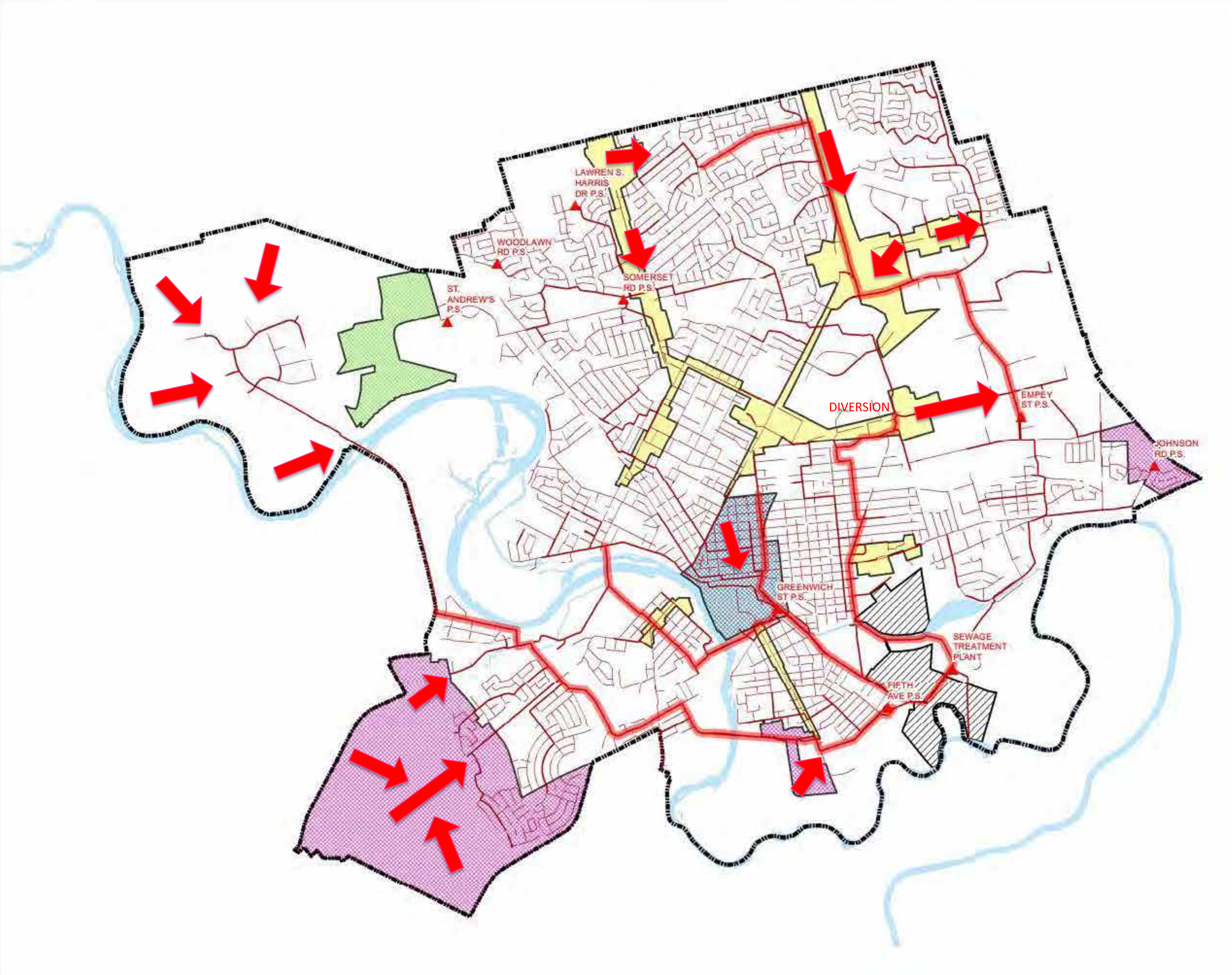
- Greenfield Area
- Intensification Area
- Under OMB Review
- Urban Growth Centre
- Municipal Boundary
- Rivers
- Six Nations of the Grand River Territory
- Schematic Wastewater Servicing

BluePlan

June 2014
1:44,000 | UTM83-17n



BRANTFORD
THE CORPORATION OF THE CITY OF
City of Brantford
2014 Master Servicing Plan (MSP)
for Water, Sanitary and Stormwater Services
Figure 4.10 - Servicing Strategy 3
Increased Conveyance + Diversion from Empey SPS
N
UPGRADES
Storage
Sanitary Pipe
EXISTING WASTEWATER INFRASTRUCTURE
<=250
>250
Pumping Stations
Schematic Wastewater Servicing
GROWTH AREAS
Greenfield Area
Intensification Area
Under OMB Review
Urban Growth Centre
Municipal Boundary
Rivers
Six Nations of the Grand River Territory
Schematic Wastewater Servicing
LAWREN S. HARRIS DR P.S.
WOODLAWN RD P.S.
ST. ANDREW'S P.S.
SOMERSET RD P.S.
DIVERSION
EMPEY ST P.S.
JOHNSON RD P.S.
GREENWICH ST P.S.
SEWAGE TREATMENT PLANT
FIFTH AVE P.S.
BluePlan
June 2014
1:44,000 | UTM83-17n



N

BRANTFORD

THE CORPORATION OF THE CITY OF

City of Brantford
2014 Master Servicing Plan (MSP)
for Water, Sanitary and Stormwater Services

Figure 4.11 - Servicing Strategy 4
Increased Conveyance + Diversion to Empey SPS

UPGRADES

- Storage
- Sanitary Pipe

EXISTING WASTEWATER INFRASTRUCTURE

- <=250
- >250
- Pumping Stations
- Schematic Wastewater Servicing

GROWTH AREAS

- Greenfield Area
- Intensification Area
- Under OMB Review
- Urban Growth Centre
- Municipal Boundary
- Rivers
- Six Nations of the Grand River Territory
- Schematic Wastewater Servicing

BluePlan

June 2014
1:44,000 | UTM83-17n

5.5.1 Servicing Strategy Evaluation

At this stage, each Strategy was subjected to a five-point evaluation, which includes environmental, technical, socio/cultural, financial, and legal/jurisdictional impacts. Each Strategy was scored based on the positive and negative aspects identified for each impact category using a rating system of high, medium and low, where high indicates "more favorable".

The results of the servicing strategy evaluation process is provided in Appendix 4C and is summarized below.

Table 4.10 – Servicing Strategy Evaluation

Strategy	Overall Score
Strategy 1 – Increased Conveyance	Medium
Strategy 2 – Increased Conveyance + Storage	Low
Strategy 3 – Increased Conveyance + Diversion *from* Empey SPS	Medium
Strategy 4 – Increased Conveyance + Diversion *to* Empey SPS	High **Selected as Preferred**

5.5.2 Northwest Service Area Evaluation

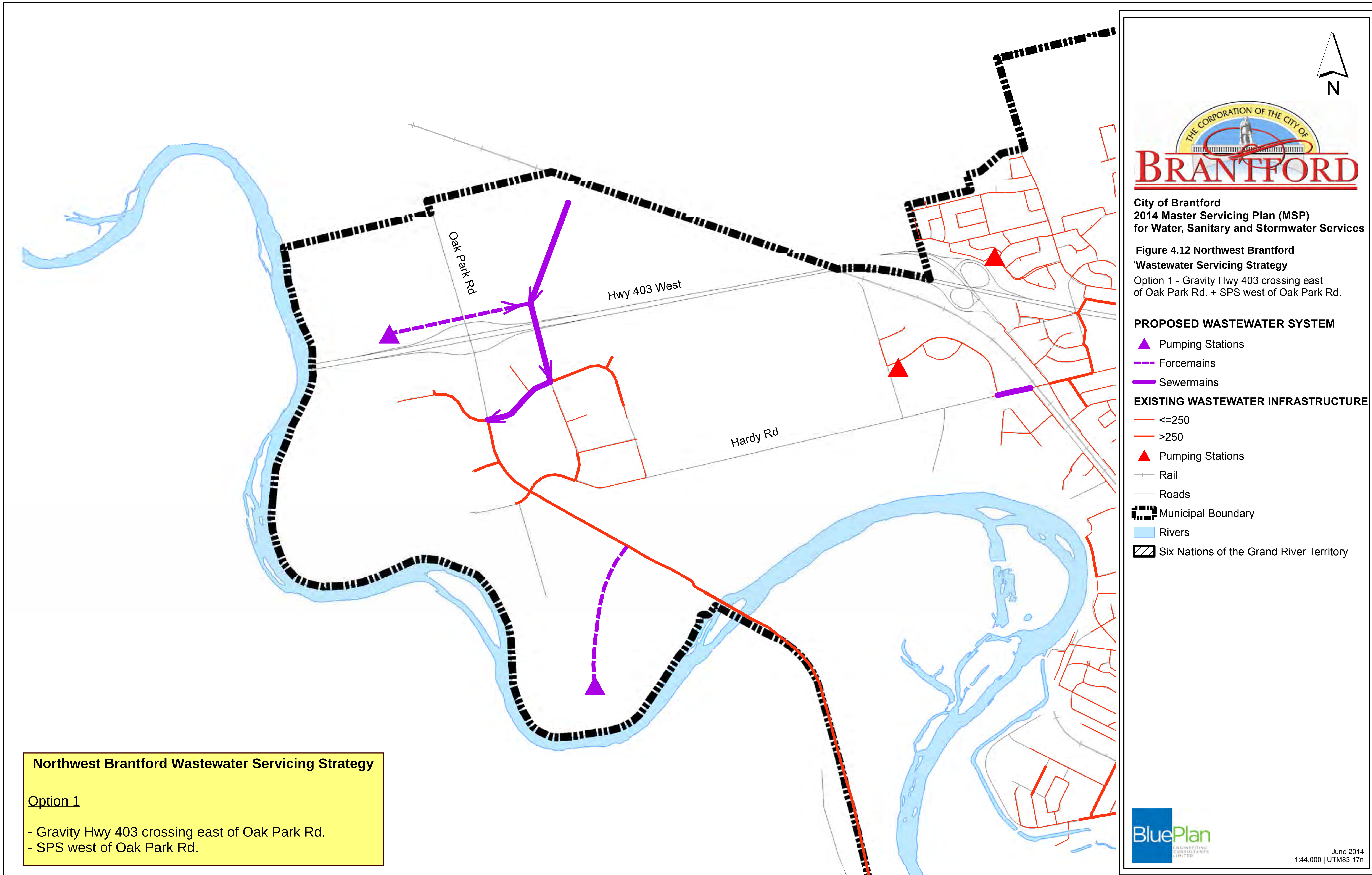
As a subset to the overall servicing strategy evaluation process, further development and evaluation of servicing options was required for the Northwest Service Area.

Servicing Northwest Brantford has several challenges, such as Hwy 403 crossing, Oak Park Road Crossing, consideration for post 2031 expansion, connection potential to the existing network. Due to these servicing challenges, several servicing options to satisfy growth in northwest Brantford were identified. These options are outlined below and shown in Figure 4.12 to Figure 4.16. The full 5 point evaluation is included in Appendix 4C.

Option 1 – Gravity Hwy 403 crossing East of Oak Park Road + SPS west of Oak Park Road
Option 2 – Gravity Hwy 403 crossing west of Oak Park Road
Option 3 – Pumped Hwy 403 crossing west of Oak Park Road + SPS west of Oak Park Road
Option 4 – Pumped Hwy 403 crossing along SC Johnson Trail Bridge + SPS west of Oak Park Road
Option 5 – Two gravity crossings; west and east of Oak Park Road

This sub-strategy has been evaluated and a preferred Option was selected based on the 5-point evaluation matrix. **Option 2** was selected as the preferred servicing option for the northwest service area. This option provides lower capital costs, O&M costs as well as takes advantage of the existing Hwy 403 Crossing easement.

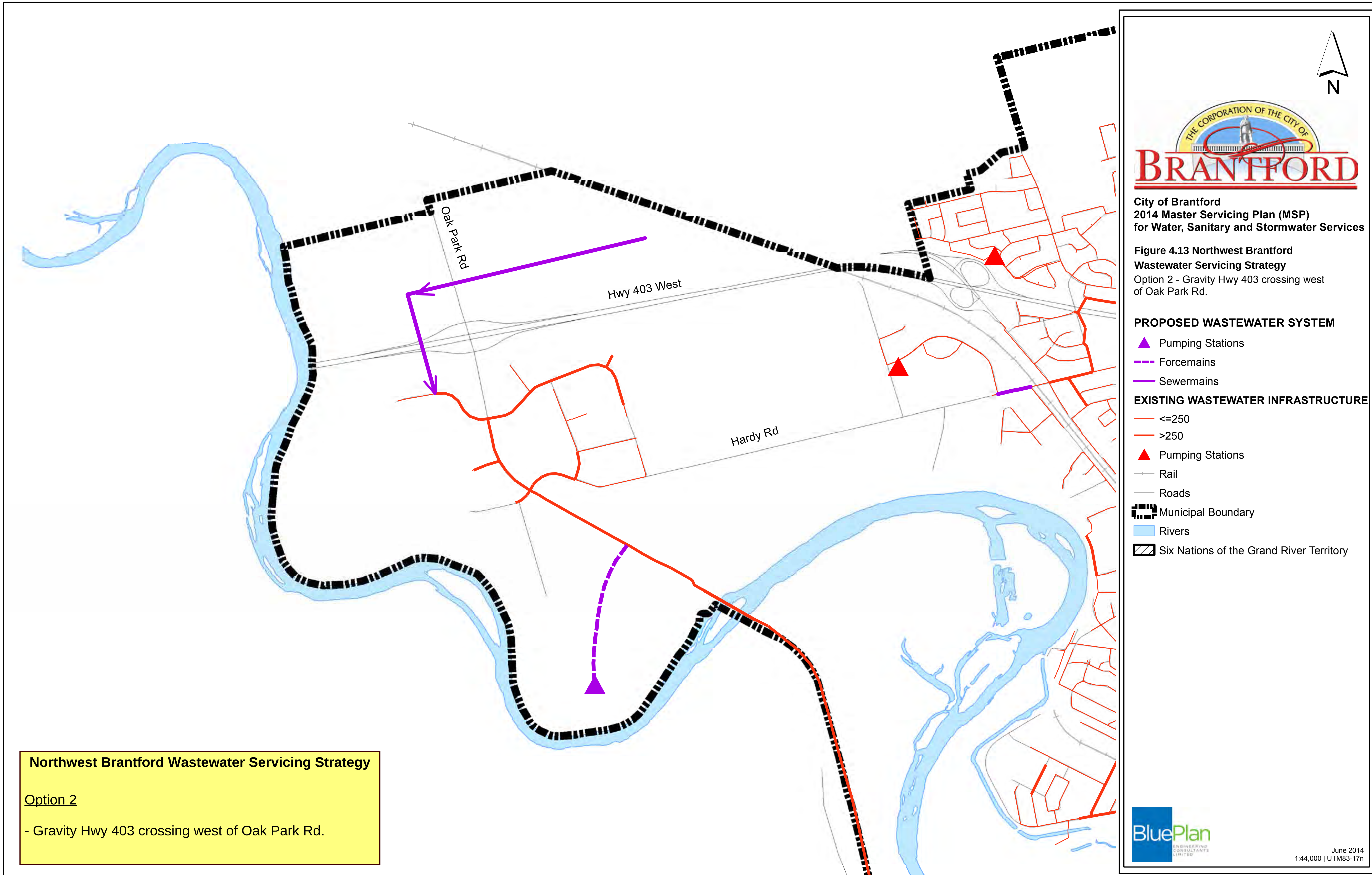
The preferred servicing for this area includes a deep gravity sewer crossing of Hwy 403 west of Oak Park Road along the existing City easement and an extension of the gravity sewer across Oak Park Road into the remaining service area.



Northwest Brantford Wastewater Servicing Strategy

Option 1

- Gravity Hwy 403 crossing east of Oak Park Rd.
- SPS west of Oak Park Rd.



City of Brantford
2014 Master Servicing Plan (MSP)
for Water, Sanitary and Stormwater Services

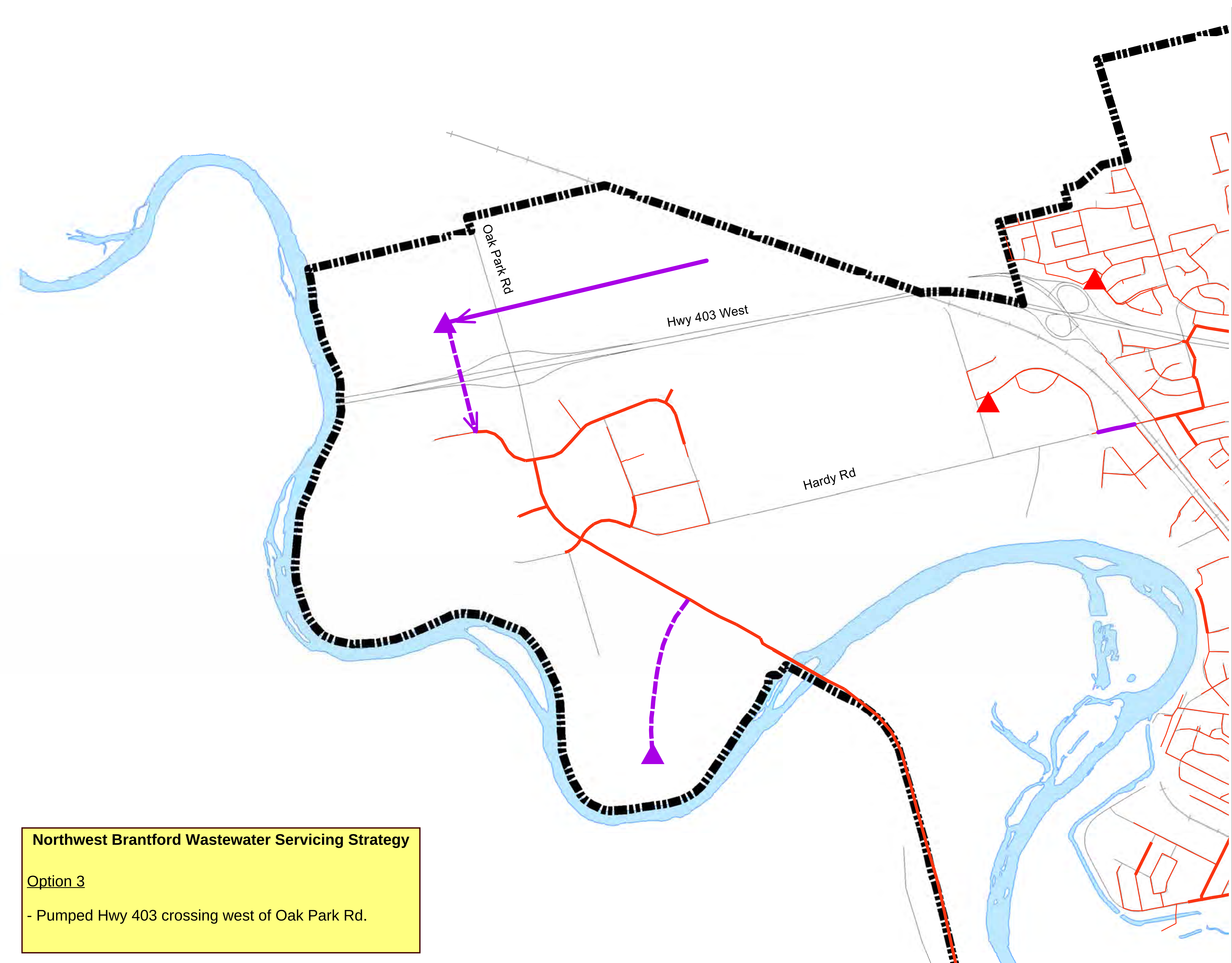
Figure 4.13 Northwest Brantford Wastewater Servicing Strategy

Option 2 - Gravity Hwy 403 crossing west of Oak Park Rd.

Northwest Brantford Wastewater Servicing Strategy

Option 2

- Gravity Hwy 403 crossing west of Oak Park Rd.



Northwest Brantford Wastewater Servicing Strategy

Option 3

- Pumped Hwy 403 crossing west of Oak Park Rd.

N

BRANTFORD
THE CORPORATION OF THE CITY OF

City of Brantford
2014 Master Servicing Plan (MSP)
for Water, Sanitary and Stormwater Services

Figure 4.14 Northwest Brantford Wastewater Servicing Strategy

Option 3 - Pumped Hwy 403 crossing westof Oak Park Rd + SPS West of Oak Park Road.

PROPOSED WASTEWATER SYSTEM

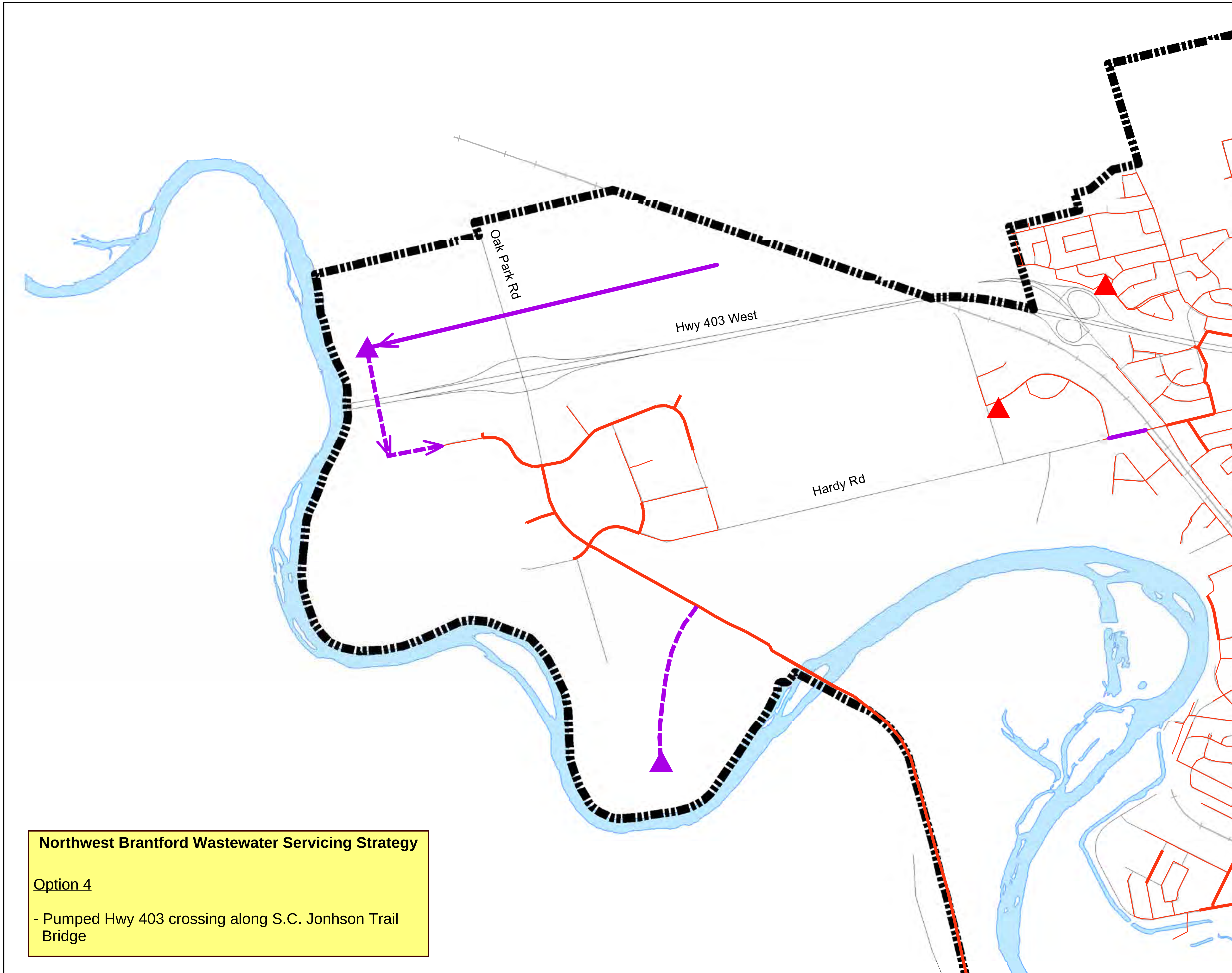
- Pumping Stations
- Forcemains
- Sewermains

EXISTING WASTEWATER INFRASTRUCTURE

- <=250
- >250
- Pumping Stations
- Rail
- Roads
- Municipal Boundary
- Rivers
- Six Nations of the Grand River Territory

BluePlan ENGINEERING CONSULTANTS LIMITED

June 2014
1:44,000 | UTM83-17n



N

BRANTFORD

City of Brantford
2014 Master Servicing Plan (MSP)
for Water, Sanitary and Stormwater Services

Figure 4.15 Northwest Brantford Wastewater Servicing Strategy

Option 4 - Pumped Hwy 403 crossing along S.C. Johnson Trail Bridge

PROPOSED WASTEWATER SYSTEM

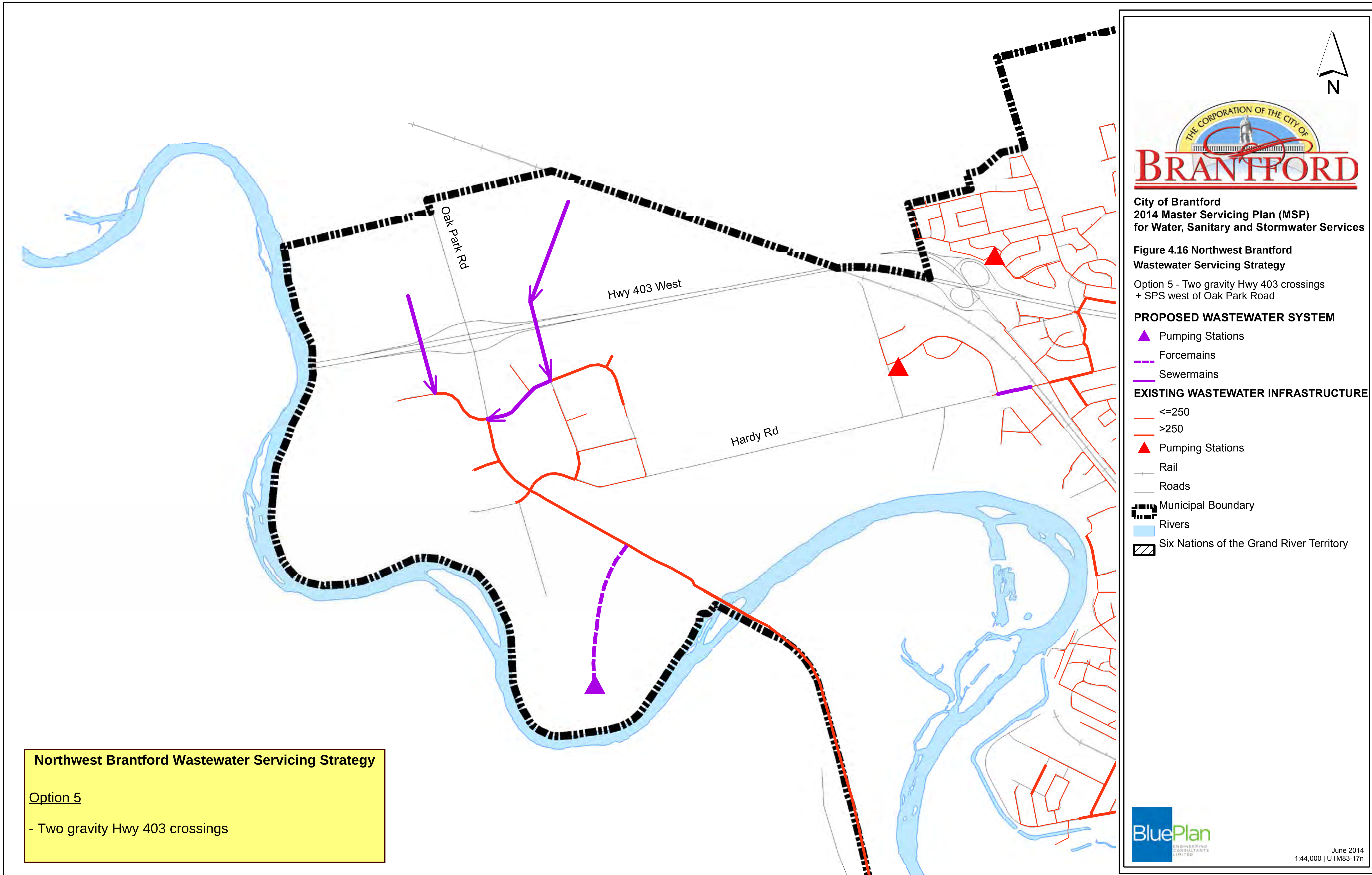
- Pumping Stations
- Forcemains
- Sewermains

EXISTING WASTEWATER INFRASTRUCTURE

- <=250
- >250
- Pumping Stations
- Rail
- Roads
- Municipal Boundary
- Rivers
- Six Nations of the Grand River Territory

BluePlan ENGINEERING CONSULTANTS LIMITED

June 2014
1:44,000 | UTM83-17n


Oak Park Rd
Hwy 403 West
Hardy Rd
N
THE CORPORATION OF THE CITY OF
BRANTFORD
City of Brantford
2014 Master Servicing Plan (MSP)
for Water, Sanitary and Stormwater Services
Figure 4.16 Northwest Brantford
Wastewater Servicing Strategy
Option 5 - Two gravity Hwy 403 crossings
+ SPS west of Oak Park Road
PROPOSED WASTEWATER SYSTEM
Pumping Stations
Forcemains
Sewermains
EXISTING WASTEWATER INFRASTRUCTURE
<=250
>250
Pumping Stations
Rail
Roads
Municipal Boundary
Rivers
Six Nations of the Grand River Territory
BluePlan
June 2014
1:44,000 | UTM83-17n
Northwest Brantford Wastewater Servicing Strategy
Option 5
- Two gravity Hwy 403 crossings

6 Preferred Wastewater Servicing Strategy

This section summarizes the Preferred Wastewater Servicing Strategy for the City of Brantford to service projected growth to 2031. In addition, this section includes the capital costing and implementation plan for the preferred solution.

6.1 Preferred Servicing Strategy

Several separate wastewater servicing components are recommended throughout the City of Brantford that collectively make up the overall Preferred Strategy. Strategy 4 was evaluated as the preferred Servicing Strategy from the 5-point evaluation to satisfy growth to 2031. This strategy consists of extension of the existing network into Greenfield growth areas as well as diversion of flow to the Empey SPS and capacity upgrades to the Empey SPS.

Greenfield growth within 2031 extends along Shellard Lane west of McGuiness Drive. The preferred wastewater servicing strategy within this area requires extension of a trunk sewer along Shellard Lane. In addition, a local network of gravity sewers along future road alignments will be required to drain the future growth flows to the trunk sewer.

Greenfield growth also extends north of Hwy 403 on either side of Oak Park Road. Extension of gravity servicing, crossing Hwy 403 will service the new growth and connect the growth area to the existing sanitary network. Further refinement of the strategy for this area was previously described in Section 5.5.2.

Other main components that make up the preferred servicing strategy are as follows:

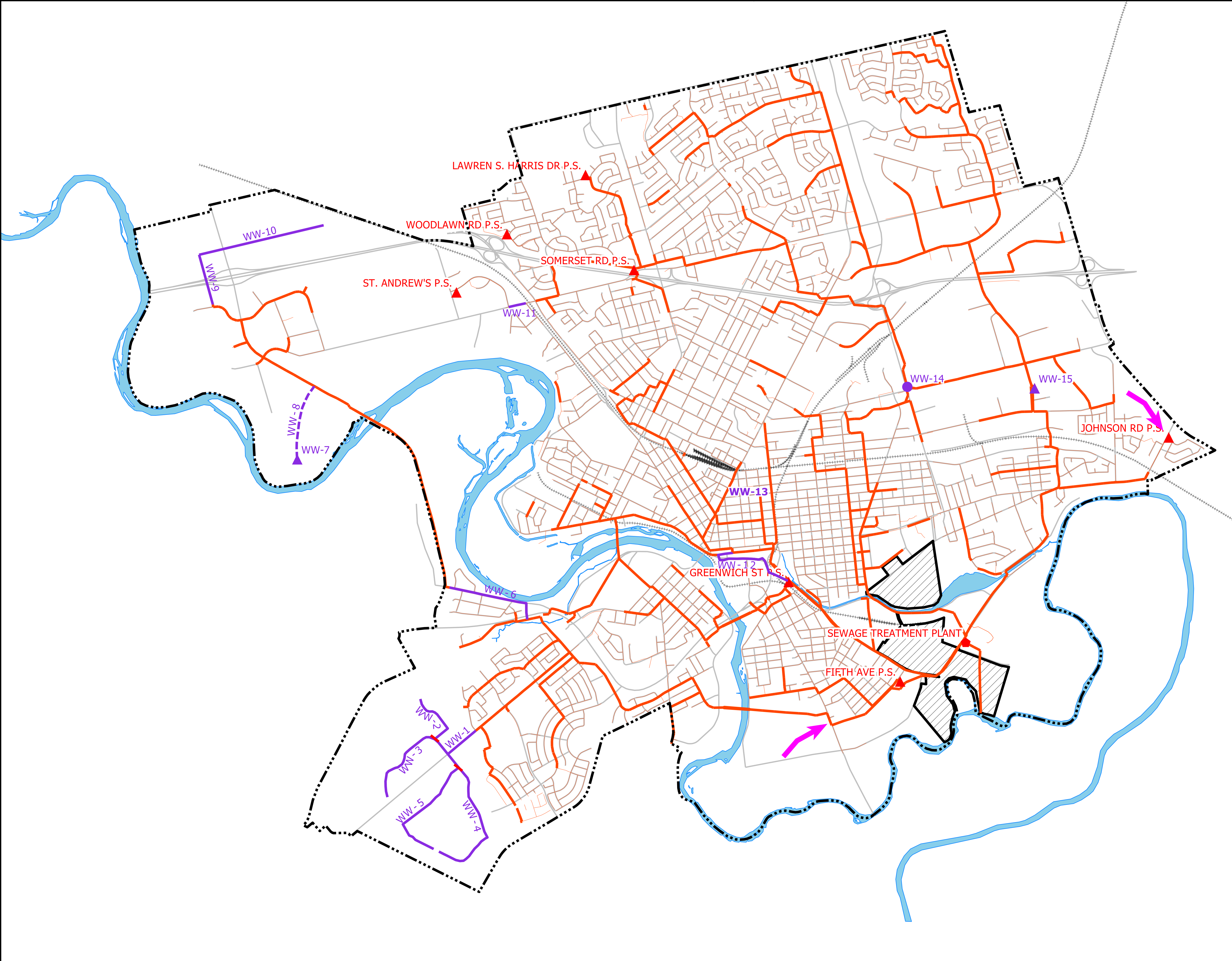
- Upgrades to the Empey SPS
- Upgrade to trunk sewer upstream of Greenwich SPS
- Intensification upgrades (as required under further detailed study)
- Oak Hill Sewer upgrade
- Oak Park Road Extension Residential SPS and Forcemain

As part of the Preferred Strategy, several benefits of diverting flow to the Empey SPS and upgrading the pumping capacity are:

- Diversion allows optimization of the flow split and maximizing capacity within both downstream sewer sections
- Avoids twinning downstream section of sewer within the built-up area
- Adds pumping capacity at the Empey SPS which can support post 2031 flows.

Further to the identified capital projects, it is recommended that the City of Brantford incorporate Inflow and Infiltration reduction strategies as part of the City's ongoing infrastructure maintenance and renewal program.

The Preferred Wastewater Servicing Strategy is shown in Figure 4.17.



N

THE CORPORATION OF THE CITY OF BRANTFORD

City of Brantford
2014 Master Servicing Plan (MSP)
for Water, Sanitary and Stormwater Services

Figure 4.17- Preferred Wastewater Servicing Strategy

Proposed System
- Pumping Stations
- Sanitary Project
- Sewermains
- Forcemains
- Expansion of Local System

Existing Sanitary Infrastructure
- Pumping Stations
- Sewage Treatment Plant
- > 250 mm
- <= 250 mm

- Roads
- Water Bodies
- Municipal Boundary
- Six Nations of the Grand River Territory

BluePlan

June, 2014
1:40,000 | UTM83-17n

6.2 Capital Program for the Preferred Wastewater Servicing Strategy

As described in the previous sections and depicted in Figure 4.17, the Preferred Wastewater Servicing Strategy has been developed to satisfy the existing and growth areas within Brantford to 2031. The capital costs for each project within the Preferred Strategy were developed according to the costing methodology within Section 2.2. These projects are listed according to their project number and are shown in Table 4.11. Within the Capital Program Table is the project description, proposed timing, dimensions and estimated total project cost. Further timing and implementation details are shown in Section 6.3.

BRANTFORD MASTER SERVICING PLAN

Table 4.11 Preferred Wastewater Servicing Capital Program

Project Number	Project Name	Project Scope/Description	Project Limits	Project Trigger	Year in Service	Class EA Schedule	Project Type	Size/ Capacity	Length (m)	Total Project Cost (2014$)
1	West Conklin Trunk Sewer	434 m - 675 mm sewer on Shellard Ln from McGuiness Dr west approximately 434 m	Southwest Brantford from Mcguiness Dr to approximately 434 m west	Growth in southwest Brantford	2014-2016	A+	SAN	675 mm	434 m	$953,000
2	West Conklin Sub-Trunk Sewer 2	711 m - 375 mm sub trunk sewer within new development on future road alignment, north of Shellard Ln connecting to future 450 mm sewer WW-3	Southwest Brantford from north of Shellard Ln to Project WW-3	Growth in southwest Brantford, north of Shellard Ln	2021-2026	A+	SAN	375 mm	711 m	$686,000
3	West Conklin Sub-Trunk Sewer 3	1,295 m - 450 mm sub trunk sewer within new development, north of Shellard Ln connecting to future 675 mm sewer WW-1	Southwest Brantford, north of Shellard Ln from Project WW-2 to approximately 1,295 m west	Growth in southwest Brantford, north of Shellard Ln	2021-2026	A+	SAN	450 mm	1295 m	$1,755,000
4	West Conklin Sub Trunk Sewer 4	1,851 m - 450 mm sub trunk sewer within new development, south of Shellard Ln connecting to future 675 mm sewer WW-1	Southwest Brantford, south of Shellard Ln from Project WW-5 through develoment	Growth in southwest Brantford, south of Shellard Ln	2014-2016	A+	SAN	450 mm	1851 m	$2,111,000
5	West Conklin Sub Trunk Sewer 5	1,453 m - 450 mm sub trunk sewer within new development, southwest of Shellard Ln connecting to future 675 mm sewer WW-1	Southwest Brantford, south of Shellard Ln from Project WW-4 through develoment	Growth in southwest Brantford, south of Shellard Ln	2016-2021	A+	SAN	450 mm	1453 m	$1,490,000
6	Oakhill Dr Sewer Upgrade	Replacement of existing 675 mm / 750 mm with 1050 mm sewer along Oakhill Dr from Jennings Rd to Colborne St W	Oakhill Dr from Jennings Rd to Colborne St W	Project is required to support existing service area as well as growth. Near term trigger to improve existing system performance	2016-2021	A+	SAN	1050 mm	1127 m	$4,236,000
7	Grand River Residential Sewage Pumping Station	New 15 L/s Sewage Pumping Station approximately 1,300 m south of Oak Park Rd/Hardy Rd servicing new residential growth (EA requirements to be met by future developer-led local servicing plan and land use planning process)	Residential area approximately 1,300 m wouth of Oak Park Rd/Hardy Rd	Growth south of Hardy Rd	2016-2021	B (separate)	SPS	15 L/s		$3,000,000
8	Grand River Twinned Residential Forcemains	914 m of twinned 150 mm forcemains on Oak Park Rd extention from new Grand River Residential SPS to sewer south of Hardy Rd (EA requirements to be met by future developer-led local servicing plan and land use planning process)	New road alignment from new SPS Project WW-7 to trunk sewer south of Hardy Rd crossing Grand River	Growth south of Hardy Rd	2016-2021	B (separate)	FM	150 mm	914 m	$1,079,000
9	Northwest Extension Trunk Sewer	613 m - 825 mm sewer from existing 825 mm sewer stub on Fen Ridge Ct. north approximately 613 m on easement, Hwy 403 crossing and future road alignment (shared easement with water project W-1	Existing Hwy 403 crossing easement from Fen Ridge Ct to future development area	Growth in Northwest Industrial Lands	2021-2026	A+	SAN	825 mm	613 m	$6,125,000
10	Northwest Extension Sub Trunk Sewer 1	1,522 m - 525 mm sub trunk sewer on future road alignment within new industrial development from future 825 mm sewer east approximately 1,522 m	Northwest Brantforn on new road alignment from Project WW-9 to approximately 1,522 m east	Growth in Northwest Industrial Lands, east of Oak Hill Dr	2021-2026	A+	SAN	525 mm	1522 m	$2,230,000
11	Hardy Rd Sewer Upgrade	210 m - 375 mm sewer upgrade along Hardy Rd from St Andrews Dr to Railway	Hardy Rd from St Andrews Dr to Railway	Current capacity deficit triggers upgrade	2014-2016	A+	SAN	375 mm	210 m	$304,000
12	Greenwich Sewer Upgrade	1,186 m - 375 mm / 450 mm sewer on Greenwich Dr and Icomm Dr from the Greenwich SPS to west of Clarence St S. Replacement of 300 mm sewer with 375 mm and 450 mm sewer	Greenwich Dr and Icomm Dr from Greenwich SPS to west of Clarence St	Existing capacity constraints as well as growth within downtown core trigger upgrade	2014-2016	A+	SAN	375mm / 450mm	1186 m	$2,432,000
13	General Intensification Upgrades	Lump Sum cost for pipe upgrades within intensification areas (Approx 2,700 m of 450 mm sewer at urban construction cost)	Downtown core; exact project extents to be determined through development	Growth within downtown core in excess of existing watermain capacity	2014-2031	A+	SAN	450 mm	2,700 m	$5,500,000
14	Empey Diversion Structure	Diversion control structure at intersection of Henry St and Wayne Gretzky Pkwy to balance flows between Empey St SPS and Stanley St Trunk Sewer	Intersection of Henry St and Wayne Gretzky Pkwy	Existing capacity constraints as well as growth within north Brantford trigger upgrade	2016-2021	A	Other			$209,000
15	Empey SPS Pumps Upgrade	Upgrade Empey SPS pumping capacity through upgrade of pumps within existing building 2 new 378 L/s pumps	Empey SPS	Diversion from Project WW-14 triggers SPS caoacity upgrade	2016-2021	A+	SAN			$2,316,000
										$34,426,000

6.3 Implementation & Class EA Requirements

As outlined in Volume II of the Master Plan, this Water, Wastewater and Stormwater Master Servicing Plan sets out to satisfy the EA Approach II requirements according to the MEA Class EA document. The Preferred Wastewater Servicing Strategy will support the servicing needs of the City of Brantford's Greenfield and urban growth to 2031. This Strategy will be implemented in accordance with each projects Class EA schedule. The Class EA requirements for each project have been identified in the Capital Program Table 4.11. Schedule A and A+ projects may move forward to design and construction, with A+ projects requiring public notification prior to implementation. Schedule B projects that have been identified within the Preferred Wastewater Servicing Strategy will be part of a developer-led local servicing plan and will satisfy the EA requirements through separate study prior to design and construction. The Preferred Wastewater Strategy does not identify any Schedule C projects.

During the next steps of the implementation program, primarily during detailed design of the projects, the following requirements will be considered:

- Finalization of property requirements
- Refinement of infrastructure alignment
- Identification of preferred construction methodologies
- Completion of additional supporting investigations as required (geotechnical, hydrogeological, etc)
- Review and mitigation of potential construction related impacts
- Satisfying of all provincial, municipal and conservation authority approval requirements

Based on the consultation undertaken with the review agencies during the Master Plan process, it is recommended that all key projects undertake a pre-design consultation with the applicable review agencies. This early consultation prior to the detailed design will ensure sufficient technical and environmental information is available to support the preferred design and that the project scope is well understood. Ultimately this process will facilitate project approvals moving forward.

With respect to City planning and budgeting, these program will be utilized as high level baseline estimates for the City capital budgets. These costs will be further developed and refined during the implementation phases as more detailed information becomes available. For example, effort has been given during the Master Servicing Plan analyses to identify potential impacts related to the natural environment such as environmental features and endangered species. Despite these efforts, there is potential that additional project requirements, costs and implementation time may be required to obtain approvals and mitigate the impacts.

Given the growth-related nature of the servicing strategies, the capital programs form the foundation for the water, wastewater and stormwater components of the City of Brantford Development Charges (DC) By-Law.

The anticipated timing of each project within the Preferred Strategy has been established based on the projected population and employment growth within the City of Brantford. The wastewater program's project scheduling has also been cross referenced with water program to ensure project coordination along common alignments. The project timing has been broken down according to the anticipated duration of the design and construction of the projects. This implementation schedule for the program is shown in Table 4.12.

In addition to the coordination of water and wastewater timing, other opportunities to coordinate the Master Servicing Plan projects were investigated to potentially achieve cost savings and efficiencies. The Preferred Wastewater Servicing Strategy, Water Servicing Strategy (Volume III) and Transportation Master Plan Preferred Strategies were overlaid to determine the opportunities to coordinate works along common alignments.

Additionally, the City of Brantford updates its Water, Sewer and Road asset condition ratings on an annual basis. As part of the Master Servicing Plan, the aggregated condition of the three assets were compiled and analyzed to determine priority alignments for State of Good Repair works. As intensification growth occurs within the City, and infrastructure upgrades are required based on capacity needs, this State of Good Repair coordination analysis will provide a baseline condition reference for coordination of upgrades. On a go forward basis, there will be opportunity to align growth-related and State of Good Repair Projects.

BRANTFORD MASTER SERVICING PLAN

Table 4.12 - Capital Program Scheduling & Implementation

STUDY

DESIGN

CONSTRUCTION

			IMPLEMENTATION PROGRAM - SCHEDULE																	
Project Number	Project Name	Project Scope/Description	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
1	West Conklin Trunk Sewer	434 m - 675 mm sewer on Shellard Ln from McGuiness Dr west approximately 434 m																		
2	West Conklin Sub-Trunk Sewer 2	711 m - 375 mm sub trunk sewer within new development on future road alignment, north of Shellard Ln connecting to future 450 mm sewer WW-3																		
3	West Conklin Sub-Trunk Sewer 3	1,295 m - 450 mm sub trunk sewer within new development, north of Shellard Ln connecting to future 675 mm sewer WW-1																		
4	West Conklin Sub Trunk Sewer 4	1,851 m - 450 mm sub trunk sewer within new development, south of Shellard Ln connecting to future 675 mm sewer WW-1																		
5	West Conklin Sub Trunk Sewer 5	1,453 m - 450 mm sub trunk sewer within new development, southwest of Shellard Ln connecting to future 675 mm sewer WW-1																		
6	Oakhill Dr Sewer Upgrade	Replacement of existing 675 mm / 750 mm with 1050 mm sewer along Oakhill Dr from Jennings Rd to Colborne St W																		
7	Grand River Residential Sewage Pumping Station	New 15 L/s Sewage Pumping Station approximately 1,300 m south of Oak Park Rd/Hardy Rd servicing new residential growth																		
8	Grand River Twinned Residential Forcemains	914 m of twinned 150 mm forcemains on Oak Park Rd extention from new Grand River Residential SPS to sewer south of Hardy Rd																		
9	Northwest Extension Trunk Sewer	613 m - 825 mm sewer from existing 825 mm sewer stub on Fen Ridge Ct. north approximately 613 m on easement, Hwy 403 crossing and future road alignment (shared easement with water project W-1																		
10	Northwest Extension Sub Trunk Sewer 1	1,522 m - 525 mm sub trunk sewer on future road alignment within new industrial development from future 825 mm sewer east approximately 1,522 m																		
11	Hardy Rd Sewer Upgrade	210 m - 375 mm sewer upgrade along Hardy Rd from St Andrews Dr to Railway																		
12	Greenwich Sewer Upgrade	1,186 m - 375 mm / 450 mm sewer on Greenwich Dr and Icomm Dr from the Greenwich SPS to west of Clarence St S. Replacement of 300 mm sewer with 375 mm and 450 mm sewer																		
13	General Intensification Upgrades	Lump Sum cost for pipe upgrades within intensification areas (Approx 2,700 m of 450 mm sewer at urban construction cost)																		
14	Empey Diversion Structure	Diversion control structure at intersection of Henry St and Wayne Gretzky Pkwy to balance flows between Empey St SPS and Stanley St Trunk Sewer																		
15	Empey SPS Pumps Upgrade	Upgrade Empey SPS pumping capacity through upgrade of pumps within existing building 2 new 378 L/s pumps																		

7 Post-2031 Vision

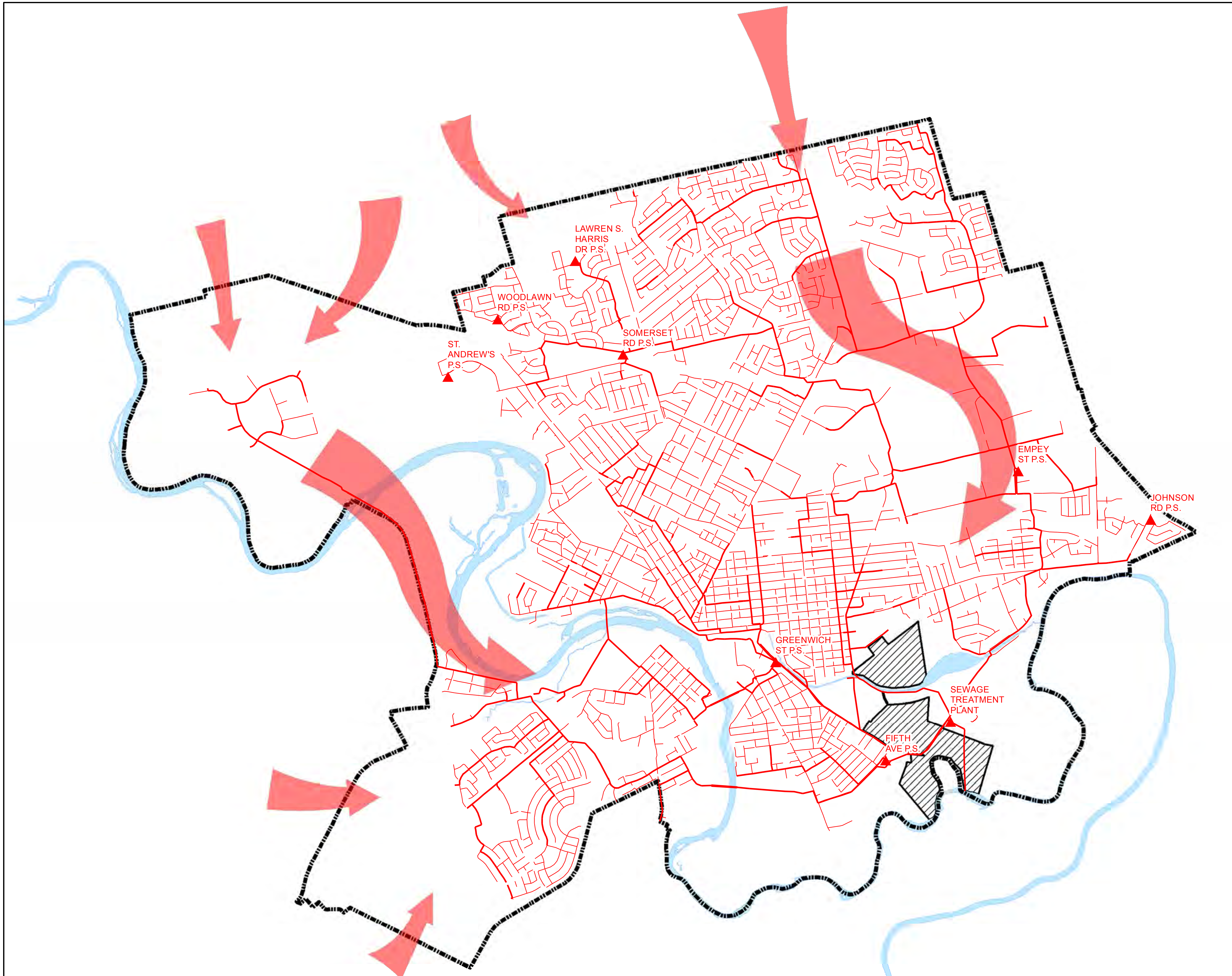
The 2014 Master Servicing Plan has put forward a comprehensive wastewater servicing strategy to service growth within the City of Brantford to the approved Places to Grow 2031 forecast. While the approved urban boundary and growth targets are to 2031, the Master Servicing Plan also considered implications of potential post-2031 growth on the system. Post-2031 growth is anticipated to occur within both Intensification and Greenfield Areas.

The Preferred Wastewater Servicing Strategy addresses the growth needs to 2031, and also establishes flexibility within the system to implement a post-2031 strategy, once the long-term targets are confirmed and approved.

The majority of the water and wastewater infrastructure extensions have occurred towards the north and west, following the residential and employment growth within the City of Brantford. Throughout this growth, the City of Brantford has incorporated some minor strategic oversizing of trunk infrastructure to support development beyond existing growth horizons. Though 2031 is the planning horizon for this Master Servicing Plan, there is an expectation that there could be post-2031 growth extending further into Greenfield areas outside of the current urban boundary.

In developing the Preferred Wastewater Servicing Strategy and recommending specific capital projects, this Master Servicing Plan has considered the long-term Greenfield growth that could occur and ensured that flexibility is built into the program.

Based on information available at this time, the potential post-2031 period considerations are depicted on the following Figure 4.18.



City of Brantford
2014 Master Servicing Plan (MSP)
for Water, Sanitary and Stormwater Services

Figure 4.18 - Potential Post Period Considerations

EXISTING WASTEWATER INFRASTRUCTURE

- <=250
- >250
- Pumping Stations
- Wastewater_Post 2031 Vision
- Municipal Boundary
- Rivers
- Six Nations of the Grand River Territory

BluePlan ENGINEERING CONSULTANTS LIMITED

July 2014
1:44,000 | UTM83-17n

Appendix 4A - Wastewater Flow Projections

BRANTFORD MASTER SERVICING PLAN

Wastewater Flow Projections

Wastewater Design Criteria			
	Avg day (lpcd)	Harmon PF	Extraneous I/I (L/s/ha)
Residential	270		0.2
Employment	300		

Population Projections					
Drainage Area	2011	2016	2021	2026	2031
St. Andrews	282	282	282	282	282
Woodlawn	1,412	1,425	1,434	1,442	1,450
Somerset	7,182	7,224	7,415	7,487	7,530
Lawren	847	855	860	865	870
US_Split	13,487	13,683	14,086	14,365	14,474
Empey	38,944	39,491	40,987	41,406	41,643
Greenwich	8,697	9,183	9,789	10,134	12,059
Fifth Ave	4,255	4,285	4,901	6,223	6,680
Gravity 1	11,584	14,061	17,554	19,375	21,271
Johnson	556	722	970	970	970
Gravity 2	29,614	30,482	32,522	35,731	38,641
Total	93,650	98,225	106,723	113,839	121,264

Employment Projections					
Drainage Area	2011*	2016	2021	2026	2031
St. Andrews	67	67	68	69	69
Woodlawn	**325**	**332**	**339**	**346**	**349**
Somerset	1,712	1,750	1,788	1,826	1,852
Lawren	195	199	203	207	209
US_Split	5,673	5,822	5,955	6,052	6,111
Empey	18,105	18,776	20,613	21,201	21,419
Greenwich	4,968	5,149	5,524	5,899	6,275
Fifth Ave	1,126	1,136	1,147	1,157	1,168
Gravity 1	4,268	4,585	4,742	7,617	9,421
Johnson	0	1	30	31	32
Gravity 2	18,425	18,934	19,994	20,776	21,363
Total	46,892	48,582	52,049	56,682	59,678

Population Growth					
Drainage Area	2011	2016	2021	2026	2031
St. Andrews		0	0	0	0
Woodlawn		14	22	31	39
Somerset		43	234	305	348
Lawren		8	13	18	23
US_Split		196	599	878	988
Empey		548	2,043	2,462	2,699
Greenwich		486	1,091	1,437	3,362
Fifth Ave		30	646	1,967	2,424
Gravity 1		2,478	5,971	7,791	9,688
Johnson		166	414	414	414
Gravity 2		868	2,908	6,117	9,027
Total		4,575	13,073	20,189	27,614

Population Growth					
Drainage Area	2011*	2016	2021	2026	2031
St. Andrews		1	1	2	2
Woodlawn		7	14	21	24
Somerset		38	76	115	141
Lawren		4	8	12	14
US_Split		149	282	379	438
Empey		671	2,508	3,096	3,314
Greenwich		180	556	931	1,306
Fifth Ave		10	21	31	42
Gravity 1		318	474	3,349	5,154
Johnson		1	30	31	32
Gravity 2		509	1,569	2,351	2,938
Total		1,690	5,157	9,790	12,786

Wastewater Flow Calculation

Residental Flows Average Dry Weather Flows (m3/d)					
Drainage Area	2011	2016	2021	2026	2031
St. Andrews		0	0	0	0
Woodlawn		4	6	8	10
Somerset		12	63	82	94
Lawren		2	4	5	6
US_Split		53	162	237	267
Empey		148	552	665	729
Greenwich		131	295	388	908
Fifth Ave		8	174	531	655
Gravity 1		669	1,612	2,104	2,616
Johnson		45	112	112	112
Gravity 2		234	785	1,652	2,437
Total		1,235	3,530	5,451	7,456

Employment Flows Average Dry Weather Flows (m3/d)					
Drainage Area	2011	2016	2021	2026	2031
St. Andrews		0	0	1	1
Woodlawn		2	4	6	7
Somerset		11	23	34	42
Lawren		1	2	4	4
US_Split		45	85	114	131
Empey		201	752	929	994
Greenwich		54	167	279	392
Fifth Ave		3	6	9	13
Gravity 1		95	142	1,005	1,546
Johnson		0	9	9	10
Gravity 2		153	471	705	881
Total		507	1,547	2,937	3,836

Total Wastewater Flows Average Dry Weather Flows (m3/d)					
Drainage Area	2012	2016	2021	2026	2031
St. Andrews		0	0	1	1
Woodlawn		6	10	15	18
Somerset		23	86	117	136
Lawren		4	6	9	11
US_Split		98	246	351	398
Empey		349	1,304	1,594	1,723
Greenwich		185	461	667	1,300
Fifth Ave		11	181	541	667
Gravity 1		764	1,754	3,108	4,162
Johnson		45	121	121	121
Gravity 2		387	1,256	2,357	3,319
Total		1,742	5,077	8,388	11,292

	62.5%		37.5%		
Straight Calc	25,286	64.3%	14,068	35.7%	39,353

Harmon Peaking Factor					
Drainage Area	2011	2016	2021	2026	2031
St. Andrews		4.00	4.00	4.00	4.00
Woodlawn		3.70	3.69	3.69	3.69
Somerset		3.09	3.08	3.08	3.08
Lawren		3.84	3.84	3.84	3.84
US_Split		2.82	2.81	2.80	2.79
Empey		2.36	2.35	2.34	2.34
Greenwich		2.99	2.96	2.95	2.87
Fifth Ave		3.31	3.25	3.16	3.13
Gravity 1		2.81	2.71	2.67	2.63
Johnson		3.89	3.81	3.81	3.81
Gravity 2		2.47	2.44	2.40	2.37
Total		2.01	2.00	2.00	2.00

Harmon Peaking Factor					
Drainage Area	2011	2016	2021	2026	2031
St. Andrews		4.00	4.00	4.00	4.00
Woodlawn		4.00	4.00	4.00	4.00
Somerset		3.63	3.62	3.62	3.61
Lawren		4.00	4.00	4.00	4.00
US_Split		3.18	3.17	3.17	3.16
Empey		2.68	2.64	2.63	2.62
Greenwich		3.23	3.20	3.18	3.15
Fifth Ave		3.76	3.76	3.76	3.76
Gravity 1		3.28	3.27	3.07	2.98
Johnson		4.00	4.00	4.00	4.00
Gravity 2		2.68	2.65	2.64	2.62
Total		2.28	2.25	2.21	2.19

Harmon Peaking Factor					
Drainage Area	2012	2016	2021	2026	2031
St. Andrews		4.00	4.00	4.00	4.00
Woodlawn		3.63	3.63	3.62	3.62
Somerset		3.00	2.99	2.99	2.98
Lawren		3.79	3.78	3.78	3.78
US_Split		2.66	2.65	2.64	2.64
Empey		2.20	2.18	2.18	2.17
Greenwich		2.80	2.77	2.75	2.69
Fifth Ave		3.21	3.17	3.08	3.06
Gravity 1		2.68	2.61	2.52	2.47
Johnson		3.89	3.80	3.80	3.80
Gravity 2		2.27	2.24	2.22	2.19
Total		2.00	2.00	2.00	2.00

Peak Dry Weather Flow (m3/d)					
Drainage Area	2011	2016	2021	2026	2031
St. Andrews		0	0	0	0
Woodlawn		14	22	31	38
Somerset		36	195	253	289
Lawren		9	14	19	24
US_Split		149	454	663	745
Empey		349	1,294	1,557	1,705
Greenwich		392	873	1,144	2,608
Fifth Ave		27	567	1,676	2,046
Gravity 1		1,877	4,368	5,609	6,868
Johnson		174	426	426	426
Gravity 2		579	1,918	3,969	5,778
Total		2,479	7,059	10,902	14,912

Peak Dry Weather Flow (m3/d)					
Drainage Area	2011	2016	2021	2026	2031
St. Andrews		1	1	2	3
Woodlawn		8	17	25	29
Somerset		42	83	124	153
Lawren		5	10	15	17
US_Split		143	269	360	416
Empey		540	1,986	2,440	2,608
Greenwich		175	534	888	1,235
Fifth Ave		12	24	35	47
Gravity 1		312	464	3,086	4,608
Johnson		1	36	37	38
Gravity 2		409	1,249	1,859	2,313
Total		1,154	3,479	6,503	8,416

Peak Dry Weather Flow (m3/d)					
Drainage Area	2012	2016	2021	2026	2031
St. Andrews		1	2	3	3
Woodlawn		21	37	53	64
Somerset		69	257	349	407
Lawren		13	23	33	40
US_Split		260	654	927	1,051
Empey		770	2,845	3,467	3,743
Greenwich		519	1,278	1,834	3,496
Fifth Ave		36	572	1,667	2,040
Gravity 1		2,050	4,570	7,841	10,269
Johnson		175	459	460	461
Gravity 2		878	2,819	5,222	7,274
Total		3,485	10,154	16,776	22,583

Peak WetWeather Flow (m3/d)					
Drainage Area	2011	2016	2021	2026	2031
St. Andrews		0	0	0	0
Woodlawn		14	22	31	38
Somerset		36	195	253	289
Lawren		9	14	19	24
US_Split		149	454	663	745
Empey		685	1,630	1,893	2,041
Greenwich		392	873	1,144	2,608
Fifth Ave		553	1,093	2,202	2,572
Gravity 1		13,429	15,920	17,161	18,420
Johnson		585	837	837	837
Gravity 2		579	1,918	3,969	5,778
Total		15,303	19,884	23,727	27,737

Peak Wet Weather Flow (m3/d)					
Drainage Area	2011	2016	2021	2026	2031
St. Andrews		1	1	2	3
Woodlawn		8	17	25	29
Somerset		42	83	124	153
Lawren		5	10	15	17
US_Split		143	269	360	416
Empey		876	2,322	2,776	2,944
Greenwich		175	534	888	1,235
Fifth Ave		537	549	561	573
Gravity 1		11,864	12,016	14,638	16,160
Johnson		412	447	448	449
Gravity 2		409	1,249	1,859	2,313
Total		13,979	16,303	19,328	21,241

PeakWetWeather Flow (m3/d)					
Drainage Area	2012	2016	2021	2026	2031
St. Andrews		1	2	3	3
Woodlawn		21	37	53	64
Somerset		69	257	349	407
Lawren		13	23	33	40
US_Split		260	654	927	1,051
Empey		1,106	3,181	3,803	4,079
Greenwich		519	1,278	1,834	3,496
Fifth Ave		562	1,098	2,193	2,566
Gravity 1		13,602	16,122	19,393	21,821
Johnson		586	870	871	872
Gravity 2		878	2,819	5,222	7,274
Total		16,309	22,978	29,601	35,408

Appendix 4B - Historical Wastewater Flows

BRANTFORD MASTER SERVICING PLAN

Historical Wastewater Flows

WPCP

Date	Montly Average Flow (m3/day)	Daily Max Flow (m3/day)	Daily Min Flow (m3/day)
Jan-12	41,181	43,900	38,100
Feb-12	39,317	43,100	36,800
Mar-12	39,532	44,600	36,400
Apr-12	34,880	40,300	32,500
May-12	32,532	34,700	30,000
Jun-12	31,677	36,200	29,100
Jul-12	29,023	32,200	24,200
Aug-12	28,600	33,400	23,400
Sep-12	27,357	33,400	12,800
Oct-12	29,816	40,600	16,400
Nov-12	30,853	36,600	13,600
Dec-12	29,726	32,700	26,800
Average	**32,874**		

Empey SPS

Date	Montly Average Flow (m3/day)	Daily Max Flow (m3/day)	Daily Min Flow (m3/day)
Jan-12	20,594	23,863	17,714
Feb-12	21,789	23,756	19,629
Mar-12	23,196	25,388	17,229
Apr-12	22,282	23,517	17,590
May-12	22,691	26,540	20,125
Jun-12	21,983	23,845	20,113
Jul-12	18,387	21,399	12,047
Aug-12	19,656	22,676	13,104
Sep-12	25,827	32,767	20,893
Oct-12	32,752	32,767	32,468
Nov-12	28,134	32,767	11,424
Dec-12	13,855	15,073	11,085
Average	**22,596**		

Geenwich SPS

Date	Montly Average Flow (m3/day)	Daily Max Flow (m3/day)	Daily Min Flow (m3/day)
Jan-12	6,976	7,662	6,003
Feb-12	6,153	6,659	5,620
Mar-12	6,020	6,476	4,478
Apr-12	5,629	6,408	4,642
May-12	4,952	5,805	2,659
Jun-12	5,389	6,289	5,056
Jul-12	5,565	6,690	4,908
Aug-12	5,984	6,708	5,454
Sep-12	5,101	5,760	4,660
Oct-12	5,221	6,724	4,674
Nov-12	5,662	6,579	4,957
Dec-12			
Average	**5,696**		

5th Avenue SPS

Date	Montly Average Flow (m3/day)	Daily Max Flow (m3/day)	Daily Min Flow (m3/day)
Jan-12	832	948	769
Feb-12	753	839	695
Mar-12	736	865	685
Apr-12	740	830	683
May-12	747	842	706
Jun-12	776	869	722
Jul-12	758	846	713
Aug-12	754	841	695
Sep-12	768	884	710
Oct-12	762	880	708
Nov-12	704	860	614
Dec-12	660	767	613
Average	**749**		

Sommerset SPS

Date	Montly Average Flow (m3/day)	Daily Max Flow (m3/day)	Daily Min Flow (m3/day)
Jan-12	1,791	2,943	2,346
Feb-12	2,578	3,018	2,251
Mar-12	2,479	2,872	2,281
Apr-12	2,087	2,497	1,882
May-12	1,791	1,957	1,634
Jun-12	1,649	1,880	1,517
Jul-12	1,432	1,620	1,115
Aug-12	1,531	5,396	1,273
Sep-12	1,480	1,684	1,332
Oct-12	1,537	2,177	1,359
Nov-12	1,911	2,362	1,622
Dec-12	1,763	2,054	1,618
Average	**1,836**		

St. Andrews SPS

Date	Montly Average Flow (m3/day)	Daily Max Flow (m3/day)	Daily Min Flow (m3/day)
Jan-12	440	483	416
Feb-12	430	486	397
Mar-12	430	476	396
Apr-12	427	469	402
May-12	410	450	390
Jun-12	407	448	386
Jul-12	400	435	375
Aug-12	383	416	359
Sep-12	382	431	354
Oct-12	383	428	355
Nov-12	383	432	348
Dec-12	374	417	351
Average	**404**		

Northridge SPS

Date	Montly Average Flow (m3/day)	Daily Max Flow (m3/day)	Daily Min Flow (m3/day)
Jan-12	295	331	266
Feb-12	275	317	252
Mar-12	273	310	243
Apr-12	277	310	253
May-12	265	300	245
Jun-12	261	291	243
Jul-12	246	264	226
Aug-12	233	254	219
Sep-12	247	282	226
Oct-12	257	297	233
Nov-12	267	303	244
Dec-12	271	298	249
Average	**264**		

Johnson SPS

Date	Montly Average Flow (m3/day)	Daily Max Flow (m3/day)	Daily Min Flow (m3/day)
Jan-12	187	311	149
Feb-12	172	239	152
Mar-12	159	203	134
Apr-12	144	164	126
May-12	140	157	128
Jun-12	146	174	127
Jul-12	142	165	129
Aug-12	160	223	136
Sep-12	167	262	143
Oct-12	215	403	150
Nov-12	220	334	180
Dec-12	234	259	201
Average	**174**		

Appendix 4C - Wastewater Evaluation Tables

Wastewater Concepts Evaluation Tables

Brantford Concept Evaluation

Concept Number	Concept Description	Advantages	Disadvantages	Rating	Carried forward/ Screened out
1	Do nothing	No cost in the short term	Existing and future capacities issues not solved Does not address growth within existing urban boundary Would limit growth	**Low**	**Screened out**
2	Increase Conveyance Capacity	Addresses growth within existing urban boundary Maximizes use of existing PS and WWTP	High cost associated with upgrades and new linear infrastructure It might trigger capacity constraints at PS	**High**	**Carried Forward**
3	Storage	Maximizes use of existing capacity at Pumping Stations and WWTP Would minimize need to upgrade conveyance and WWTP capacity Would rely on traditional tried and tested technology, minimizing risk	Unlikely to be able to efficiently solve all constraints Site acquisitions required for storage facilities; locating sufficient land supply for required volumes may be difficult Increase asset stock; Will incur in additional O&M costs	**Medium**	**Carried Forward**
4	Inflow & Infiltration Reduction	Maximizes use of existing infrastructure No major facility or conveyance upgrades required Would reduce flow in system, creating savings in pumping, treatment and need for upgraded infrastructure	Requires implementation of flow reduction program Potential not to meet flow reduction targets Dependent on public and private participation and commitment Not considered feasible as a complete solution	**High**	**Carried Forward**
5	Regulation/by law to reduce and limit I&I	Maximizes use of existing infrastructure No major facility or conveyance upgrades required Would reduce flow in system, creating savings in pumping, treatment and need for upgraded infrastructure	Lengthy implementation which may not meet schedule Potential not to meet flow reduction targets Not considered feasible as a complete solution Results are not quantifiable in terms of flow or extra capacity	**Medium**	**Carried Forward**
6	Optimized System Operation	Maximizes use of existing infrastructure Would minimize the need for upgraded infrastructure Full use of the system throughout its useful life Cost effective in the long and short term	Increase of O&M related costs Difficult to quantify potential benefits Not considered feasible as a complete solution	**High**	**Carried Forward**
7	New WWTP (West Brantford)	Provide potential additional capacity downstream reducing conveyance expansion needs Provides service area flexibility (i.e. flows could be diverted to west Brantford) Would address growth and meet long term servicing requirements could incorporate new technology; water quality benefits	High capital costs associated with new treatment plant, site acquisition and new linear infrastructure Does not maximize the use of existing treatment facility which has additonal capacity Will incur in additional O&M costs	**Low**	**Screened out**
8	Satellite Treatment - multiple micro treatment plants	Minimizes the need for upgrades in conveyance and WWTP Distributed risk as WW would be treated at various locations	Does not maximize the use of existing treatment facility which has enough capacity High costs associated with new treatment site at multiple locations Will incur additional O&M costs at multiple sites compared to the economies of scale that can be achieved at one central site	**Low**	**Screened out**
9	High Flow Rate Treatment	Minimize the need for upgrades in conveyance and WWTP Small footprint in comparison with other conventional treatment facilities manages peak flows and associated impacts	High cost associated with new treatment facilities and O&M Requirement to meet stringent effluent discharge criteria Concern with environmentally sensitive receiving body	**Low**	**Screened out**
10	Deep Tunnel	Potential to solve most downstream surcharging/ capacity issues Would provide large storage volumes with relatively low disturbance to the surface	High capital and construction costs Most costly storage capacity option Installation of a deep tunnel may be technically challenging	**Low**	**Screened out**

Wastewater Strategy Evaluation Tables

Brantford Wastewater Strategy Evaluation

Strategy	Strategy 1	Strategy 2	Strategy 3	Strategy 4
Description	**Increased Conveyance**	**Increased Conveyance + Storage**	**Increased Conveyance + Diversion from Empey SPS Catchment**	**Increased Conveyance + Diversion to Empey SPS**
Environmental	Linear infrastructure upgrades and extensions to be undertaken in existing or future road right of way minimizing the potential for environmental impacts Linear upgrades required along Maitland St/Stanley St and Stanley St, and potential Grand River crossing upgrade required. Higher potential for increased environmental impact due to increased number of water/environmental crossings for conveyance including the potential need for a Grand River crossing	Linear infrastructure upgrades and extensions to be undertaken in existing or future road right of way minimizing the potential for environmental impacts Storage tank construction to avoid extensive linear upgrades. Slightly reduced potential for environmental impact compared to Strategy 1 and 3 due to reduced linear projects and environmental crossings but higher than Strategy 4 due to need for storage sites	Linear infrastructure upgrades and extensions to be undertaken in existing or future road right of way minimizing the potential for environmental impacts Additional linear upgrades required along Maitland St and Stanley St, and potential Grand River crossing upgrade required. Higher potential for increased environmental impact due to increased number of water/environmental crossings for conveyance including the potential need for a Grand River crossing	Linear infrastructure upgrades and extensions to be undertaken in existing or future road right of way minimizing the potential for environmental impacts Reduced linear upgrades and no Grand River crossing upgrade required. Reduced potential for environmental impact due to reduced linear projects, no storage sites and minimized environmental crossings
Sub-Score (1, 2, or 3)	1	2	1	3
Technical	Extension of linear infrastructure to new greenfield growth areas common requirement for all alternatives Empey SPS upgrades required Maximize use of existing capacity at WWTP Gravity sewer twinning required upstream of Greenwich SPS Extension of gravity network west of Conklin Capacity constraints along Maitland St and Stanley St downstream of Wayne Gretzky Pkwy/Henry St Avoids requirement for storage facilities Capacity constraints along Greenwich St require linear upgrade	Extension of linear infrastructure to new greenfield growth areas common requirement for all alternatives Storage structure required upstream of Empey SPS Maximize use of existing capacity at WWTP Storage structure required upstream of Greenwich SPS Extension of gravity network west of Conklin The use of storage provides opportunities to manage peak wet weather flows within the system and at the plants Potential to balance conveyance and storage to achieve most appropriate system-wide solution Capacity constraints along Greenwich St require linear upgrade	Extension of linear infrastructure to new greenfield growth areas common requirement for all alternatives Diversion from the Empey Catchment will result in capacity constraints along Maitland St, Stanley St and Greenwich St Maximize use of existing capacity at WWTP Gravity sewer twinning required upstream of Greenwich SPS Extension of gravity network west of Conklin Increased capacity constraints along Maitland St, Stanley St downstream of Wayne Gretzky Pkwy/Henry St due to diversion from Empey SPS Catchment Avoids requirement for storage facilities Capacity constraints along Greenwich St require linear upgrade	Extension of linear infrastructure to new greenfield growth areas common requirement for all alternatives Diversion to the Empey Catchment will result in pumping upgrade requirements Maximize use of existing capacity at WWTP Gravity sewer twinning required upstream of Greenwich SPS Extension of gravity network west of Conklin Reduced capacity constraints along Maitland St and Stanley St downstream of Wayne Gretzky Pkwy/Henry St due to diversion to Empey SPS Catchment Avoids requirement for storage facilities Capacity constraints along Greenwich St require linear upgrade
Sub-Score (1, 2, or 3)	1	2	1	3
Socio / Cultural	Higher potential for impact/disruption during construction due to multiple locations for capacity upgrades	Strategy balances conveyance solutions with storage. As both will be constructed within built-up areas, there is some potential for impact/disruption Strategy requires multiple storage sites likely within existing built area Potential for odour related nuisance problems caused by storage	Higher potential for impact/disruption during construction due to multiple locations for capacity upgrades	Potential to minimize impact/disruption during construction as strategy minimizes construction within existing urban areas
Sub-Score (1, 2, or 3)	2	1	2	3
Financial	Capital cost is higher due to increased linear upgrades required and urban constuction Marginal potential increase in O&M due to increased length of linear projects High cost of upgrading sewer along along Maitland St, Stanley St within built up area	High cost strategy due to the need for multiple storage facilities within existing urban boundary Balancing the need for conveyance appropriately may allow a lower cost solution than the conveyance only strategy New O&M costs introduced due to new storage facilities	Potential high cost of upgrading sewer along along Maitland St, Stanley St within built up area	Minimizes cost for linear project and low cost for upgrade of Empey SPS Marginal increase in O & M cost for increased flows to Empey SPS
Sub-Score (1, 2, or 3)	2	1	2	3
Legal / Jurisdictional	May require land acquisition for linear upgrades	Will require land acquisition for storage	May require land acquisition for linear upgrades	May require land acquisition for linear upgrades
Sub-Score (1, 2, or 3)	2	1	2	2
Total Score	8	7	8	14
Overall Score	Medium	Low	Medium	High

Wastewater Sub-Strategy Evaluation Tables

Brantford Wastewater Strategy Evaluation - Northwest Brantford

Strategy	Strategy 1	Strategy 2	Strategy 3	Strategy 4	Strategy 5
Description	**Gravity 403 Crossing East of Oak Park Rd + SPS West of Oak Park Rd**	**Gravity 403 Crossing West of Oak Park Rd**	**Pumped 403 Crossing West of Oak Park Rd + SPS West of Oak Park Rd**	**Pumped 403 Crossing along SC Johnson Trail bridge + SPS West of Oak Park Rd**	**Two gravity 403 Crossings west and east of Oak Park Rd**
Environmental	Linear infrastructure upgrades and extensions to be undertaken in existing or future road right of way minimizing the potential for environmental impacts Single 403 crossing will minimize potential environment impacts due to crossing construction and tunnelling (common to all alternatives) Single SPS and overflow required, increasing potential for impact during construction Potential environmental impacts of SPS overflow during operation	Linear infrastructure upgrades and extensions to be undertaken in existing or future road right of way minimizing the potential for environmental impacts Single 403 crossing will minimize potential environment impacts due to crossing construction and tunnelling (common to all alternatives) No SPS required No potential for SPS overflow	Linear infrastructure upgrades and extensions to be undertaken in existing or future road right of way minimizing the potential for environmental impacts Single 403 crossing will minimize potential environment impacts due to crossing construction and tunnelling (common to all alternatives) Single SPS and overflow required, increasing potential for impact during construction Potential environmental impacts of SPS overflow during operation	Linear infrastructure upgrades and extensions to be undertaken in existing or future road right of way minimizing the potential for environmental impacts Single 403 crossing will minimize potential environment impacts due to crossing construction and tunnelling (common to all alternatives) Single SPS and overflow required, increasing potential for impact during construction Potential environmental impacts of SPS overflow during operation	Focused infrastructure on exisiting and future roads, minimizing environmental impacts Two deep 403 crossings will have greater impact than a single crossing No SPS required No potential for SPS overflow
Sub-Score (1, 2, or 3)	2	3	2	2	2
Technical	Single 403 crossing required along new easement Proposed Hwy 403 crossing not along existing City of Brantford Easement Does not make use of existing stub on Fen Ridge Crt and existing Hwy 403 crossing easement Eastern Hwy 403 sewer crossing can be coordinated with potential future watermain crossing SPS will provide ability to attenuate peak flows Single deep gravity sewer requried for Hwy 403 crossing and along Savannah Oaks Dr for connection to deeper sewer invert at Oak Park Rd Forcemain crossing of Oak Park Rd required Duplicates gravity sewers along Savannah Oaks Dr Operation and maintenance of single SPS Development of area west of Oak Park Rd will depend on construction of gravity crossing of 403 east of Oak Park Rd - Staging impacts Uncertainty of future ground elevations for development west of Oak Park Rd. SPS solution mitigates risk of low future ground elevations Extensive redundancy required for SPS to mitigate overflow risk Deep eastern 403 crossing enables gravity servicing of a slightly larger post period service area to the north	Single 403 crossing required along existing easement Proposed Hwy 403 crossing along existing City of Brantford Easement Strategy makes use of existing stub on Fen Ridge Crt and existing Hwy 403 crossing easement No flow attenuation via SPS Single deep gravity sewer requried for Hwy 403 crossing for connection to stub at Fen Ridge Crt. Gravity crossing of Oak Park Rd required No SPS operation and maintenance required Development of area east of Oak Park Rd will depend on gravity crossing of 403 west of Oak Park Rd - Staging impacts Uncertainty of future ground elevations for development west of Oak Park Rd. Gravity solution has higher risk of challenging elevations Western 403 crossing enables gravity servicing of a portion of post period service area to the north	Single 403 crossing required along existing easement Proposed Hwy 403 crossing along existing City of Brantford Easement Strategy makes use of existing stub on Fen Ridge Crt and existing Hwy 403 crossing easement SPS will provide ability to attenuate peak flows Single forcemain requried for Hwy 403 crossing for discharge to stub at Fen Ridge Crt. Gravity crossing of Oak Park Rd required Operation and maintenance of single SPS Development of area east of Oak Park Rd will depend on pumped crossing of 403 west of Oak Park Rd - Staging impacts Uncertainty of future ground elevations for development west of Oak Park Rd will not impact pumped solution. Lower risk of servicing impacts due to low ground elevations Extensive redundancy required for SPS to mitigate overflow risk Western 403 crossing enables gravity servicing of a portion of post period service area to the north	Single 403 crossing required hung from pedestrial bridge Proposed Hwy 403 crossing along existing trail easement Does not make use of existing stub on Fen Ridge Crt and existing Hwy 403 crossing easement SPS will provide ability to attenuate peak flows Single forcemain rquired for Hwy 403 crossing to be hung from SC Johnson Trail bridge. Discharge to upstream end of sewer on Fen Ridge Crt Gravity crossing of Oak Park Rd required Operation and maintenance of single SPS Development of area east of Oak Park Rd will depend on forcemain crossing of 403 west of Oak Park Rd - Staging impacts Uncertainty of future ground elevations for development west of Oak Park Rd will not impact pumped solution. Lower risk of servicing impacts due to low ground elevations Extensive redundancy required for SPS to mitigate overflow risk Western 403 crossing enables gravity servicing of a portion of post period service area to the north	Two 403 crossings required, additional easement needed. Western Hwy 403 crossing along existing City of Brantford Easement Strategy makes use of existing stub on Fen Ridge Crt and existing Hwy 403 crossing easement however, requires additional easement and deep sewer to connect to sewer at Oak Park Rd / Savannah Oaks Dr Eastern Hwy 403 sewer crossing can be coordinated with potential future watermain crossing No flow attenuation via SPS Two deep gravity sewer crossings No crossing of Oak Park Rd required Duplicates gravity sewers along Savannah Oaks Dr No SPS operation and maintenance required Each area can develop independently, potentially facilitating staging Uncertainty of future ground elevations for development west of Oak Park Rd. Gravity solution has higher risk of challenging elevations Deep eastern 403 crossing enables gravity servicing of a slightly larger post period service area to the north
Sub-Score (1, 2, or 3)	2	3	2	1	3
Socio / Cultural	High potential for disruption due to construction of deep sewer along Savannah Oaks Dr	Low potential disruption from gravity sewer crossing of Oak Park Rd and tunnelled gravity sewer crossing of Hwy 403	Low potential disruption from gravity sewer crossing of Oak Park Rd and tunnelled forcemain crossing of Hwy 403	Low potential disruption from gravity sewer crossing of Oak Park Rd and hung forcemain crossing of Hwy 403	High potential for disruption due to construction of deep sewer along Savannah Oaks Dr
Sub-Score (1, 2, or 3)	1	2	2	2	1
Financial	High capital cost due to SPS and deep gravity sewer crossing of Hwy 403 and along Savannah Oaks Dr High O & M costs due to operation of SPS Construction of overflow pipe required	Lower capital costs due to construction of gravity solution Lower O & M costs for gravity only solution No overflow pipe required	Moderate capital cost due to SPS and forcemain crossing of Hwy 403 High O & M costs due to operation of SPS Construction of overflow pipe required	Moderate capital cost due to SPS and forcemain crossing of Hwy 403. Likely lower cost to hang forcemain rather than tunnel High O & M costs due to operation of SPS Construction of shorter overflow pipe required	Higher capital costs due to construction of two crossings and deep sewer along Savannah Oaks Dr Lower O & M costs for gravity only solution No overflow pipe required
Sub-Score (1, 2, or 3)	1	3	2	2	2
Legal / Jurisdictional	Will require land acquisition for SPS and crossing Will requiring MTO permitting for crossing and encroachment of Hwy 403 (common to all alternatives) Will require GRCA approval and permitting for overflow infrstructure	Will use existing easement for Hwy 403 crossing Will requiring MTO permitting for crossing and encroachment of Hwy 403 (common to all alternatives)	Will require land acquisition for SPS, however, will be able to use existing easement for Hwy 403 crossing Will requiring MTO permitting for crossing and encroachment of Hwy 403 (common to all alternatives) Will require GRCA approval and permitting for overflow infrstructure	Will require land acquisition for SPS and part of forcemain Will requiring MTO permitting for crossing and encroachment of Hwy 403 (common to all alternatives) Will require GRCA approval and permitting for overflow infrstructure	Will use existing easement for western Hwy 403 crossing, however, will require land acquisition for eastern crossing
Sub-Score (1, 2, or 3)	1	3	2	1	2
Total Score	7	14	10	8	10
Overall Score	Low	High	Medium	Low	Medium

Appendix 4D - Unit Costs

CITY OF BRANTFORD MASTER SERVICING PLAN

WASTEWATER UNIT RATES

Sewer Depth - 5m

Pipe Diameter (mm)	Final Recommened UR 2014$
250	$625
300	$657
375	$692
450	$735
525	$780
600	$865
675	$1,086
750	$1,190
825	$1,239
900	$1,517
975	$2,349
1050	$2,693
1200	$3,006
1350	$3,383
1500	$3,794
1650	$4,202
1800	$4,742
2100	$5,355
2400	$6,960
3000	$9,509

Sewer Depth - 10m

Pipe Diameter (mm)	Final Recommened UR 2014$
250	$2,111
300	$2,222
375	$2,339.16
450	$2,393.73
525	$2,453.69
600	$2,903.09
675	$3,191.18
750	$3,313.34
825	$3,357.63
900	$3,720.24
975	$3,784.59
1050	$4,449.27
1200	$4,693.35
1350	$5,043.76
1500	$5,757.59
1650	$6,164.85
1800	$6,732.74
2100	$7,377.60
2400	$8,986.49
3000	$11,533.32

Forcemains

Pipe Diameter (mm)	Final Recommened UR 2014$
150	$564
200	$608
250	$656
300	$713
350	$910
400	$1,072
450	$1,232
500	$1,402
600	$1,784
750	$1,900
900	$2,211
1050	$2,597
1200	$2,987

note: Unit Rates for sewers include manholes.
Assumptions are:

Diameter	Spacing
375-750	100 m
825 - 900	125 m
975 - 3000	150 m

Sewer Trenchless Crossings Assumed Length Stated on table and inclds manhole each side of crossing

For Creeks & Trans Canada

Length = 20

Diameter	Cost
200	$64,000
250	$64,000
300	$64,000
375	$142,000
450	$153,000
525	$165,000
600	$176,000
675	$212,000
750	$223,000
825	$235,000
900	$295,000
975	$306,000
1050	$332,000
1200	$355,000
1350	$378,000
1500	$400,000
1650	$423,000
1800	$483,000
2100	$528,000
2400	$574,000
3000	$664,000

For Major Roads, Rail and Hydro Corridors

Length = 60

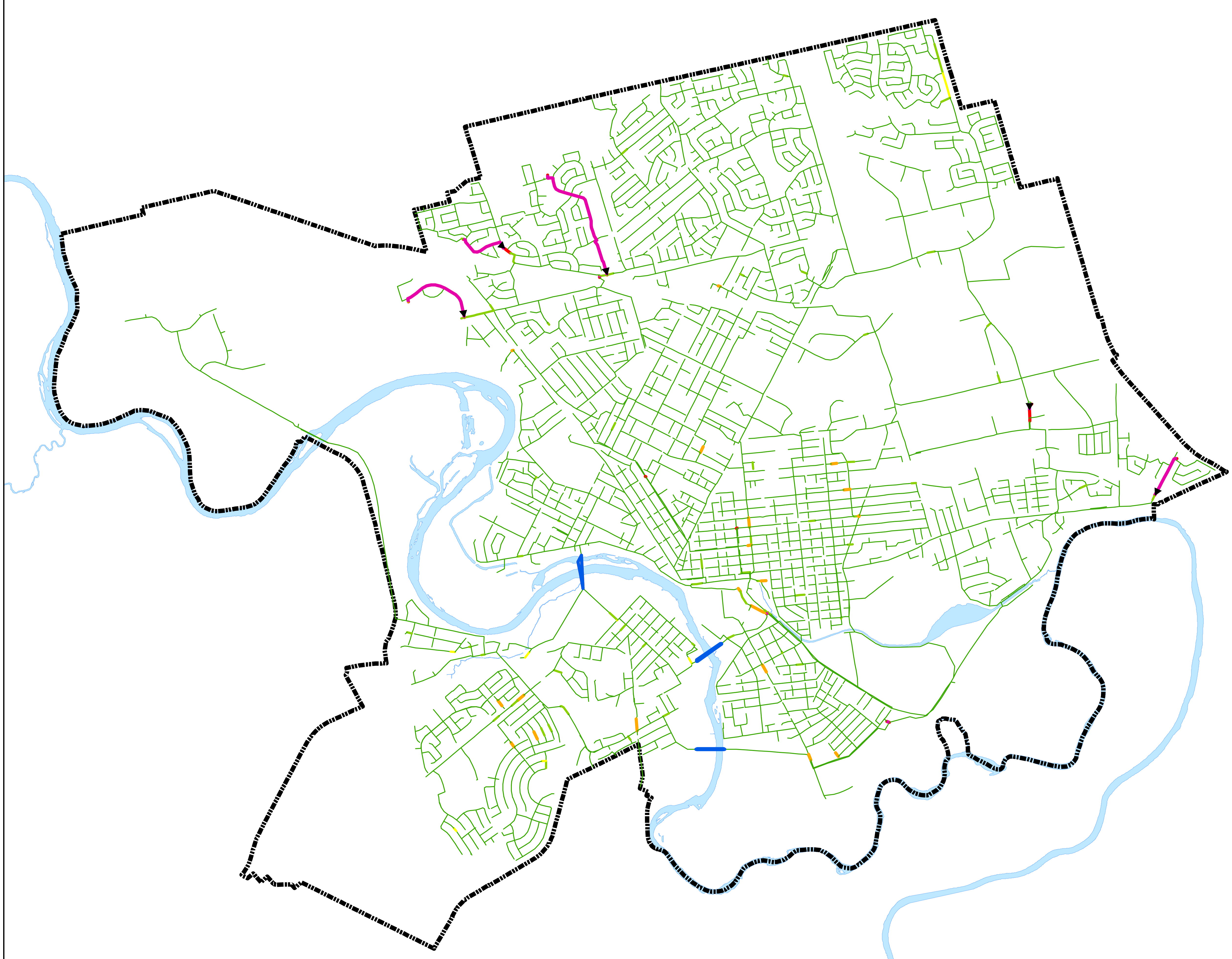
Diameter	Cost
200	$108,000
250	$108,000
300	$108,000
375	$343,000
450	$377,000
525	$411,000
600	$445,000
675	$504,000
750	$538,000
825	$572,000
900	$655,000
975	$689,000
1050	$737,000
1200	$806,000
1350	$874,000
1500	$942,000
1650	$1,010,000
1800	$1,115,000
2100	$1,252,000
2400	$1,388,000
3000	$1,661,000

For Freeways, Major Creek Crossings

Length = 150

Diameter	Cost
200	$207,000
250	$207,000
300	$207,000
375	$795,000
450	$880,000
525	$965,000
600	$1,050,000
675	$1,160,000
750	$1,245,000
825	$1,330,000
900	$1,464,000
975	$1,550,000
1050	$1,649,000
1200	$1,820,000
1350	$1,990,000
1500	$2,161,000
1650	$2,331,000
1800	$2,539,000
2100	$2,879,000
2400	$3,220,000
3000	$3,902,000

Appendix 4E - Preliminary Wastewater Model Results



City of Brantford
2014 Master Servicing Plan (MSP)
for Water, Sanitary and Stormwater Services

Preliminary Wastewater Model Results
2011 PDWF

FMs & Siphons

FM
Siphon

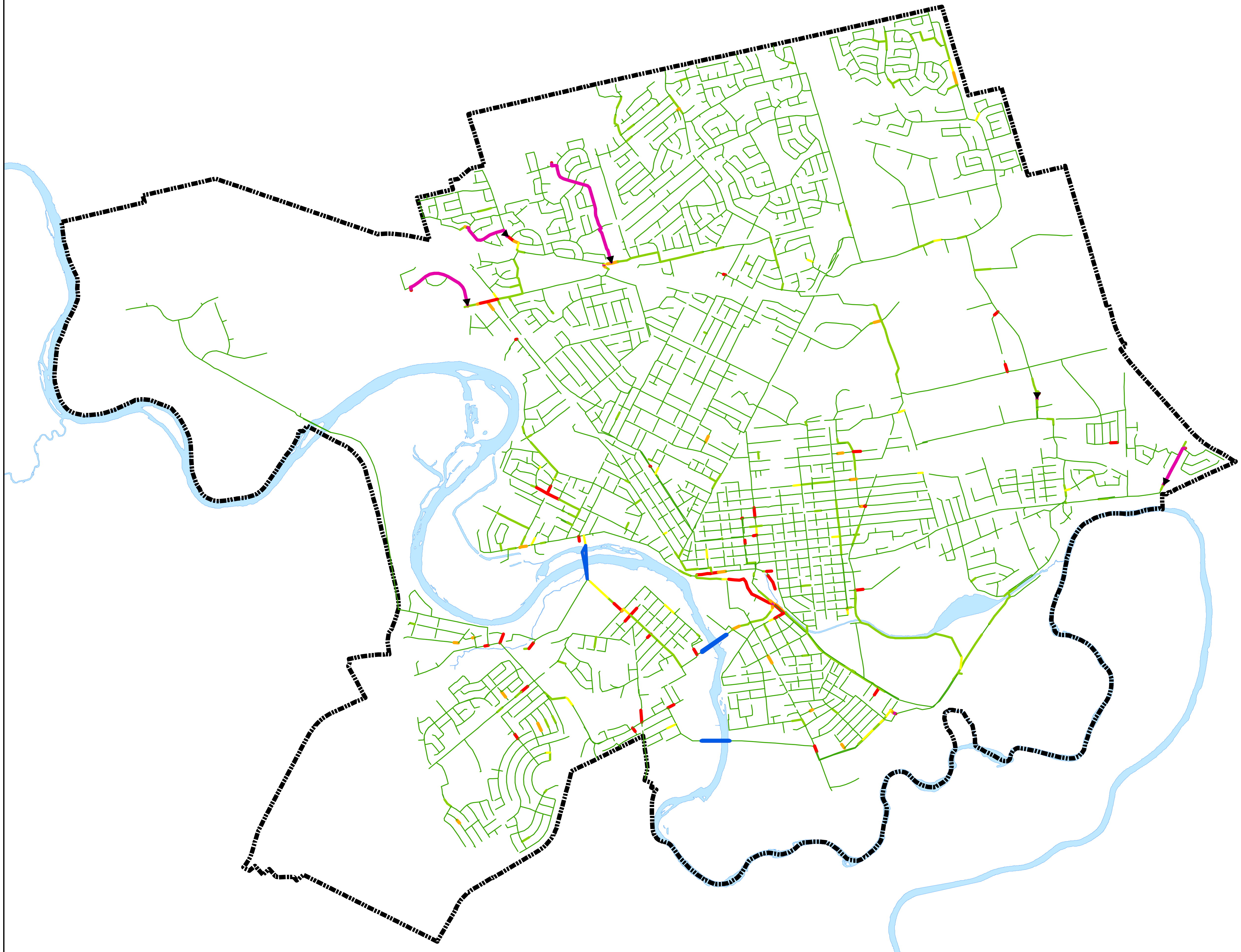
Pipe d/D

< 0.5 d/D
0.5 - 0.75 d/D
0.75 - 0.85 d/D
0.85 - 1.0 d/D
> 1.0 d/D
Municipal Boundary
Rivers

Preliminary Model results based on 2011/2031 flow/demand conditions without MSP upgrades.

BluePlan ENGINEERING CONSULTANTS LIMITED

July 2014
1:44,000 | UTM83-17n



N

THE CORPORATION OF THE CITY OF BRANTFORD

City of Brantford
2014 Master Servicing Plan (MSP)
for Water, Sanitary and Stormwater Services

Preliminary Wastewater Model Results
2011 PWWF

FMs & Siphons

- FM
- Siphon

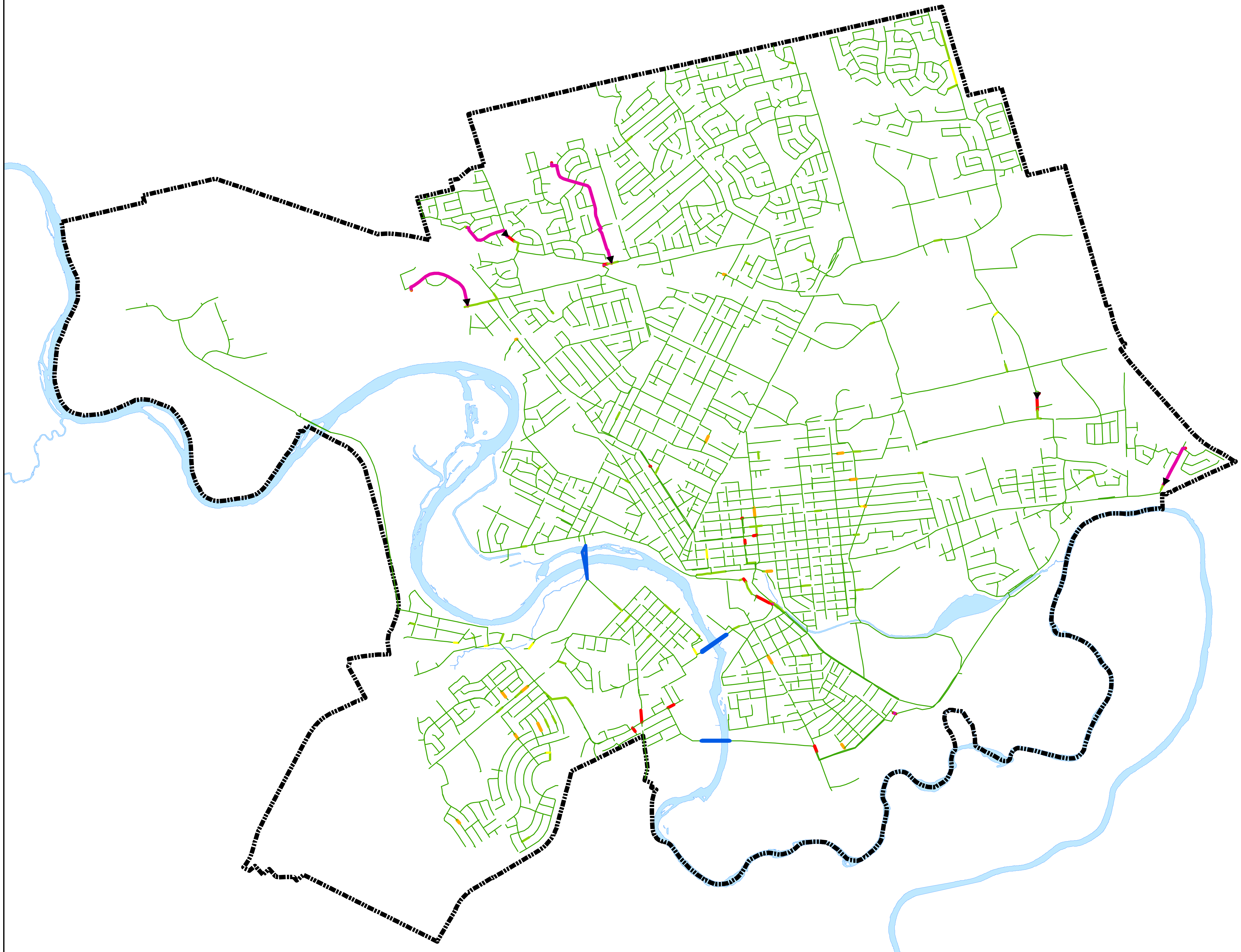
Pipe d/D

- < 0.5 d/D
- 0.5 - 0.75 d/D
- 0.75 - 0.85 d/D
- 0.85 - 1.0 d/D
- > 1.0 d/D
- Municipal Boundary
- Rivers

Preliminary Model results based on 2011/2031 flow/demand conditions without MSP upgrades.

BluePlan ENGINEERING CONSULTANTS LIMITED

July 2014
1:44,000 | UTM83-17n



N

BRANTFORD

THE CORPORATION OF THE CITY OF

City of Brantford
2014 Master Servicing Plan (MSP)
for Water, Sanitary and Stormwater Services

Preliminary Wastewater Model Results
2031 PDWF

FMs & Siphons

- FM
- Siphon

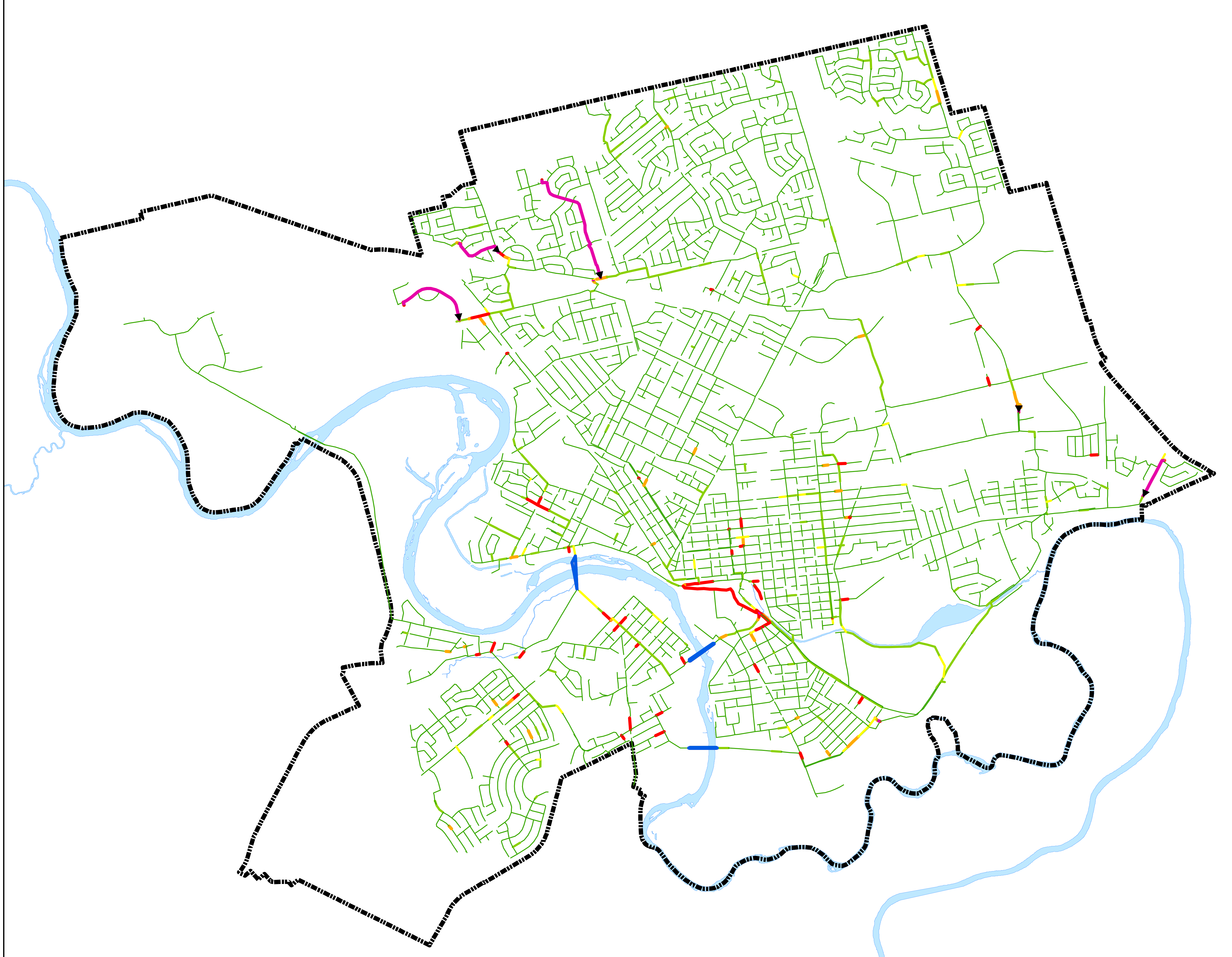
Pipe d/D

- < 0.5 d/D
- 0.5 - 0.75 d/D
- 0.75 - 0.85 d/D
- 0.85 - 1.0 d/D
- > 1.0 d/D
- Municipal Boundary
- Rivers

Preliminary Model results based on 2011/2031 flow/demand conditions without MSP upgrades.

BluePlan ENGINEERING CONSULTANTS LIMITED

July 2014
1:44,000 | UTM83-17n



N

THE CORPORATION OF THE CITY OF BRANTFORD

City of Brantford
2014 Master Servicing Plan (MSP)
for Water, Sanitary and Stormwater Services

Preliminary Wastewater Model Results
2031 PWWF

FMs & Siphons

- FM
- Siphon

Pipe d/D

- < 0.5 d/D
- 0.5 - 0.75 d/D
- 0.75 - 0.85 d/D
- 0.85 - 1.0 d/D
- > 1.0 d/D
- Municipal Boundary
- Rivers

Preliminary Model results based on 2011/2031 flow/demand conditions without MSP upgrades.

BluePlan ENGINEERING CONSULTANTS LIMITED

July 2014
1:44,000 | UTM83-17n