Prepared for:
Grand Niagara Co-Owners and
City of Niagara Falls

PRELIMINARY MUNICIPAL SERVICING REPORT

GRAND NIAGARA SECONDARY PLAN

14.15039 | November 2016

WSP | MMM GROUP

Contents

Appendices

APPENDIX A – FIGURES

- Figure SD1 – Proposed Development Areas and Equivalent Populations
- Figure W1 – Overall City Water Distribution Plan
- Figure W2 – Existing External Water Distribution
- Figure W3 – Existing Water Distribution
- Figure W4 – Proposed Watermain Layout
- Figure SA1 – Overall City Wastewater Collection Plan
- Figure SA2 – Existing External Sanitary Sewers
- Figure SA3 – Existing Sanitary Sewers
- Figure SA4 – Proposed Sanitary Sewer Layout
- Figure P1 – Collector Road Profiles

APPENDIX B – EXCERPTS FROM REFERENCE MATERIALS

- Niagara Region W&WWMSP - DeCew and Niagara Service Area – 2031 Service Pressure
- Niagara Region W&WWMSP - DeCew and Niagara Service Area – 2031 Hydraulic Gradient
- Niagara Region W&WWMSP - DeCew and Niagara Service Area – 2031 Available Fire Flow

APPENDIX C – DESIGN CALCULATIONS / SHEETS

- Preliminary Water Flow Demand Calculation
- Preliminary Sanitary Flow Design Sheet

1 INTRODUCTION

MMM Group Limited, a WSP Company (herein called MMM) has been retained by the Grand Niagara Co-Owners to prepare a Preliminary Servicing Report to assess the municipal servicing (water distribution and sanitary collection) opportunities and constraints in support of the Grand Niagara Secondary Plan (herein called the Secondary Plan area or site) located in the City of Niagara Falls, which lies within the Regional Municipality of Niagara. Figure 1 illustrates the site location. This report provides the conceptual framework for water distribution, sanitary sewage and storm drainage for the site. A Preliminary Stormwater Management Report outlining the proposed stormwater quality and quantity controls has been prepared under separate cover.

1.1 Site Description

The Secondary Plan area occupies land bounded by Biggar Road to the south, the Welland River to the North, Crowland Road to the West, the Queen Elizabeth Way (QEW) to the East, in the City of Niagara Falls. The Subject Lands have a total area of 330 hectares (815 acres) with the majority of the lands currently occupied by a golf course, some residential uses along Grassy Brook Road, and employment uses along the east and west sides of Montrose Road. A Canadian Pacific (CP) rail line runs diagonally through the site.

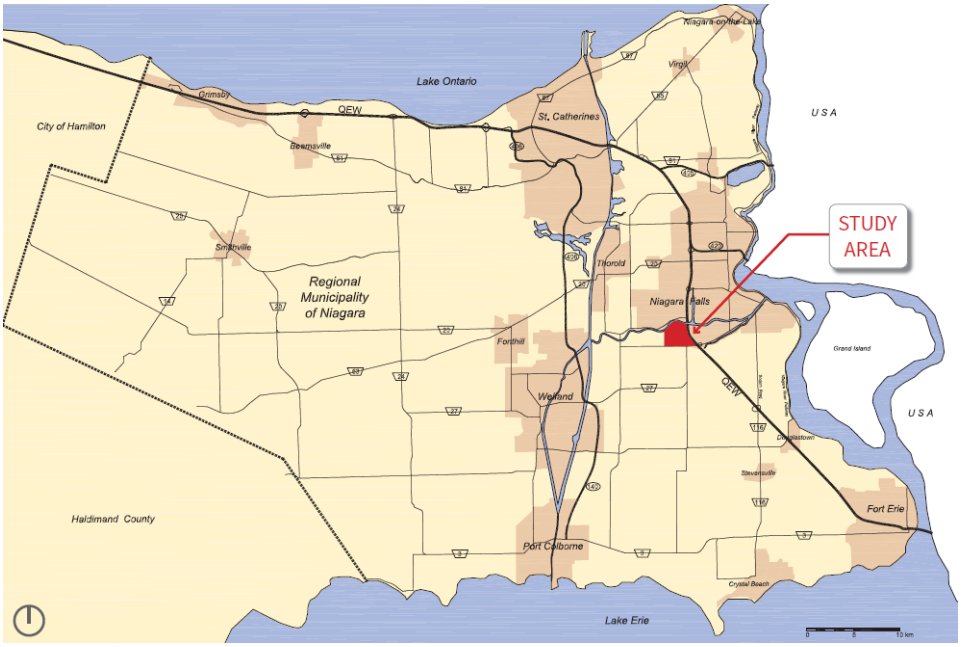


Figure 1: Location Map

The majority of the site is owned by the Grand Niagara Co-Owners. The remaining lands are owned by other property owners who have been notified of the Secondary Plan process.

The Secondary Plan proposes redeveloping the site by replacing the existing golf course and surrounding lands with a complete community containing residential, commercial, institutional (including a hospital), employment, community facilities, park and open space uses. Figure 2 illustrates the proposed development plan for the site.

NiagaraFalls CANADA

FIGURE 2

GRAND NIAGARA SECONDARY PLAN

Legend

- Grand Niagara Secondary Plan
- Urban Area Boundary
- Lands within the Built Boundary
- residential low / medium density
- mixed use
- ES proposed elementary
- P open space / parkland
- tourist commercial
- hospital employment campus
- employment
- natural heritage system (see Appendix C)
- N1 Neighbourhoods
- roads
- rail line
- utility corridor
- pipeline easement

DRAFT

Scale 1:8,000

0 100 200 300 400 500m

1.2 Reference Materials

To review and assess the existing infrastructure within the vicinity of the Secondary Plan area, and to determine design criteria requirements to service the site, the following documents were reviewed:

1. Region of Niagara Water and Wastewater Master Servicing Plan (W&WWMSP, by AECOM, 2011)
2. City of Niagara Falls Engineering Design Guidelines Manual (amended January 2012)
3. Record Drawings:
    a. Grassy Brook Road As-Constructed Plan/Profiles
    b. Montrose Road Drive As-Constructed Plan/Profiles
    c. Chippawa Creek As-Constructed Plan/Profiles
    d. Grassy Brook Sewage Pumping Station As-Constructed Site Plan/SCADA Drawings
4. Ministry of Environment Design Guidelines for Drinking Water Systems (MOE, 2008)
5. Ministry of Environment Design Guidelines for Sewage Works (MOE, 2008)
6. Aerial Topographic Survey (by MMM Geomatics, January 25, 2016)
7. Ministry of Environment C of A for the Grassy Brook SPS.
8. Water Supply for Public Fire Protection Guidelines (Fire Underwriters Survey, 1999)

2 WATER DISTRIBUTION

Section 2 discusses the following topics related to Niagara Falls water distribution system:

- Description of jurisdiction and responsibilities
- Existing conditions of the system as a whole and in vicinity of the Secondary Plan area
- Proposed design for the Secondary Plan area and its impacts on the existing system

2.1 Water Jurisdiction and Responsibility

Niagara Region has jurisdiction over the drinking water supply for homes and businesses throughout the Region. Water servicing in the Region is based on a two-tiered approach. The Region is responsible for the treatment, storage, pumping and watermains over 300mm diameter. The City of Niagara Falls is responsible for watermains 300mm or less.

2.2 Existing Water Distribution System

Section 2.2 discusses the existing conditions external to and within the Secondary Plan area.

Existing Conditions External to Secondary Plan Area

The Secondary Plan area is supplied with water through the Niagara Falls water distribution network. The Niagara Region W&WWMSP (2011) provides detailed information about the system. Some key points relevant to the site are listed below:

1. There is only one pressure zone for Niagara Falls, NF1. The site falls within this pressure zone. The source of the NF1 system is the Niagara Falls Water Treatment Plant, located east of the Secondary Plan area.
2. Water design parameters were modelled and illustrated in figures in the W&WWMSP. 2031 baseline modelling results of these design parameters related to the Secondary Plan area are listed below:
    a. System Pressure – greater than 100 psi.
    b. Hydraulic Gradient – less than 2.5m per 1000m.
    c. Available Fire Flow – greater than 360 L/s.

    The W&WWMSP Modelling Figures that support the above results can be found in Appendix B. We note that the 2011 version of the W&WWMSP did not account for the scale of development planned for in the Grand Niagara Secondary Plan. The 2011 W&WWMSP did however account for some additional residential development within this area through previous approval for a golf course/resort development.
3. The watermain system is expected to meet long-term demands for the City and the Secondary Plan area. The Niagara Falls WTP has the capacity to supply 145.50 million litres per day (MLD) and the anticipated full buildout scenario of City of Niagara Falls developable lands will require 112.81 MLD.

Figure W1 in Appendix A illustrates the existing overall water distribution network for the City of Niagara Falls.

Existing Conditions within the Secondary Plan Area

The existing larger diameter watermains within the Secondary Plan area are as follows:

1. A City 300mm watermain which runs east-west along Grassy Brook Rd., connecting to Montrose Rd. to the east and crossing the Welland River to the Northwest onto Chippawa Creek Rd.
2. A City 300mm watermain which runs north-south along Montrose Rd. from Lyon's Creek Rd. / Biggar Rd. to the South continuing north to the 500mm Regional watermain on McLeod Rd.

These watermain pipes are part of a well-looped distribution network which connects to the Regional watermain on McLeod Road. Please see Figure W2 and W3 in Appendix A, which illustrates the existing water distribution network within and external to the Secondary Plan area.

2.3 Proposed Water Distribution Network

Section 2.3 discusses the feasibility and basic layout of a proposed water distribution network for the Secondary Plan area. The Section will elaborate on the following items:

- Design criteria and proposed demand results
- Demand effects on existing system capacity
- Proposed water distribution layout and features

Design Criteria and Proposed Demand Results

The proposed water system for the Secondary Plan area shall be designed in accordance with the City's Design Criteria. The City's manual states that design flow criteria must conform to the MOE's design guidelines for domestic flows and include an allowance and/or conform with the "Water Supply for Public Fire Protection Guidelines" by the Fire Underwriters Survey for fire flows.

Design criteria relevant in determining the flow demand for the site from the City of Niagara Falls Design Criteria are as follows:

1. Minimum new development fire flow allowance = 80 L/s
2. Minimum residential pipe size = 150 mm dia.
3. Minimum school pipe size = 300 mm dia.
4. Minimum commercial/industrial pipe size = 200 mm dia.
5. Maximum pressure = 100 psi
6. Minimum pressure (peak hour) = 40 psi
7. Minimum pressure (max. day + fire) = 20 psi

Design criteria relevant in determining the flow demand for the site from Section 3.4, "Design Flow" of the MOE Design Guidelines are as follows:

1. Average domestic daily residential flow demand = 270-450 Lpcd
2. Average domestic daily commercial flow demand = 2,500-5,000 L/m^2/d
3. Average domestic daily hospital flow demand = 900-1,800 L/bed/d
4. Average domestic daily school flow demand = 70-140 L/student/d
5. Peak hour factor for population=10,001-25,000 = 2.85
6. Peaking factor for maximum day for population = 10,001-25,000 = 1.90
7. Peaking factor for minimum day for population = 10,001-25,000 = 0.60
8. Fire Flow allowance for population = 11,200 = 200 L/s

Design criteria relevant in determining the flow demand for the site from the 2011 Niagara Region W&WWMSP are as follows:

1. Average domestic daily residential flow demand = 300 Lpcd

For the purposes of this report, fire flow is not calculated per the 1999 Fire Protection Guidelines by the FUS, as detailed site/development statistics are currently not available.

With the design parameters noted above and an estimated equivalent population for the site (illustrated in Figure SD1 in Appendix A), the estimated flow demand is calculable for the site. Per the 2008 MOE Design Guidelines, the design flow is to be the greater of the following:

1. Peak hour domestic flow rate
2. Maximum day domestic flow rate plus fire flow rate

Supporting calculations for the Secondary Plan area's water flow demands can be found on the Preliminary Water Flow Demand Calculation in Appendix C

The appended calculation indicates that the estimated flow demand for the Secondary Plan area is 275 L/s (75 L/s domestic, 200 L/s fire).

Demand Effects on Existing System Capacity

The Secondary Plan area will be serviced by City's NF1 pressure zone. Please see Section 2.2 for model parameter results related to the site. The W&WWMSP Modelling Figures that support the above results can be found in Appendix B. These modelling results indicate that:

1. The existing watermain within the site appears to have sufficient capacity to service the site, as there currently is an available fire water flow of over 360 L/s.
2. As the 2031 baseline modelling indicates pressure to be above 100 psi pressure reduction may be required for the site.

It should be noted that an estimated land use and equivalent population count for the Secondary Plan area has been provided to the Region of Niagara as input towards water modelling to support the current W&WWMSP update. Results from the update will be accounted for during subsequent planning applications for the site.

Detailed water modelling, including hydrant flow tests shall be conducted during later subsequent planning applications to confirm existing flow rates to ensure adequate domestic and fire flows can be achieved within the Secondary Plan area.

Proposed Water Distribution Layout and Features

The location of larger diameter watermain has been proposed within the site. This is illustrated on Figure W4 in Appendix A.

3 SANITARY SEWAGE SYSTEM

Section 3 discusses the following topics related to Niagara Falls sanitary sewage collection system:

- Description of jurisdiction and responsibilities
- Existing conditions of the system as a whole and in vicinity of the Secondary Plan area
- Proposed design for the Secondary Plan area and its impacts on the existing system

3.1 Sanitary Infrastructure Jurisdiction and Responsibility

Sanitary servicing in Niagara Region is based on a two-tier approach. The Region is responsible for the wastewater treatment plants, trunk sewers, pumping stations and force mains. The City of Niagara Falls is responsible for the local gravity sewer systems.

3.2 Existing Conditions of Sanitary Sewage Collection System

Section 3.2 discusses the existing conditions external to and within the Secondary Plan area.

Existing Conditions External to Secondary Plan Area

The Secondary Plan area is serviced by the Niagara Falls Wastewater Treatment Plant (WWTP) in Niagara Falls, via a series of sanitary pumping stations (SPSs), forcemains, and gravity trunk sewers. The W&WWMSP provides detailed information about the system. Some key points relevant to the Secondary Plan area are listed below:

1. Local sewage enters the Regional system at the Grassy Brook Sanitary Pumping Station (SPS).
2. The Grassy Brook SPS pumps sewage flow north via a 150mm diameter forcemain. The forcemain pumps sewage along Montrose Road and crosses under the Welland River to a 750 mm reinforced concrete gravity sewer near the Montrose Road / Brown Road intersection.
3. The gravity sewer drains to Canadian Drive and then diverts across the QEW to the South Side Highlift SPS.
4. From the South Side Highlift SPS, the sewage flow is ultimately conveyed to the Niagara Falls Wastewater Treatment Plant (WWTP) via a series of SPSs, forcemains, and gravity sewers.

Figure SA1 in Appendix A illustrates the existing overall sanitary sewage network for the City of Niagara Falls. Figure SA2 in Appendix A illustrates the existing sanitary sewage network external to the site.

Existing Conditions within the Secondary Plan Area

The existing sanitary sewers within the Secondary Plan area are as follows:

1. 300/375mm diameter sanitary sewer which runs east-west along Grassy Brook Road, connecting to Montrose Road to the East and terminating at the Northwest corner of the site
2. 300mm/450mm diameter sanitary sewer which runs north-south along Montrose Road, starting at Lyon's Creek Road to the South continuing northward up to the Grassy Brook SPS located on the east side of Montrose Road, approximately 50m north of the intersection.

Figure SA3 in Appendix A illustrates the existing sanitary sewage network external to the site.

The existing gravity sewer system was constructed to service parts of the lands within the Grand Niagara golf course and surrounding areas. The existing commercial/industrial properties fronting onto Montrose

Road and the existing Grand Niagara golf clubhouse and maintenance building either connect to the existing sewers or have allocation to connect to them. An additional leg of gravity sewer connects from north of the Grassy Brook SPS, providing sanitary service to the E.S. Fox factory north of the SPS.

Existing Condition of the Grassy Brook Sanitary Pumping Station (SPS)

The Grassy Brook SPS receives sewage from the gravity sewers, as discussed above, and pumps sewage to a gravity sewer north via approximately 1.8 km of 150 mm diameter forcemain. Record drawings, MOE C-of-A, and the Regional Master Plan have been reviewed to gather information for the SPS.

The SPS's wet well is currently equipped with two pumps, each with rated capacity of approximately 20.9 L/s at a total dynamic head (TDH) of 33.62 m. Based on the existing piping layout and pump rating point, analysis shows one pump operation can provide approximate 18-22 L/s at about 33 m TDH. With two pumps running, the output increases to about 25-29 L/s at about 45 m TDH. This is based on theoretical Hazen-Williams based calculations; actual performance is based on field conditions and actual flow and pressure measurements.

3.3 Proposed Sanitary Sewage Flows

Section 3.3 discusses the feasibility and basic layout of a proposed sanitary network for the Secondary Plan area. The Section will elaborate on the following items:

- Design criteria and design flow results
- Flow effects on existing system capacity
- Proposed sanitary sewer layout and features

Design Criteria and Design Flow Results

The Secondary Plan area features several land uses, including residential, mixed use, employment, commercial, and institutional (hospital) uses. A Sanitary Drainage Plan has been prepared along with equivalent population counts for each parcel of land. This plan is illustrated in Figure SD1 in Appendix A.

For the purposes of the high-level infrastructure design for the Secondary Plan area, the estimated proposed sanitary sewage flow is calculated using design parameters in accordance with the Region's 2011 W&WWMSP, rather than the City of Niagara Falls Design Criteria. These parameters are used instead because the City's criteria are applicable to local, smaller gravity sewer systems rather than larger-scale infrastructure. The 2011 W&WWMSP criteria relevant in determining the flow demand for the site are as follows:

1. Average daily flow demand (res, emp., inst., comm.) = 275 Lpcd
2. Peaking factor formula = Harmon Peaking Factor
3. Infiltration flow rate (Method 1) = 0.286 L/s/ha (trunk sewers/SPSs)
4. Infiltration flow rate (Method 2) = 90 Lpcd (new development, res. only)

With these design parameters, an estimated equivalent population for the site and an estimated developable area (illustrated in Figure SD1 in Appendix A), the estimated sanitary sewage design flow for the site is 119.23 L/s. Please note that the Method 2 infiltration flow calculation for new development was used to assess the existing system's capacity. Supporting calculations for these flow demands can be found on the Preliminary Sanitary Flow Design Sheet in Appendix C.

Design Calculations with development statistics and using City Design Criteria for sewer design shall be conducted in subsequent planning applications to confirm design flows to ensure that existing infrastructure in vicinity of the Secondary Plan area has capacity, or to determine a need for local infrastructure upgrades.

It should be noted that an estimated land use and equivalent population count for the Secondary Plan area has been provided to the Region of Niagara as input towards water modelling to support the current W&WWMSP update. Results from the update will be accounted for during subsequent planning applications for the site.

Design Flow Effects on Existing System Capacity

The estimated maximum flow rate calculated for the proposed development within the Secondary Plan area is 119.23 L/s. The existing leg of gravity sewer upstream of the Grassy Brook SPS is critical for the site as it will convey the most flow. The sewer leg is 450mm in diameter and runs at 0.23%. The capacity of this sewer is calculated to be 136.70 L/s. The sewer will therefore theoretically reach 87% of its capacity once the site is fully built-out, which is acceptable per City design criteria.

As the development is built-out, it is recommended that flows to the Grassy Brook SPS be monitored to determine the need and timing for upgrade.

According to the Region's W&WWMSP, the Grassy Brook SPS currently operates at 21 L/s, but has a potential full buildout capacity of 138 L/s. With some structural and process modifications, up to 4 pumps can be accommodated in the wet well allowing for this capacity to be met, which will be able to meet the 119.23 L/s flow demand from the Subject Lands.

Proposed Sanitary Sewer Layout and Features

A high-level sanitary sewer system has been laid out for the Secondary Plan area in accordance with the City's design criteria. Parameters used to determine the sanitary sewer network layout included:

1. Minimum slope – 0.50%
2. Minimum cover – 3.0m

With this criteria applied to the existing topography, the site can drain to the existing sewers on Montrose Road and Grassy Brook Road with gravity sewers. Re-grading of the land will be undertaken to accommodate storm drainage and overland flow routes. The sanitary alignment will be designed to follow the proposed grades to minimize the depth of the sewers. It is expected that the full Secondary Plan area will be able to drain by gravity to the Grassy Brook SPS.

Figures SA4 and P1 in Appendix A illustrate the proposed high-level sanitary network along the site's conceptual collector roads. Note that the proposed gravity sewers have adequate cover and meet minimum slopes requirements as per the City's design criteria.

Proposed Grassy Brook SPS and Forcemain Upgrades

The original design of the wet well of the Grassy Brook SPS incorporated a divider wall which provides some added flexibility in operating the wet well and in developing effective liquid level control strategies for proper pump cycling. In addition, even though the inlet sewer is quite deep (11.3 m), there is still over 3.5 m of liquid level to work with in establishing new and optimized pumping configurations. The wet well is also large enough (4m by 4m) to physically accommodate installation of additional pumps.

The Grassy Brook forcemain has been preliminarily assessed for capacity. The system curve and pump rating point for the existing condition is shown in Figure 3. The rapid increase in TDH as flow increases clearly demonstrates the forcemain is undersized for the projected increases in sewage flow from the serviced area.

Below is a summary of the upgrades proposed for the Grassy Brook SPS:

1. The Grassy Brook SPS can be upgraded to meet the flow demands of the Subject lands without major building modifications
2. The Grassy Brook forcemain will need to be upgraded to meet the flow demands.

It is recommended that the design flows to the SPS will be reviewed with greater accuracy in subsequent planning applications, as estimated land uses and populations become more defined. The timing and staging for the various upgrades are contingent on site phasing. For this reason, it is recommended that there is active monitoring of the actual sewage flow to the Grassy Brook SPS.

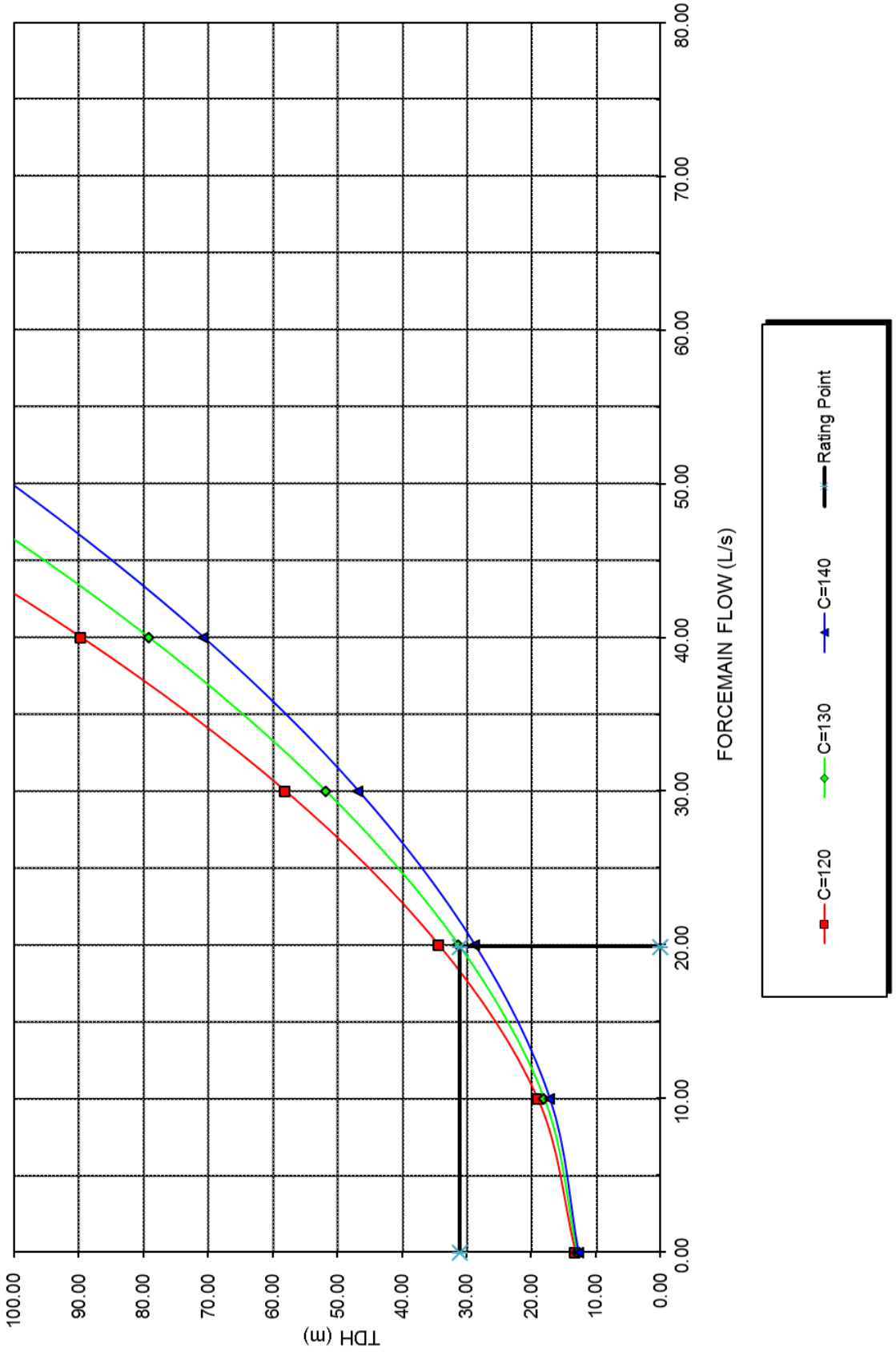


Figure 3: Grassy Brook Sanitary Pumping Station – Existing System and Pump Rating Point

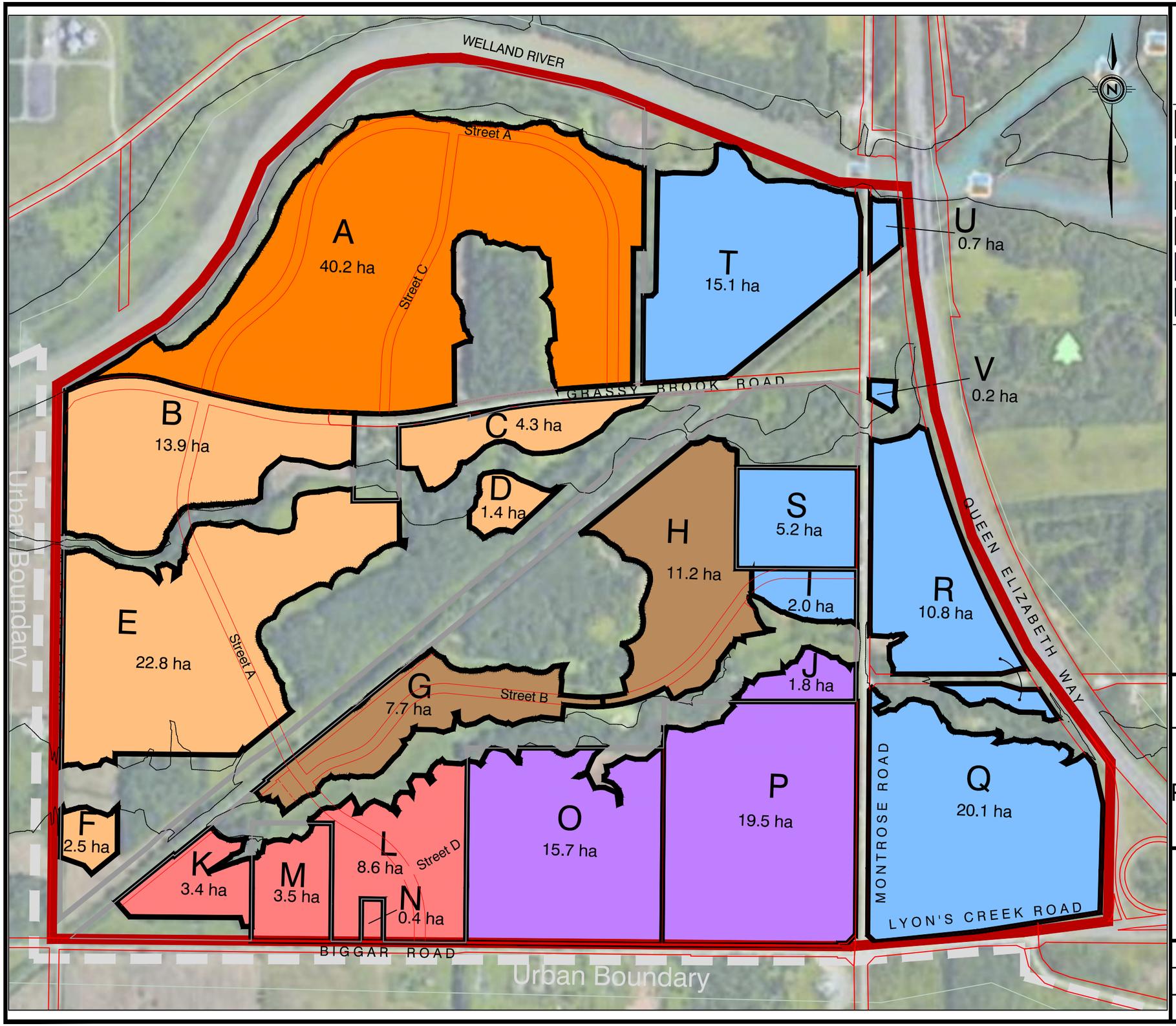
4 UTILITY CONSIDERATIONS

Niagara Peninsula Energy, Bell Canada, Cogeco Cable and Enbridge Gas have existing plant in the surrounding area. Confirmation of adequate capacity for the proposed development will be sought from each of the Utilities.

The extent of system improvements, if any, will be determined upon completion of feasibility studies by each of the Utilities once detailed loading information is available.

Utility servicing of the study area will be designed and constructed per each utility's respective design standards and will be located within the municipal right-of-way in accordance with the Utility and Municipal Standards.

Appendix A – Figures



LEGEND

	Area (ha)	People
Phase 1 Res. (A)	40.2 ha	2000
Phase 2 Res. (B,C,D,E,F)	44.9 ha	2250
Phase 3 Res. (G,H,)	18.9 ha	920
Mixed Use (K,L,M,N)	15.9 ha	1200
Hospital Emp. (J,O,P)	37.0 ha	3100
Employment (I,Q,R,S,T,U,V)	54.1ha	1730
	211.0 ha	11,200

NOTE: THE ESTIMATED POPULATION WILL BE REFINED THROUGH FUTURE DEVELOPMENT APPLICATIONS

CLIENT

GRAND NIAGARA CO-OWNERS

TITLE

GRAND NIAGARA SECONDARY PLAN

PROPOSED DEVELOPMENT AREAS AND EQUIVALENT POPULATIONS

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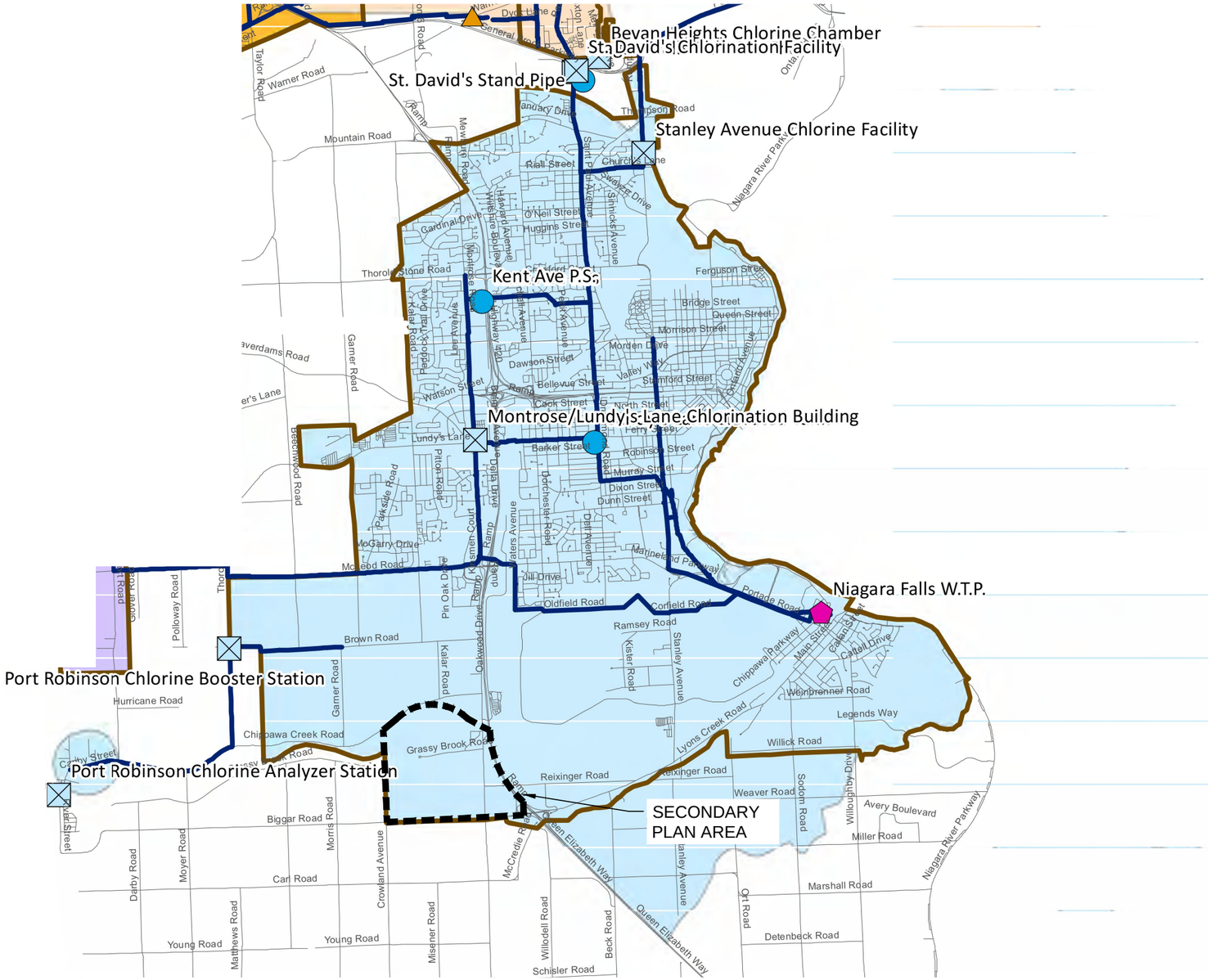

NOTE: EXCERPT FROM THE 2011 NIAGARA REGION WATER AND WASTEWATER MASTER SERVICING PLAN

Legend

- Regional Watermain
- Urban Area Boundary

Pressure Zone

- NF1

CLIENT

GRAND NIAGARA CO-OWNERS

TITLE

GRAND NIAGARA SECONDARY PLAN

OVERALL CITY WATER DISTRIBUTION PLAN

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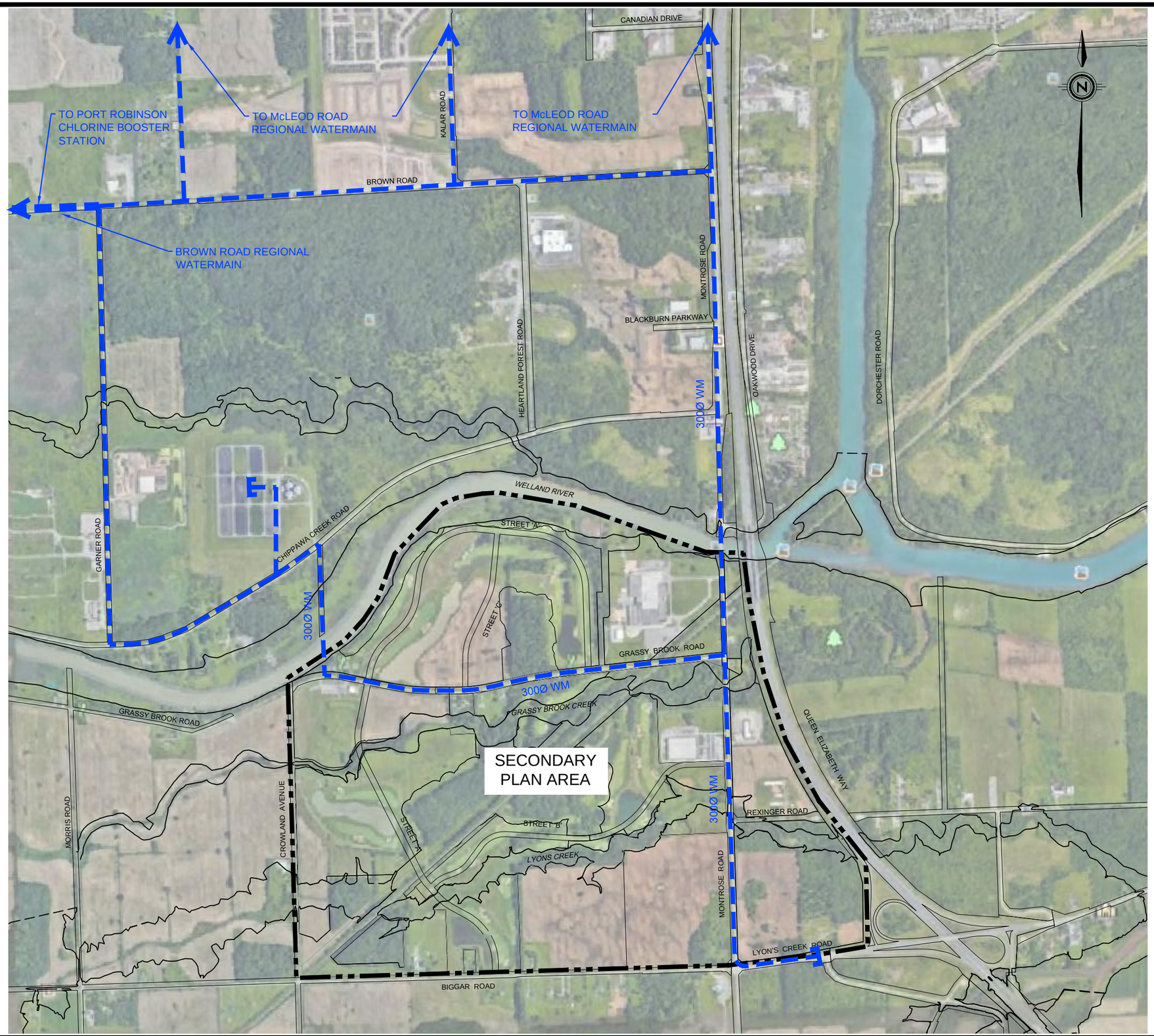

LEGEND

- EX. WATERMAIN
- SECONDARY PLAN AREA BOUNDARY

CLIENT

GRAND NIAGARA CO-OWNERS

TITLE

GRAND NIAGARA SECONDARY PLAN

EXISTING EXTERNAL WATER DISTRIBUTION

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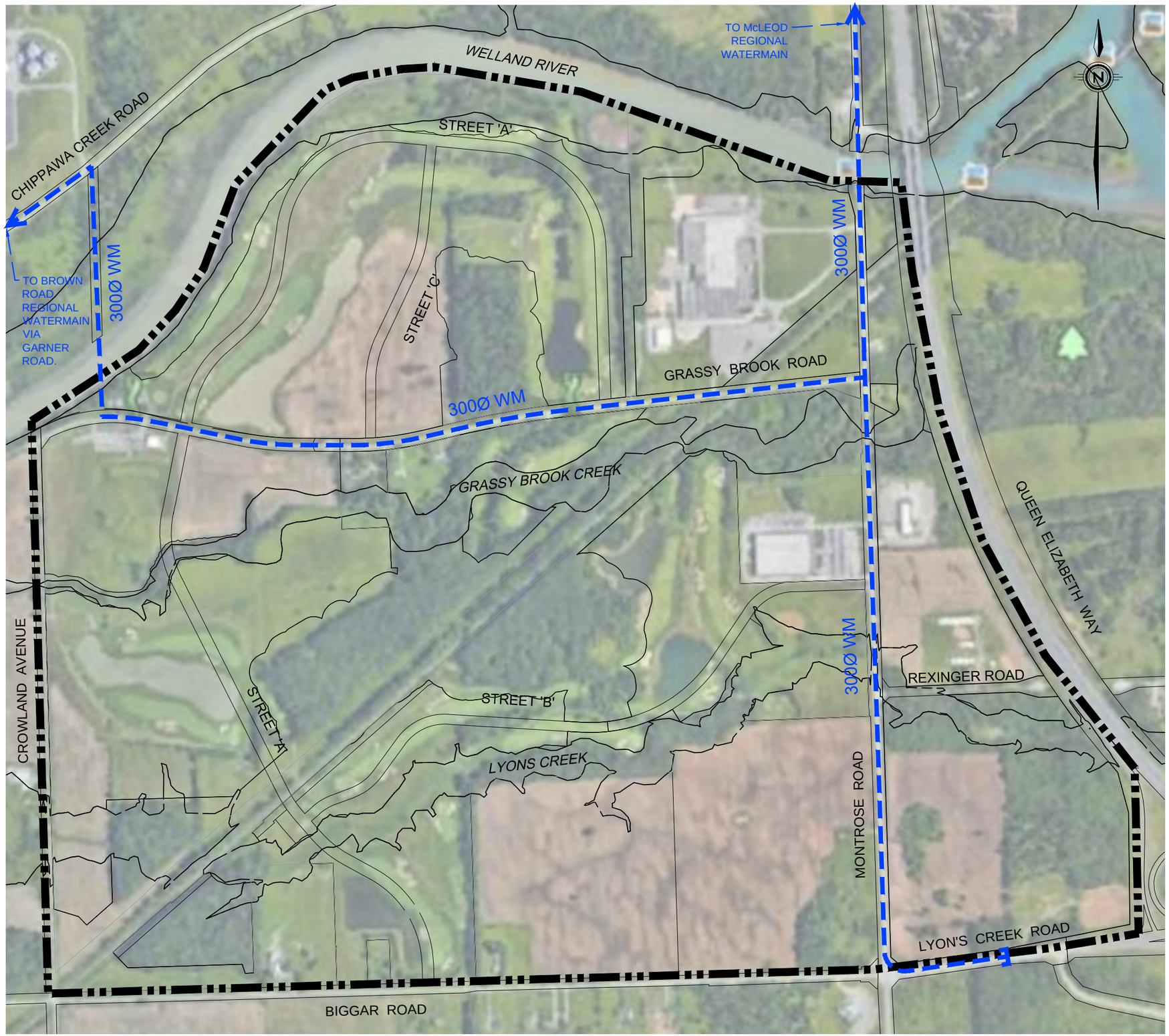

LEGEND

- EX. WATERMAIN
- SECONDARY PLAN AREA BOUNDARY

CLIENT

GRAND NIAGARA CO-OWNERS

TITLE

GRAND NIAGARA SECONDARY PLAN

EXISTING WATER DISTRIBUTION

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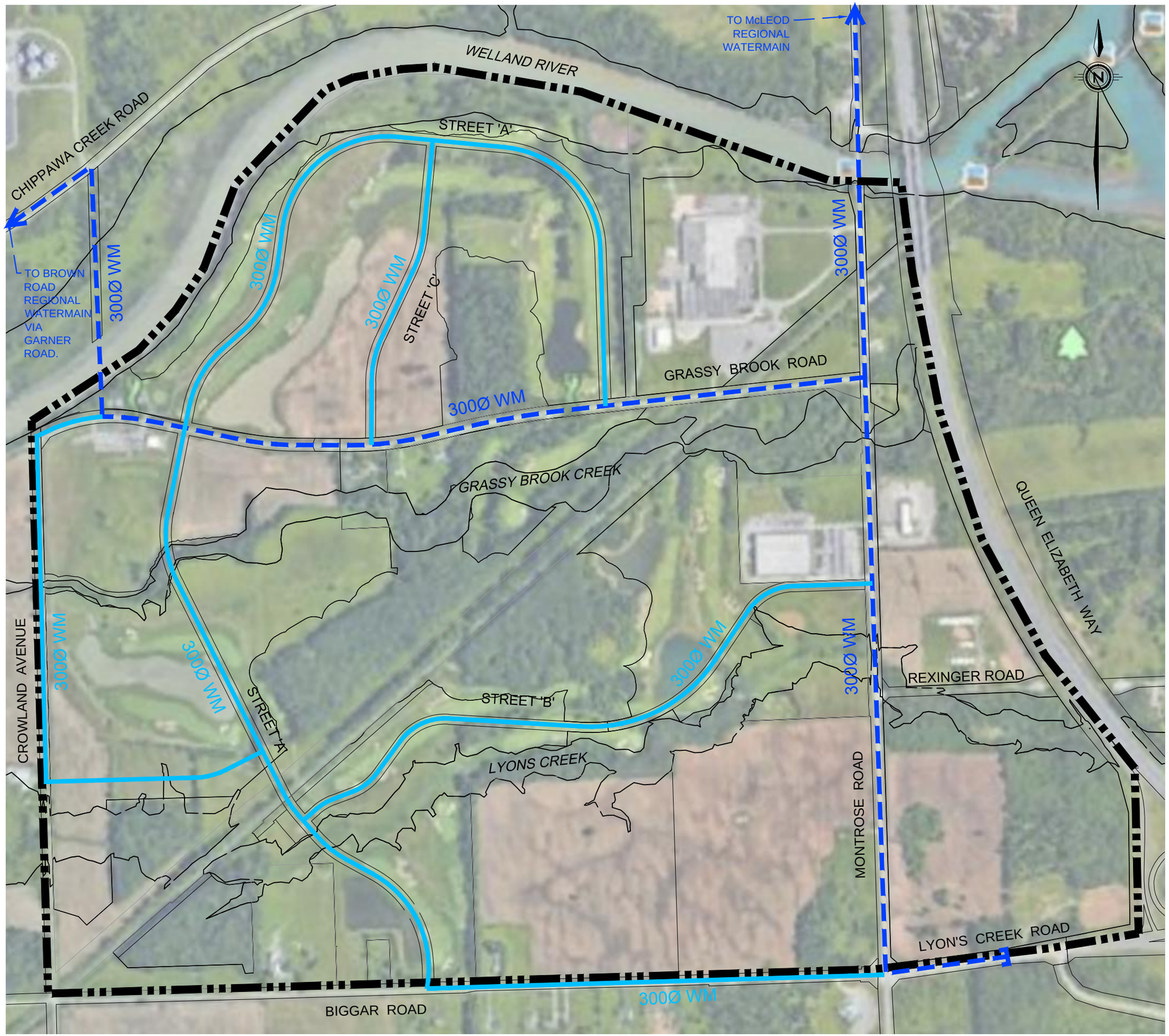

LEGEND

- EX. WATERMAIN
- SECONDARY PLAN AREA BOUNDARY
- PROP. WATERMAIN

CLIENT

GRAND NIAGARA CO-OWNERS

TITLE

GRAND NIAGARA SECONDARY PLAN

PROPOSED WATERMAIN LAYOUT

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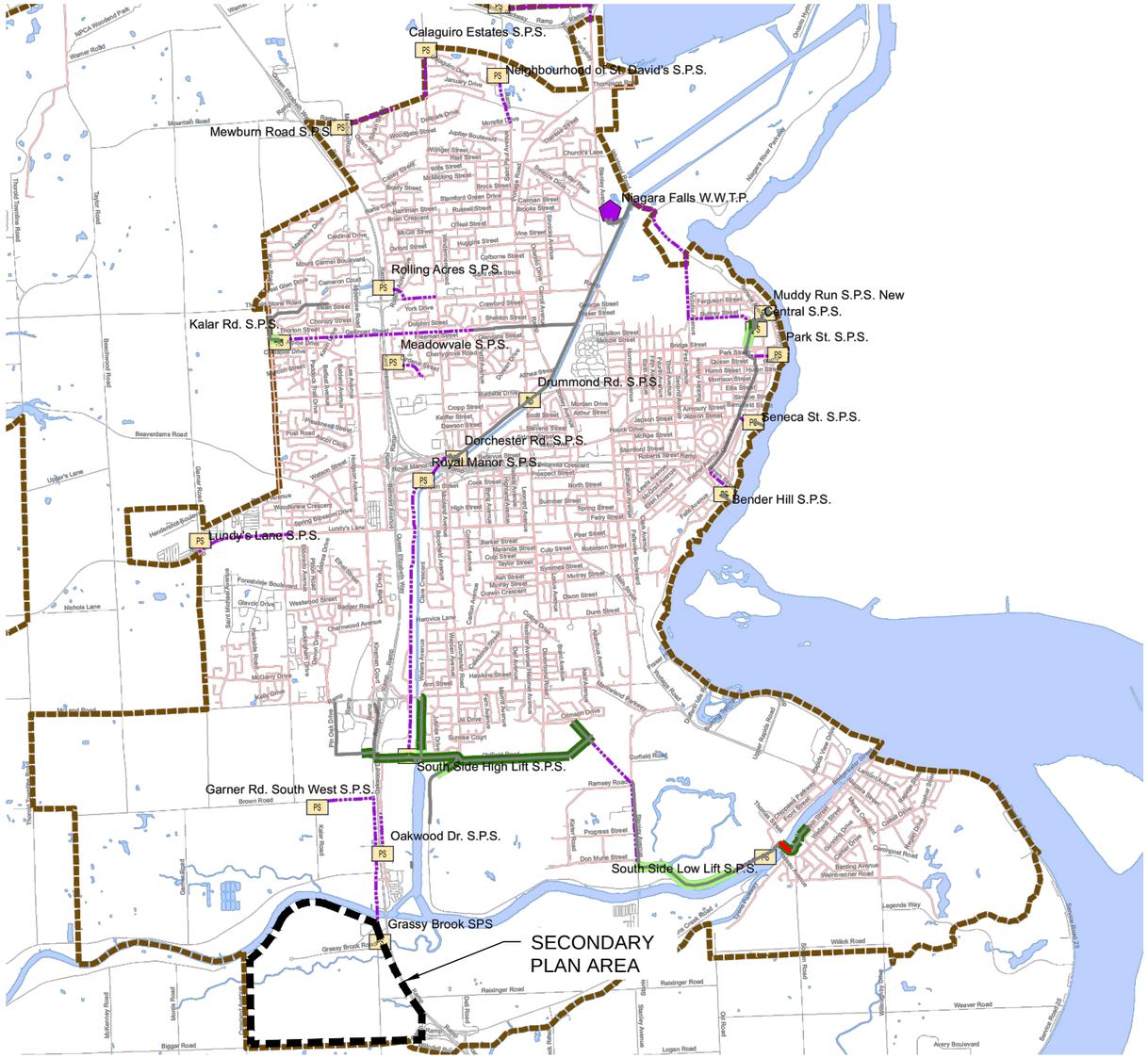

NOTE: EXCERPT FROM THE 2011 NIAGARA REGION WATER AND WASTEWATER MASTER SERVICING PLAN

Legend

- SPS
- WWTP
- Forcemain
- Forcemain Under Construction
- Municipal Sewer
- Sewer Under Construction
- Modelled Pipes
- Depth exceeds 100% of pipe full under Peak Dry Weather Flow
- Depth exceeds 50% of pipe full under Peak Dry Weather Flow
- Depth exceeds 90% of pipe full under 2 year design event
- Depth exceeds 90% of pipe full under 5 year design event
- Urban Area Boundary

CLIENT

GRAND NIAGARA CO-OWNERS

TITLE

GRAND NIAGARA SECONDARY PLAN

OVERALL CITY WASTEWATER COLLECTION PLAN

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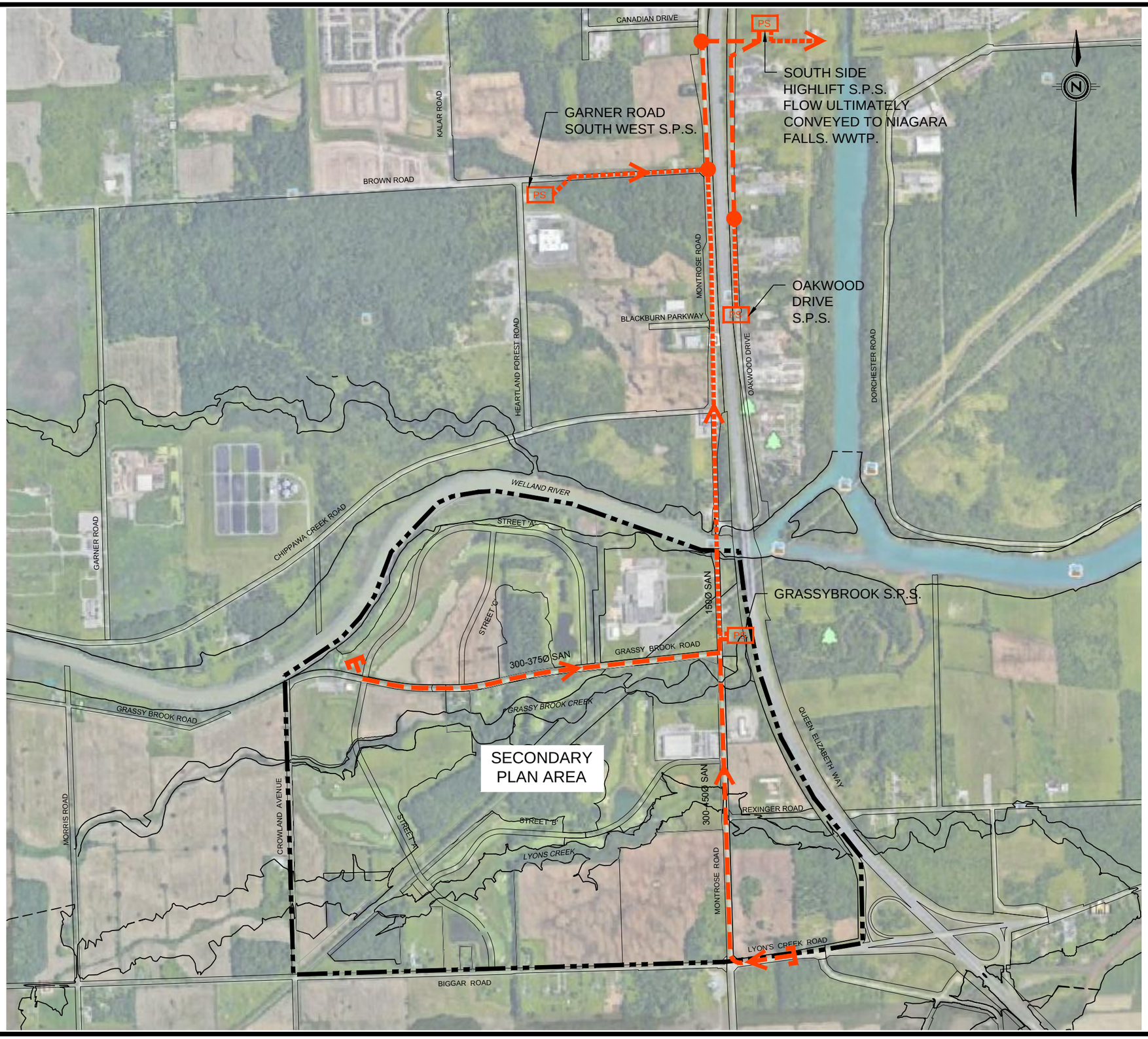

LEGEND

- EX. GRAVITY SEWER
- EX. FORCEMAIN
- PS — SANITARY PUMPING STATION
- SECONDARY PLAN AREA BOUNDARY

CLIENT

GRAND NIAGARA CO-OWNERS

TITLE

GRAND NIAGARA SECONDARY PLAN

EXISTING EXTERNAL SANITARY SEWERS

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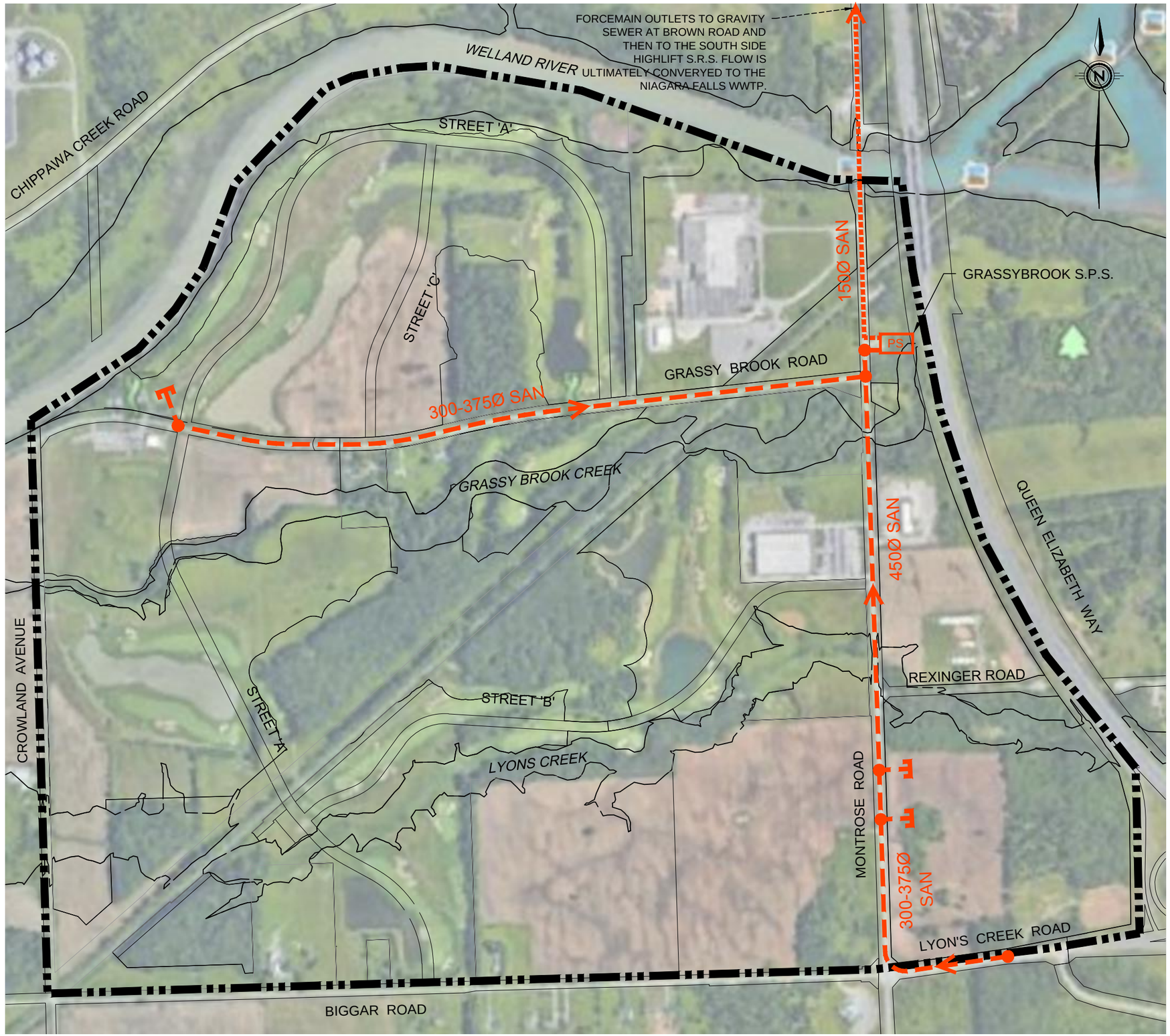

LEGEND

- EX. GRAVITY SEWER
- EX. FORCEMAIN
- PS — SANITARY PUMPING STATION
- SECONDARY PLAN AREA BOUNDARY

CLIENT

GRAND NIAGARA CO-OWNERS

TITLE

GRAND NIAGARA SECONDARY PLAN

EXISTING SANITARY SEWERS

WSP | MMM GROUP

100 Commerce Valley Dr. West, Thornhill, ON Canada L3T 0A1
t: 905.882.1100 f: 905.882.0055 www.mmm.ca

Checked	A.D.R.	Drawn	10/12 Cad
Date	NOV 2016	Proj. No.	14-15039
Scale	1: 8000	Figure No.	SA3

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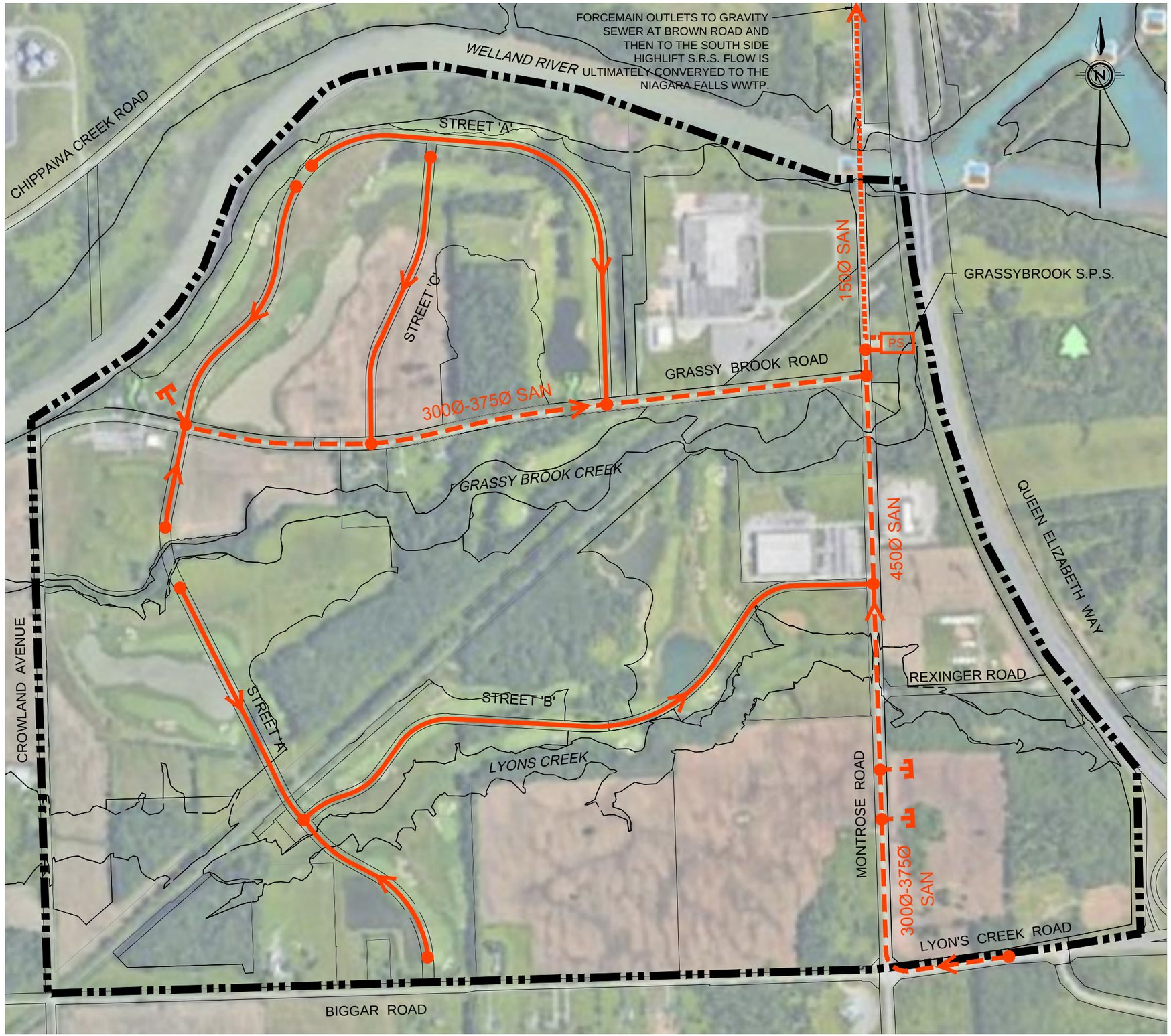

LEGEND

- EX. GRAVITY SEWER
- EX. FORCEMAIN
- PS — SANITARY PUMPING STATION
- SECONDARY PLAN AREA BOUNDARY
- PROP. GRAVITY SEWER

CLIENT

GRAND NIAGARA CO-OWNERS

TITLE

GRAND NIAGARA SECONDARY PLAN

PROPOSED SANITARY SEWERS LAYOUT

WSP | MMM GROUP

100 Commerce Valley Dr. West, Thornhill, ON Canada L3T 0A1
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Checked	A.D.R.	Drawn	10/12 Cad
Date	NOV 2016	Proj. No.	14-15039
Scale	1: 8000	Figure No.	SA4

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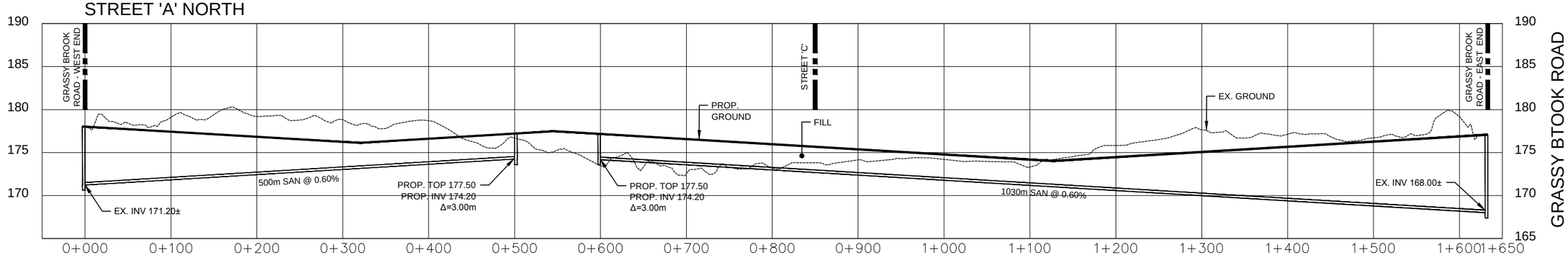
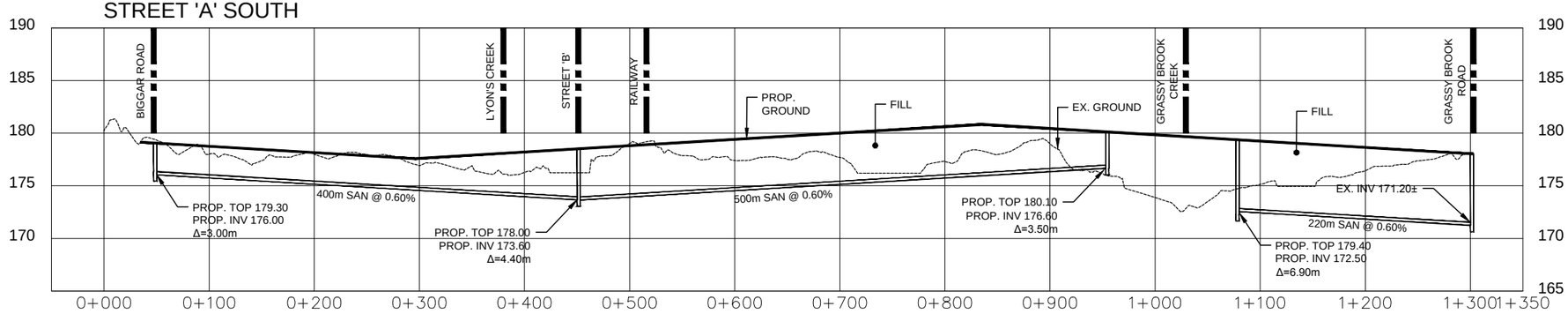
STREET 'A' NORTH

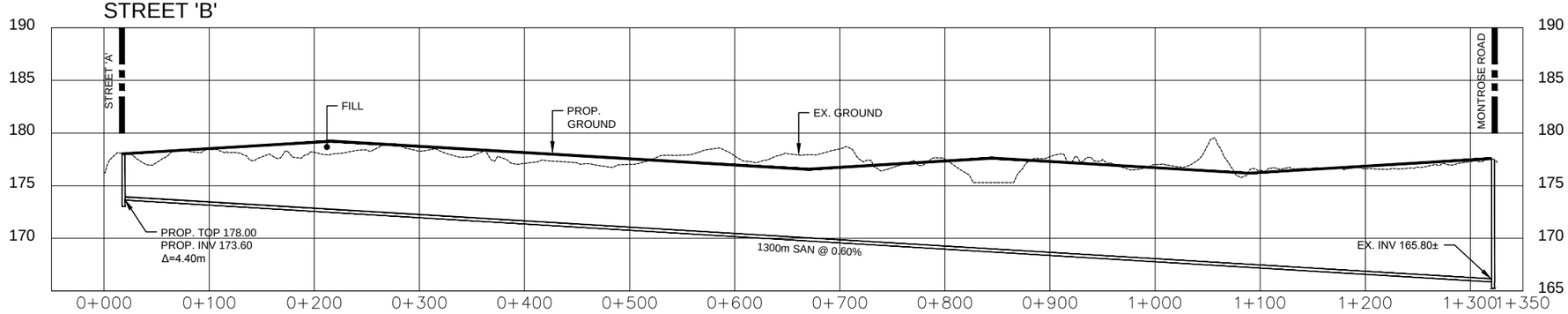


GRASSY BTOOK ROAD

STREET 'A' SOUTH



STREET 'B'



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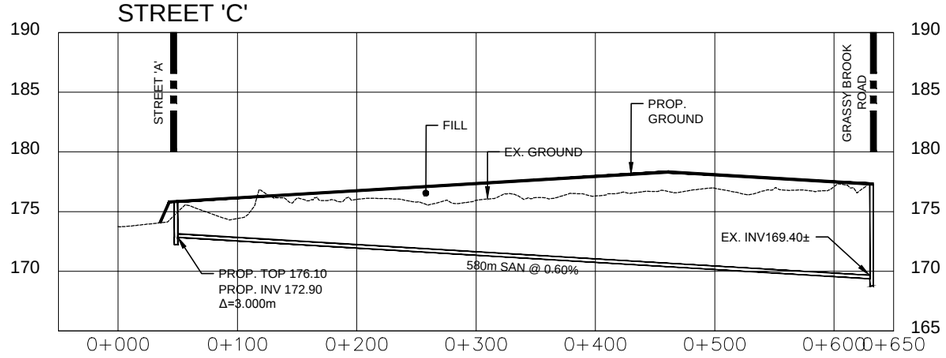

CLIENT
GRAND NIAGARA CO-OWNERS

TITLE
GRAND NIAGARA SECONDARY PLAN

COLLECTOR ROAD PROFILES

WSP | MMM GROUP
100 Commerce Valley Dr. West, Thornhill, ON Canada L3T 0A1
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Checked	A.D.R.	Drawn	10/12 Cad
Date	NOV 2016	Proj. No.	14-15039
Scale	1: 8000	Figure No.	P1

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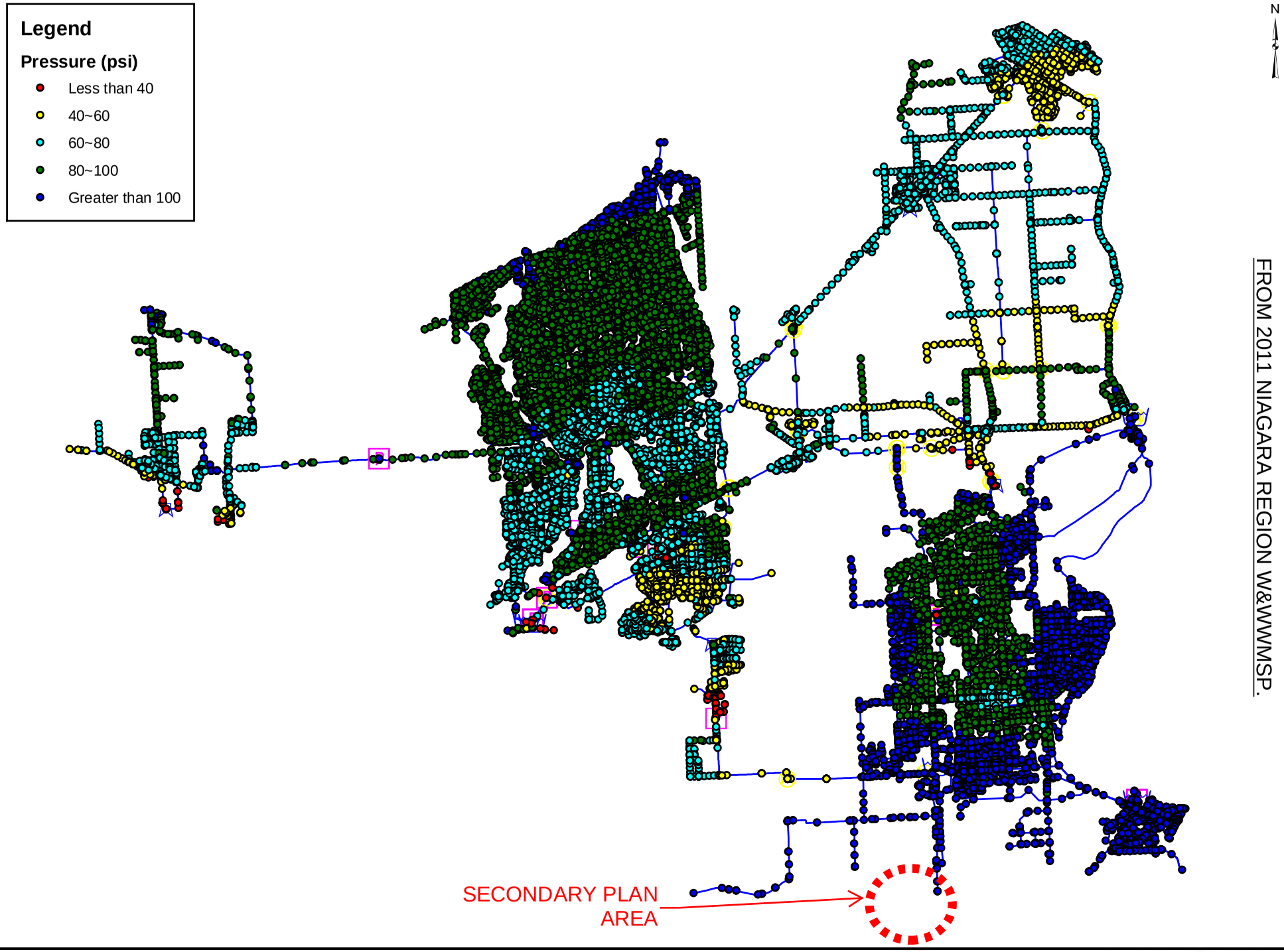
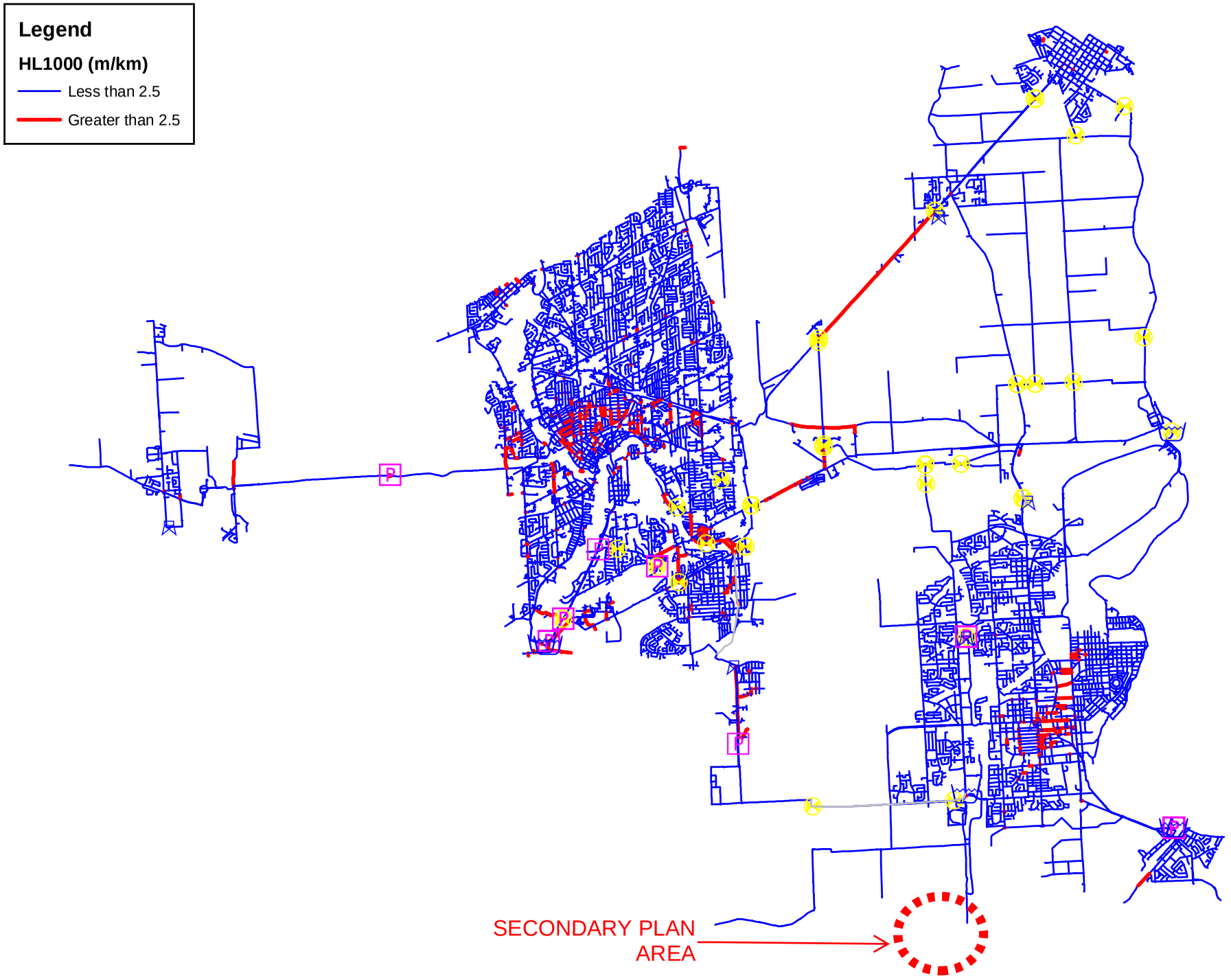
Appendix B - Excepts from Reference Materials



FROM 2011 NIAGARA REGION W&WWMSP.

DeCew and Niagara Service Area - 2031 System Pressure

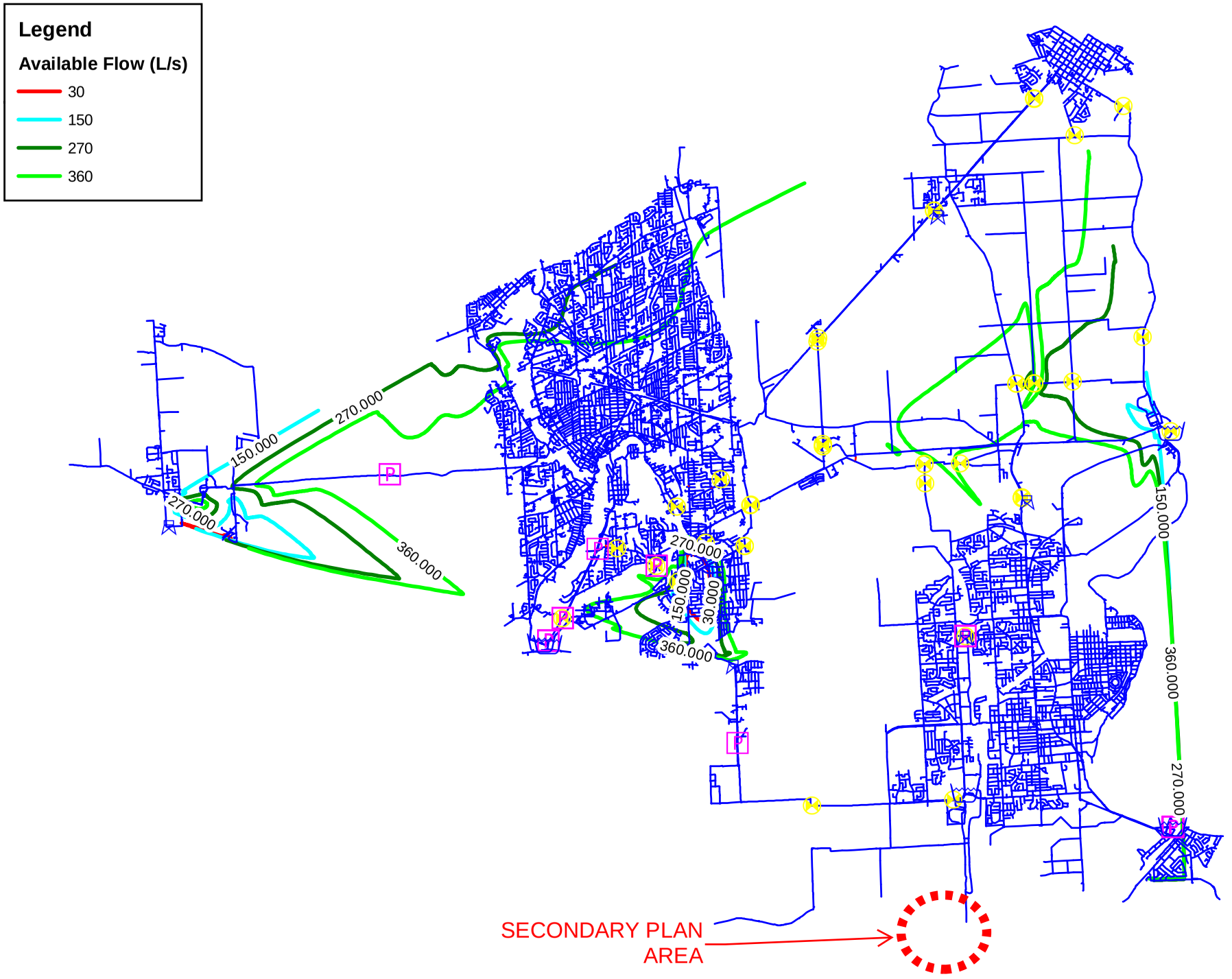
AECOM



FROM 2011 NIAGARA REGION W&WWMSP.

DeCew and Niagara Service Area - 2031 Hydraulic Gradient

AECOM



FROM 2011 NIAGARA REGION W&WWMSP.

DeCew and Niagara Service Area - 2031 Available Fire Flow

AECOM

Appendix C - Design Sheets & Calculations

Flow Calculation Fomrula:

Per City of Niagara Falls design criteria, calculation of water flow demand is undertaken per 2008 MOE Design Guidelines.

Per the 2008 MOE Design Guidelines, total water flow demand is equal to the greater value of either of the following formulas:

$$Q_{t1} = \frac{Q_a \cdot P(d) \cdot C}{86{,}400} + \mathrm{F} \qquad Q_{t2} = \frac{Q_a \cdot P(h) \cdot C}{86{,}400}$$

Where,

Qt = Total water flow demand (L/s)
Q_a = Average daily residential domestic water flow (Lpcd)
P(h) = Peak hour factor
P(d) = Maximum day peaking factor
C = Equivalent residential population (cap.)
F = Fire flow allowance (L/s)

Population:

Estimated from the Secondary Plan area's concept Plan:

C = 11,200 cap.

Domestic Flow Criteria:

From the 2008 MOE Design Guidelines for Drinking Water Systems:

Q_a = 270-450 Lpcd
P(h) = 2.85 (for a pop. = 10,001-25,000)
P(d) = 1.90 (for a pop. = 10,001-25,000)

From the current 2011 Niagara Region W&WWMSP:

Q_a = 300 Lpcd

NOTE: The average daily residential domestic flow from the Niagara Region 2011 W&WWMSP is used in the calculation as it better pertains to the high-level nature of the assessment of the Secondary Plan area.

Fire Flow Criteria:

From the 2012 City of Niagara Falls Design Criteria Manual:

F = 80 L/s

From the MOE Design Guidelines for Drinking Water Systems:

F = 200 L/s (for a pop. = 11,200)

NOTE: The fire flow from the MOE Design Guidelines is used in the calculation as it better pertains to the high-level nature of the assessment of the Secondary Plan area.

Calculation:

$$Q_{t1} = \frac{(300Lpcd)(1.90)(11{,}200cap)}{86{,}400} + \left(200\,\frac{\mathrm{L}}{\mathrm{s}}\right) \sim \mathbf{275\ L/s}$$

$$Q_{t2} = \frac{(300Lpcd)(2.85)(11{,}200cap)}{86{,}400} \sim \mathbf{110\ L/s}$$

Therefore, the estimated total water flow demand for the Seoncdary Plan area is 275 L/s.

NIAGARA REGION
APPENDIX C - PRELIMINARY SANITARY FLOW DESIGN SHEET

Project / Subdivision Grand Niagara

Consulting Engineer MMM GROUP

Project No. 14-15039

Design Parameters

Manning 'n' =	0.013	
Infiltration Flow - Method 1 =	0.286	L/s/ha
Infiltration Flow - Method 2 =	90	L/cap/d (res. only)
Residential Flow =	275	L/cap/d
Mixed Use Flow =	275	L/cap/d
Commercial/Hospital Flow =	275	L/cap/d

Design Formulas

$$M = 1 + \frac{14}{4 + /(P^{0.5})}$$

$$Q(i) = 0.286 L/s * Area$$

$$Q(r) = \frac{P * q(r) * M}{86400}$$

Total dry weather flow =	103.58	L/s
Total wet weather flow (method 1 infiltration) =	163.93	L/s
Total wet weather flow (method 2 infiltration) =	119.23	L/s

Notes/Comments:

●Due to a decreased peaking factor from a larger total population, the total design and method 2 infiltration flows are less than the summation of the flows of the constituent areas of the site.

●At 450mm dia. and 0.23%, the full flow capacity of first leg of sanitary sewer upstream of Grassy Brook SPS is 136.7 L/s and will run at 87% capacity in proposed wet weather conditions with the infiltration flow method 2 calculation in consideration.

			Individual Values					Flow Calculations				
Location		Reference	Residential Area	Mixed/Emp./Hosp. Area	Residential Population	Mixed/Emp./Hosp. Population	Peaking Factor	Design Flow (L/s)	Infiltration Flow (Method 1, L/s)	Infiltration Flow (Method 2, L/s)	Total Design Flow (with Method 1 Infiltration, L/s)	Total Design Flow (with Method 2 Infiltration, L/s)
			(ha)	(ha)	P	P	M	Q(d)	Q(ins)	Q(p)	Q(t1)	Q(t1)
Phase 1 Residential		A	40.20		2000		3.59	22.83	11.50	7.47	34.32	30.30
Phase 2 Residential		B,C,D,E,F	44.90		2250		3.55	25.39	12.84	8.31	38.23	33.70
Phase 3 Residential		G,H	18.90		920		3.82	11.19	5.41	3.66	16.60	14.86
Mixed Use		K,L,M,N		15.90		1200	3.75	14.31	4.55		18.86	14.31
Hosptial Employment		J,O,P		37.00		3100	3.43	33.85	10.58		44.43	33.85
Employment		I,Q,R,S,T,U,V		54.10		1730	3.63	20.01	15.47		35.48	20.01
Total			104.00	107.00	5170	6030	2.91	103.58	60.35	15.65	163.93	119.23