Appendix B

Work Package 2 – Growth Forecast and Future Needs

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Work Package 2 – Growth Forecast and Assessment of Future Needs

Jarvis Master Servicing Plan Update

J.L.Richards
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1.0 INTRODUCTION

1.1 Project Overview

The community of Jarvis is located approximately 15 kilometres north of Lake Erie in the western part of Haldimand County (the County) at the cross roads of Highway 7 and Highway 3. The community has a population of approximately 2,000 residents (Watson, 2018), and development is predominantly residential. Industrial, commercial, and institutional (ICI) development is concentrated in the north side of the community along Highway 6.

In 2010 the Jarvis Master Servicing Plan (MSP) for Water, Wastewater, Stormwater, and Transportation (Stantec, 2010) was completed. To support planned growth and intensification identified in the County's Official Plan, Haldimand County is undertaking an engineering study to update the 2010 Master Servicing Plan (MSP). The purpose of the study is to update the four (4) servicing components (water, wastewater, stormwater, and transportation) of the 2010 Jarvis MSP to reflect updated land use and growth forecasts in the study area, and identify updates to existing conditions and related assumptions based on growth that has since occurred.

1.2 Objectives of the Master Plan

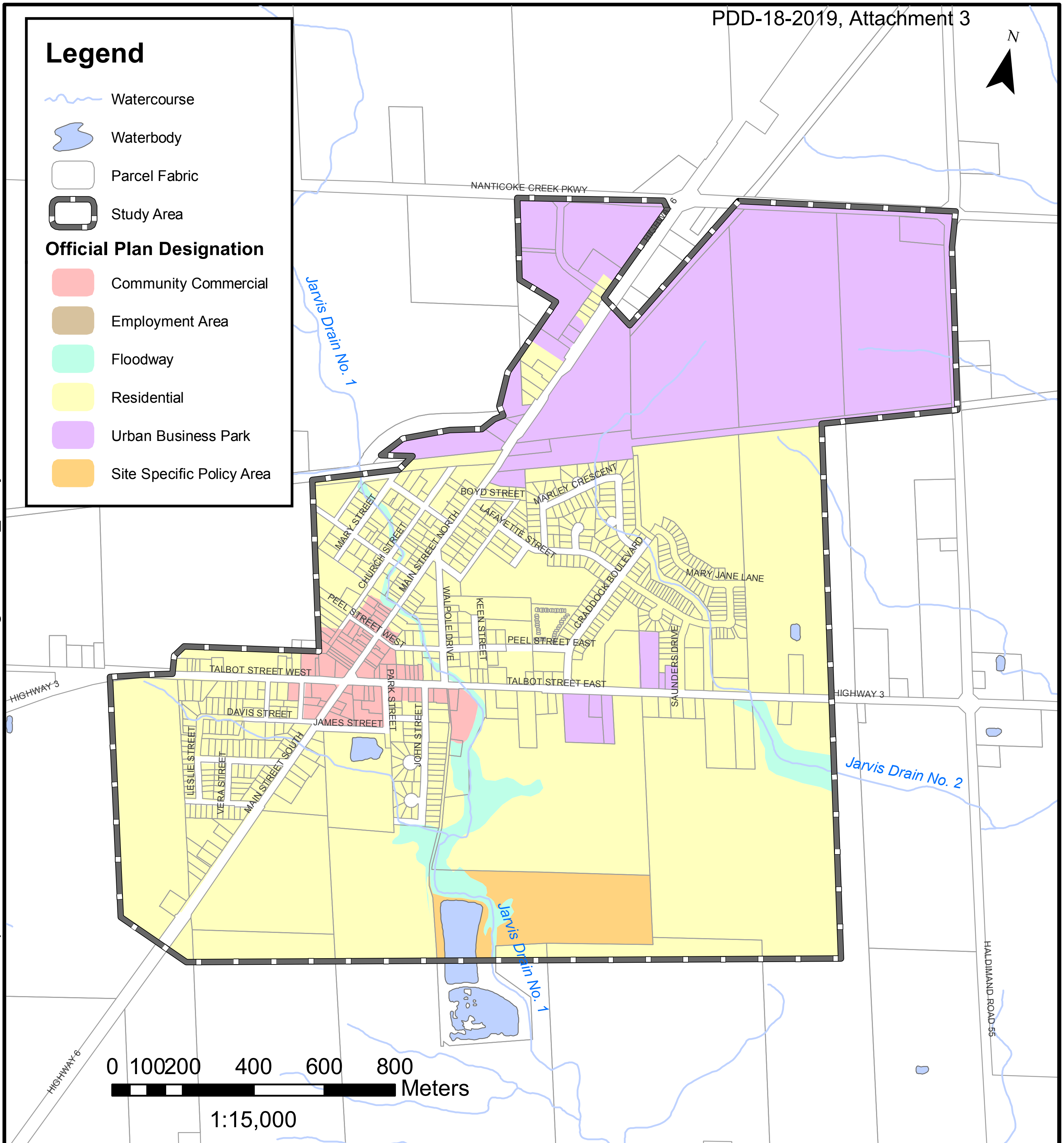
The Master Plan update will consider the findings from the 2010 MSP, as well as changes to the environment (as defined in the EA Act) and infrastructure since it was completed. Each component of the MSP update will be provided in the framework provided below:

- Work Package 1 – Background Review and Updates to Existing Conditions
- Work Package 2 – Growth Forecast and Assessment of Future Needs
- Work Package 3 – Development of Preferred Servicing Strategies
- Work Package 4 – Implementation Plan, Final Report and Presentation.

As well as updating the MSP, the County is concurrently conducting a Class EA to determine the preferred alternative to increase wastewater treatment capacity for Jarvis. The Class EA will be documented in a separate report.

1.3 Study Area Overview

The study area for the MSP update encompasses the urban boundary of Jarvis, consistent with the 2010 Jarvis MSP study area. Figure 1 illustrates the study area boundary. Municipal infrastructure in Jarvis includes a municipal water and wastewater system, stormwater infrastructure, and a transportation network.



PROJECT:

JARVIS MASTER SERVICING PLAN UPDATE

JARVIS, HALDIMAND COUNTY, ONTARIO

DRAWING:

STUDY AREA BOUNDARY AND DESIGNATED LAND USES

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FIGURE 1

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Community water is supplied via a transmission main from the Nanticoke Water Treatment Plant (WTP) and stored in a shared elevated tank north of Townsend. Wastewater in Jarvis is conveyed to the Jarvis wastewater treatment lagoons which are owned and operated by the County. The storm system in Jarvis generally consists of traditional stormwater management infrastructure (e.g. ditches, urban curb and gutter networks) and two (2) stormwater management (SWM) facilities. The community of Jarvis is built adjacent to Highway 6 (Main Street) and Highway 3 (Talbot Street). Both those highways are "connecting links" in the Provincial highway network.

1.4 Previous Studies

In 2010, a Master Servicing Plan (MSP) was prepared (Stantec, 2010) to help guide the development of water, wastewater, storm and transportation services with respect to the County's Official Plan to accommodate future development. Further details of the report findings are discussed in Work Package 1.

In addition to the 2010 MSP referenced throughout this report, the following studies related to water, wastewater, stormwater, and transportation infrastructure in Jarvis are referenced in the preparation of this Master Servicing Plan Update.

2010 MSP – present

Haldimand County Services and Planning Division. *Design Criteria*, Version 4.0, April 2015.

Ministry of Municipal Affairs and Housing. Ontario Government, *Provincial Policy Statement, 2014*, Section 3 Planning Act, 30 April 2014.

Haldimand County Planning & Economic Development Department. *The Haldimand County Official Plan*, Council adopted 26 June 2006, Ministry approved 8 June 2009.

Lake Erie Region Source Protection Committee. Long Point Region Source Protection Area Approved Source Protection Plan, Under Clean Water Act 2006, 4 November 2015.

Watson & Associates Economists Limited. *Population, Housing and Employment Projections Study Update*, 2016-2046 - Preliminary Draft Findings. October 2018.

Upper Canada Consultants. *Topographic Volumetric Survey of Jarvis Sewage Lagoons*, 17 July 2018.

Dave Chapman (CPO Inc.). *Jarvis lagoons: Capacity Assessment & Contingency and Abatement Plan Technical Memo,* 6 June 2011.

CPO Inc. and Haldimand County. *Jarvis lagoon Effluent Phosphorous Offsetting,* 20 July 2016.

Stantec Consulting Ltd. *Jarvis Master Servicing Plan Water, Wastewater, Stormwater, and Transportation*, September 2010.

Prior to 2010 MSP

Stantec Consulting Ltd. *Jarvis Inflow and Infiltration Study*, March 2010.

2.0 CLASS ENVIRONMENTAL ASSESSMENT

2.1 Class Environmental Assessment and Master Planning Process

The Ontario Environmental Assessment Act (Act) sets out a planning and decision-making process to consider potential environmental effects before a project begins. The purpose of the Act is to provide for the protection and conservation of the natural environment (R.S.O. 1990, c.E.18, s.2).

The Municipal Class EA process is followed for common types of projects to streamline the review process while ensuring that the project meets the requirements of the Act. In 1987, the first Class EA document prepared by the Municipal Engineers Association (MEA) on behalf of Ontario Municipalities was approved under the Act. Updates and amendments were subsequently made in 1993, 2000, 2007, 2011 and 2015.

This Master Servicing Plan Update is being completed with sufficient detail to fulfil the requirements for Schedule B projects (Approach #2) concurrently with a Class Environmental Assessment, for additional wastewater treatment capacity at the Jarvis Wastewater Treatment Lagoons.

Projects categorized as Schedule B or Schedule C undertakings have the potential for significant environmental impacts, and are required to follow specific phases under the Municipal Class EA. This includes consultation with all parties that may potentially be affected by the project, and the preparation of a Class EA Project File or Environmental Study Report that documents the Class EA process.

For the Master Servicing Plan Update, a Project File or Environmental Study Report shall be made available for public and agency review at the completion of the Class EA process for a mandatory 30-day period. If there are no requests to the Minister of the Environment, Conservation and Parks (MECP) for a ‘Part II Order’ within the review period, then the project may proceed to implementation (Phase 5).

2.2 Problem Statement

To support planned growth and intensification identified in the County’s Official Plan, Haldimand County is undertaking an engineering study to update the 2010 Master Servicing Plan (MSP) The purpose of the Master Servicing Plan Update is to evaluate the community’s long-term infrastructure needs and identify a preferred solution to be implemented to match growth in Jarvis over the next 20 years.

The Class EA framework will enable consideration of options and identify a preferred solution that is environmentally, socially, and financially responsible and sustainable.

The study will consider the needs and viewpoints of all participating stakeholders including, but not limited to, residents, government agencies, the general population, and Indigenous communities.

2.3 Public Consultation Plan

Public and agency consultation for this assignment is anticipated to consist of:

- Notice of Commencement
- Meetings with Review Agencies (as required)
- Project Committee Meetings
- Public Information Centre(s)
- Filing of the Project File/ESR and Notice of Completion

Consultation activities undertaken as part of the MSP Update will be documented in subsequent Work Packages.

3.0 FUTURE CONDITIONS

3.1 Population and Household Forecast

3.1.1 Residential Growth Projections

Watson & Associates Economists Limited is currently completing an update for the Halidmand County Population, Housing, and Employment Projections Study for 2016 to 2046 (Watson, 2018). Population and household growth projections for Jarvis were estimated using preliminary findings from the study. A summary of population and growth projections for 2018 to 2038 included in Table 1.

Table 1 Jarvis Population and Household Projections

Year	Population Include Undercount	Population Exclude Undercount	Households
2018	2000	2000	752
2023	2040	2000	782
2028	2140	2080	824
2033	2240	2240	880
2038	2340	2340	930

Based on the Watson 2018 Study, the anticipated population and household growth for the 20-year horizon from 2018 to 2038 is an increase of 340 persons and 178 units respectively.

3.1.2 ICI Growth Projections

Industrial, Commercial, and Institutional (ICI) Projections were obtained from Haldimand County Development Charge Background Study (Watson, 2014). Growth projections were provided in gross floor area (GFA) square feet (S.F) and converted to hectares of developed land. Actual development coverage assumed to be 75% of vacant land for industrial, commercial and institutional land uses. Summary of ICI growth projections for 2018 to 2038 is provided in Table 2.

Table 2 Jarvis ICI Projections

	Industrial GFA S.F	Commercial GFA S.F	Institutional GFA S.F	Total ICI
Mid 2018 – Mid 2038 (1)	219,700	7,700	7,700	235,100
Hectares (2)	2.72	0.10	0.10	2.91

Table 2 Notes:

1. Data from Development Charge Background Study provided for Mid 2014 to Mid 2034 assumed growth in same order of magnitude for timeframe of Mid 2018 to Mid 2038 (Watson, 2014).

2. Hectares of developed land assuming actual development coverage of 75%.

Anticipated ICI growth is approximately 2.72 ha of industrial land, 0.10 ha of commercial land and 0.10 ha of institutional land. Total ICI growth for the 20-year horizon from 2018 to 2038 is 2.91 ha of land.

3.1.3 Distribution of Growth

Future residential growth was distributed based on approved development in Jarvis and residential density. Summarized in Table 3 is the allocation of residential growth.

Table 3 Allocation of Residential Growth 2018-2038

Development	Density	Units Available	Units Allocated	Ha
Jarvis Meadows Phase 2 & Phase 3 (L. McKeen)	Low	154	87	4.74
Saunders Drive	High	Not specified	24	0.35
Milmont Estates (D. Gusenbauer)	Medium	48	34	1.85
Country Fields Phase 1 and Phase 2 (C. Walker)	Low	33	33	1.8

Anticipated growth in Jarvis is approximately 6.54 ha (120 units) of low density residential land, 1.85 ha (34 units) of medium density residential land, 0.35 ha (24 units) of high density residential land and 2.91 ha of ICI land to be developed. See Figure 2 for the distribution of future residential and ICI development from 2018-2038.

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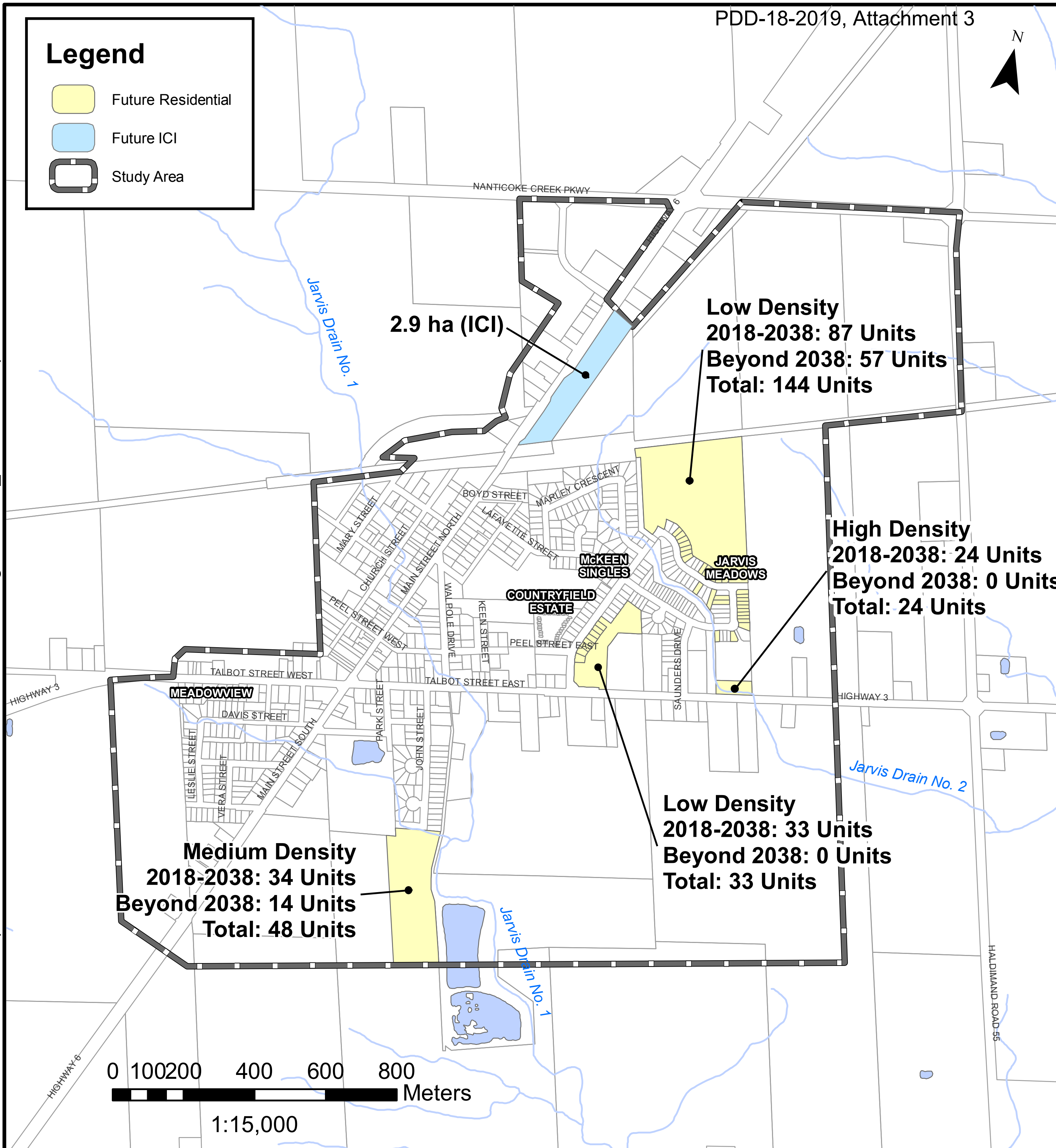

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JARVIS MASTER SERVICING PLAN UPDATE

JARVIS, HALDIMAND COUNTY, ONTARIO

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ANTICIPATED DEVELOPMENT FROM 2018 TO 2038

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FIGURE 2

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3.1.4 Equivalent Population

The following assumptions updated from 2010 MSP based on Haldimand County Design Criteria Version 4.0, April 2015 and input from County staff were used to calculate equivalent population.

- Low/medium density housing equivalent population of 55 persons/ha.
- High density housing equivalent population of 135 persons/ha.
- Commercial equivalent population of 90 persons/ha.
- Actual development coverage to be 75% of vacant land for industrial, commercial, and institutional land uses.

Anticipated growth in Jarvis is approximately 6.54 ha (120 units) of low density residential land, 1.85 ha (34 units) of medium density residential land, 0.35 ha (24 units) of high density residential land and 2.91 ha of ICI land to be developed. A summary of future equivalent population is provided in Table 4.

Table 4 Summary of Equivalent Population for Jarvis

Year(s)	Equivalent Population
Total 2017 (1)	2560
2018-2038 Residential Growth	510
2018-2038 ICI Growth	262
Total Growth	772
Total Future	3332

Table 4 Notes:

1. From Work Package 1.

3.2 Design Criteria

3.2.1 Future Flow Rates

Design criteria from Haldimand County Design Criteria Version 4.0, April 2015 along with input from County staff was used to develop design criteria for water and wastewater flows. These criteria are summarized in Table 5 below.

Table 5 Design Criteria for Estimating Future Flows

Parameter	Criteria
Average Water Consumption	290 L/capita/day
Dry Weather Average Sewage	280 L/capita/day
Infiltration Flow (Allowance)	0.23 L/s/ha
Peaking Factor	Harmon Formula

4.0 WATER SERVICING

4.1 Water Distribution System

The water model was updated to include future population growth to 2038. The extended future water distribution system is shown in Figure 3. Future watermain extensions are highlighted in yellow. All model inputs can be found in Appendix A.

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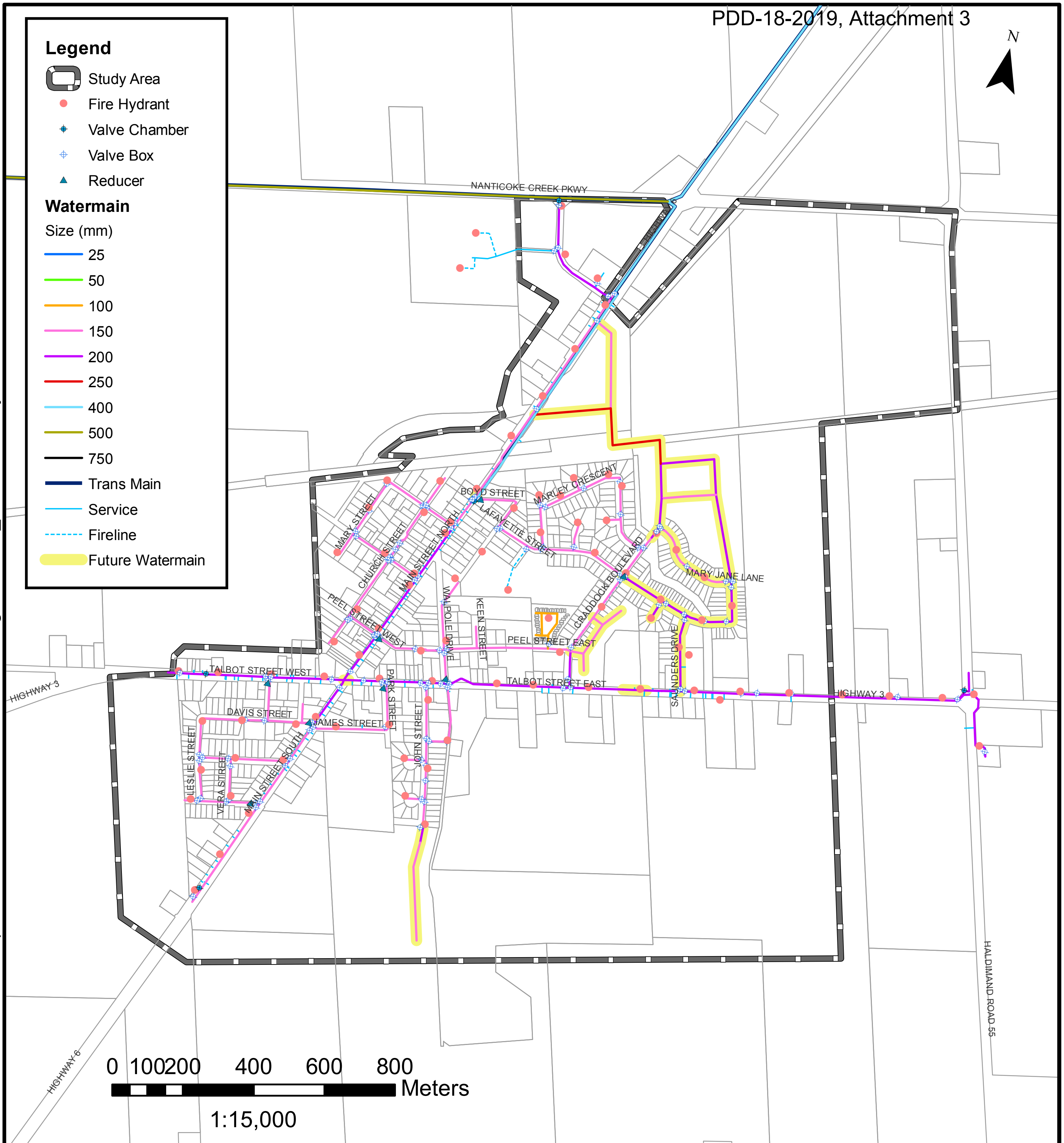

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JARVIS MASTER SERVICING PLAN UPDATE

JARVIS, HALDIMAND COUNTY, ONTARIO

DRAWING:

FUTURE (2038) WATER DISTRIBUTION SYSTEM

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FIGURE 3

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4.2 Future Modelled Water Demand

The future water demands were calculated using a uniform per capita demand and the equivalent population. To add water demand to future development lands, the equivalent population for anticipated residential and ICI growth was calculated as detailed in Section 3.1.4. Once equivalent populations for future development was established, the total future flow was determined as follows:

- Average water consumption of 290 L/capita/day
- Maximum day factor of 2.0
- Peak hour demand factor of 3.0

This new demand was added to the existing conditions water demand developed in Work Package 1. Future water demands are summarized in Table 6.

Table 6 Summary of Modelled Water Demands (Future)

Land Use	Average Day (L/s)	Maximum Day (L/s)	Peak Hour (L/s)
Total 2017 Water Demand (1)	7.89	16.77	27.61
Additional Water Depot (2)	0	0	0
Additional Residential to 2038	1.78	3.56	5.34
Additional ICI to 2038	0.88	1.76	2.64
Total 2038 Water Demand	**10.55**	**22.09**	**35.59**

Table 6 Notes:

1. Refer to Work Package 1 for development of total existing water demand.
2. No anticipated increase in water demand for the Water Depot.

The future average, maximum, and peak water demands are estimated to be 10.55 L/s, 22.09 L/s and 35.59 L/s, respectively.

4.3 Future Storage Requirements

An elevated storage tank located at the north-east of Townsend provides storage for both Jarvis and Townsend. The storage volume provided by the tank is 2,300 m^3. Storage requirements were calculated based on the MECP (formally MOE) Design Guidelines for Drinking-Water Systems (2008), with fire storage requirements modified to assume that 50% of fire flow volume is pumped and the remainder is from storage. Using this approach adopted by Haldimand County there is adequate storage to serve anticipated 20-year growth. Table 7 summarizes the future total water storage volume required for Jarvis, Townsend, and for the overall system.

Table 7 Future Treated Water Storage Requirements

Area	Maximum Daily Demand (m^3/day)	Average Day Demand (m^3/day)	Equivalent Population 2038	Fire Storage Volume Required (m^3) A	Equalization Storage (m^3) B	Emergency Storage (m^3) C	Total Water Storage Volume Required (m^3) A+B+C
Jarvis	1,908 (1)	912 (1)	3,332	414	477	223	1,114
Townsend	696 (3)	348 (2)	1,200 (4)	252	174	107	533
Total	2,604	1,260	4,532	666	651	329	1,646

Table 7 Notes:

1. Refer to Table 6 for development of Jarvis maximum daily and average day demand.
2. Calculated Average Daily Demand using the equivalent population and per capita water consumption of 290 L/day per capita to reflect anticipated future growth for Townsend.
3. Calculated maximum daily demand using maximum day factor of 2.0.
4. Townsend equivalent population from preliminary findings of Watson & Associates Economists Limited update for the Halidmand County Population, Housing and Employment Projections Study for 2016 to 2046 (Watson, 2018).

The existing storage capacity of the elevated storage tower is 2,300 m^3 and the future storage capacity required is 1,646 m^3.The existing storage capacity provided is sufficient for the future total required storage with available surplus.

4.4 Future Existing Water Servicing Conditions and Constraints

4.4.1 Service Pressure

No future service pressure deficiencies were identified in Jarvis. Modeling results indicate that the system currently operates within the MECP recommended pressure range of 275 kPa to 550 kPa during the peak hour demand scenario. Existing system pressures are shown in Figure 4.

4.4.2 Available Fire Flow

Future fire flow availability within Jarvis was found to range between 40 L/s and 285 L/s during the maximum day demand scenario. Areas with low available fire flow are at the extremities (dead-ends) of the system, and include the Water Depot, located at 1342 Nanticoke Rd., Jarvis.

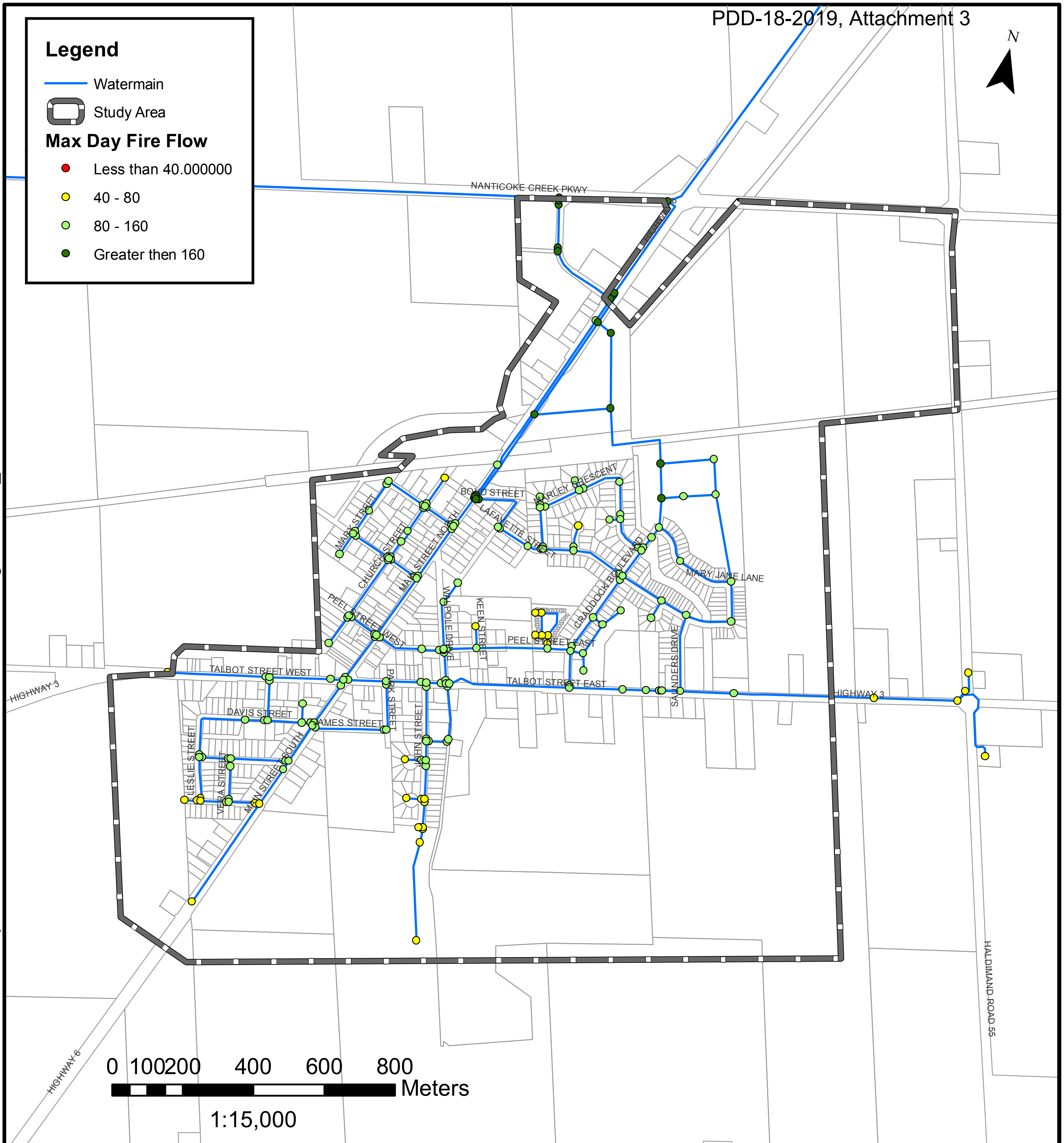
Table 8 presents a baseline for the percentage of junctions in the water model which are capable of meeting the indicated fire flow under existing conditions. Fire flow availability from the existing water distribution system is shown in Figure 5.

The County is currently developing design criteria for minimum fire flow requirements for new developments. It is anticipated that that the minimum flow permitted will be approximately 160 L/s from two adjacent hydrants (approximately 80L/s from one hydrant).

Approximately 80% of junctions are capable of meeting the proposed requirement of 80 L/s under future conditions.

Table 8 Percentage of Junctions Capable of Meeting Fire Flow (2018)

20 YEAR - Max Day + Fire Flow	
Fire Flow (L/s)	**Percentage (%) of Junctions Capable of Meeting the Fire Flow Indicated**
60	91.7%
80	83.3%
100	65.7%
150	14.2%
200	8.3%
250	3.9%



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PROJECT:

JARVIS MASTER SERVICING PLAN UPDATE

JARVIS, HALDIMAND COUNTY, ONTARIO

DRAWING:

FUTURE (2038) AVAILABLE FIRE FLOW UNDER MAXIMUM DAY DEMAND

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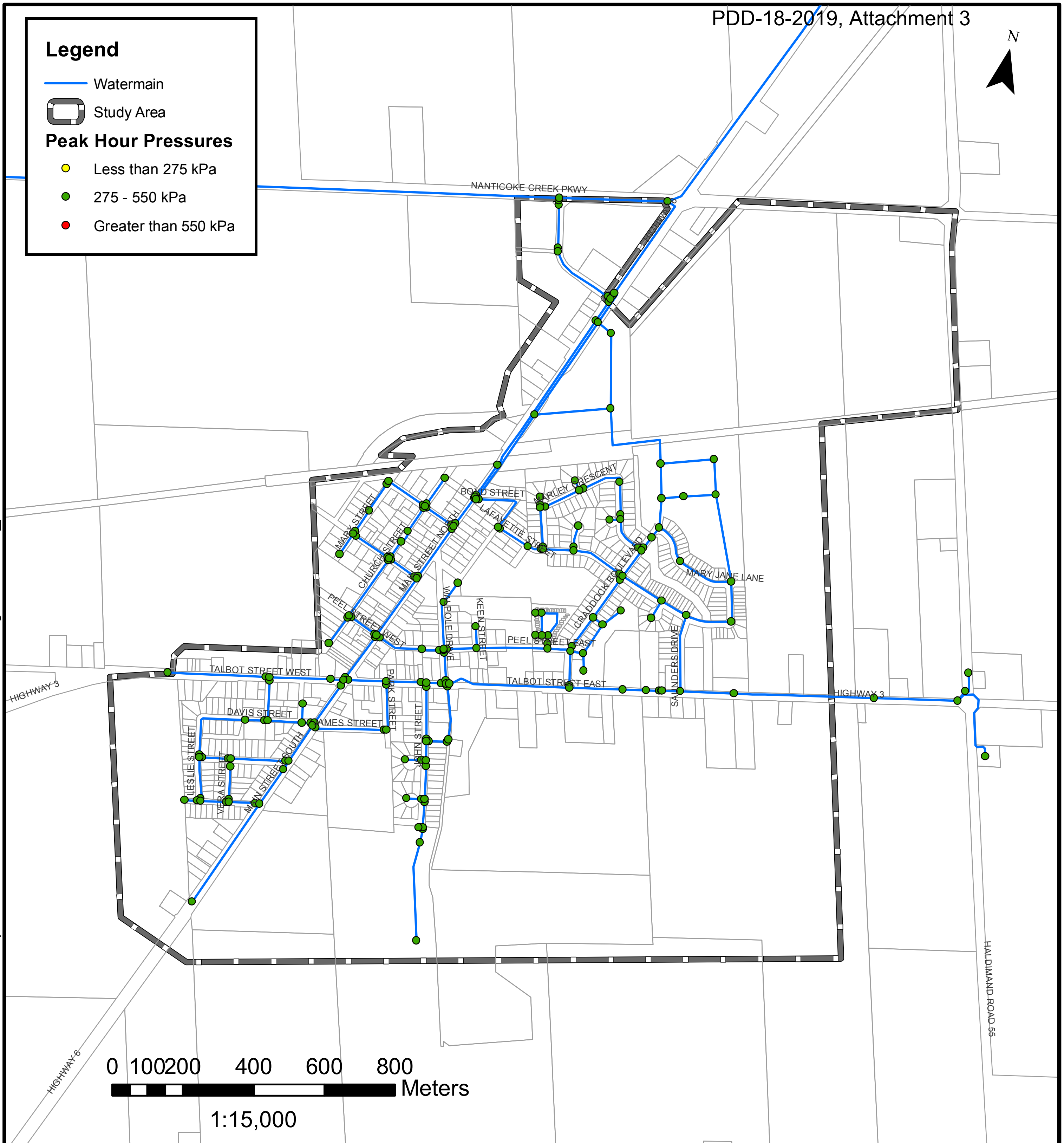
FIGURE 5



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JARVIS MASTER SERVICING PLAN UPDATE

JARVIS, HALDIMAND COUNTY, ONTARIO

DRAWING:

FUTURE (2038) SYSTEM PRESSURES UNDER PEAK HOUR DEMAND

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FIGURE 4

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4.4.3 System Redundancy

As noted in Work Package 1 and the 2010 MSP, the supply to Jarvis is a single connection via a 500 mm diameter transmission main that also provides water to Hagersville. Work Package 3 will consider an additional connection from the Nanticoke WTP to increase water supply redundancy and improve system looping.

5.0 WASTEWATER SERVICING

5.1 Wastewater Collection System

The hydrologic and hydraulic computer simulation model was updated to include future population growth to 2038. The future wastewater collection system is shown in Figure 6. Future sewermains to be added are highlighted in yellow. All model inputs can be found in Appendix B.

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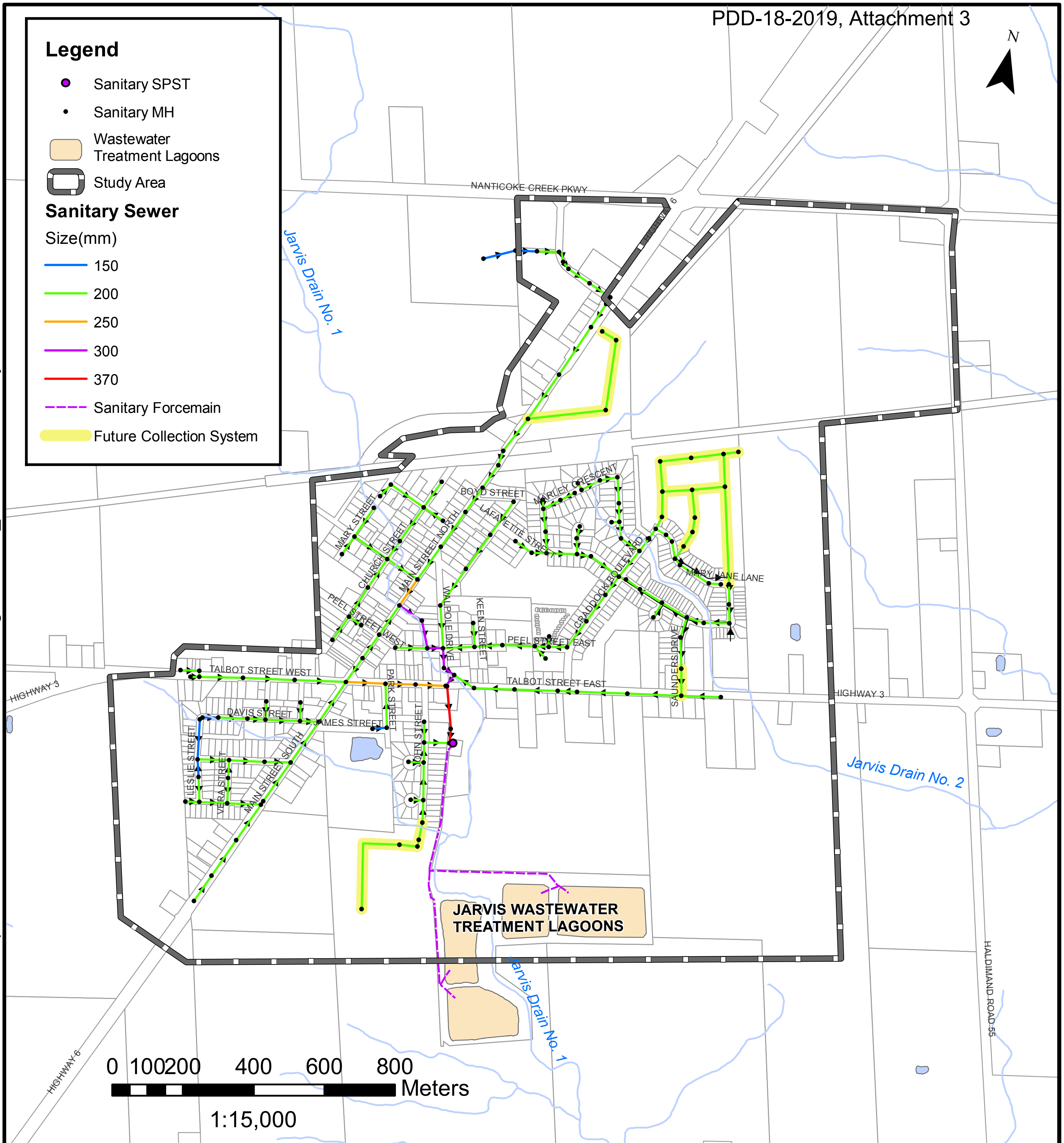

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JARVIS MASTER SERVICING PLAN UPDATE

JARVIS, HALDIMAND COUNTY, ONTARIO

DRAWING:

FUTURE (2038) WASTEWATER COLLECTION SYSTEM

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FIGURE 6

5.2 Future Modelled Wastewater Flows Collection System

The future wastewater flow rates were calculated using a uniform per capita generation rate and an equivalent population. To add wastewater flow on future development lands, the equivalent population for anticipated residential and ICI growth was calculated as detailed in Section 3.1.4. Once equivalent populations for future development was established, the total future flow was determined as follows:

- The average dry weather flow was calculated using the per capita sewage generation rate from the 2010 MSP of 280 L/capita/day.
- Peaking factors, based on the Harmon formula, were then used to determine the peak flow rates generated from newly added and existing parcels.
- Wet weather flow rates were calculated by assuming an inflow and infiltration (I/I) rate of 0.23 L/s/ha per the 2015 Haldimand County Design.

The updated average, peaked dry weather, inflow and infiltration, and total peaked wet weather flow are summarized in Table 9.

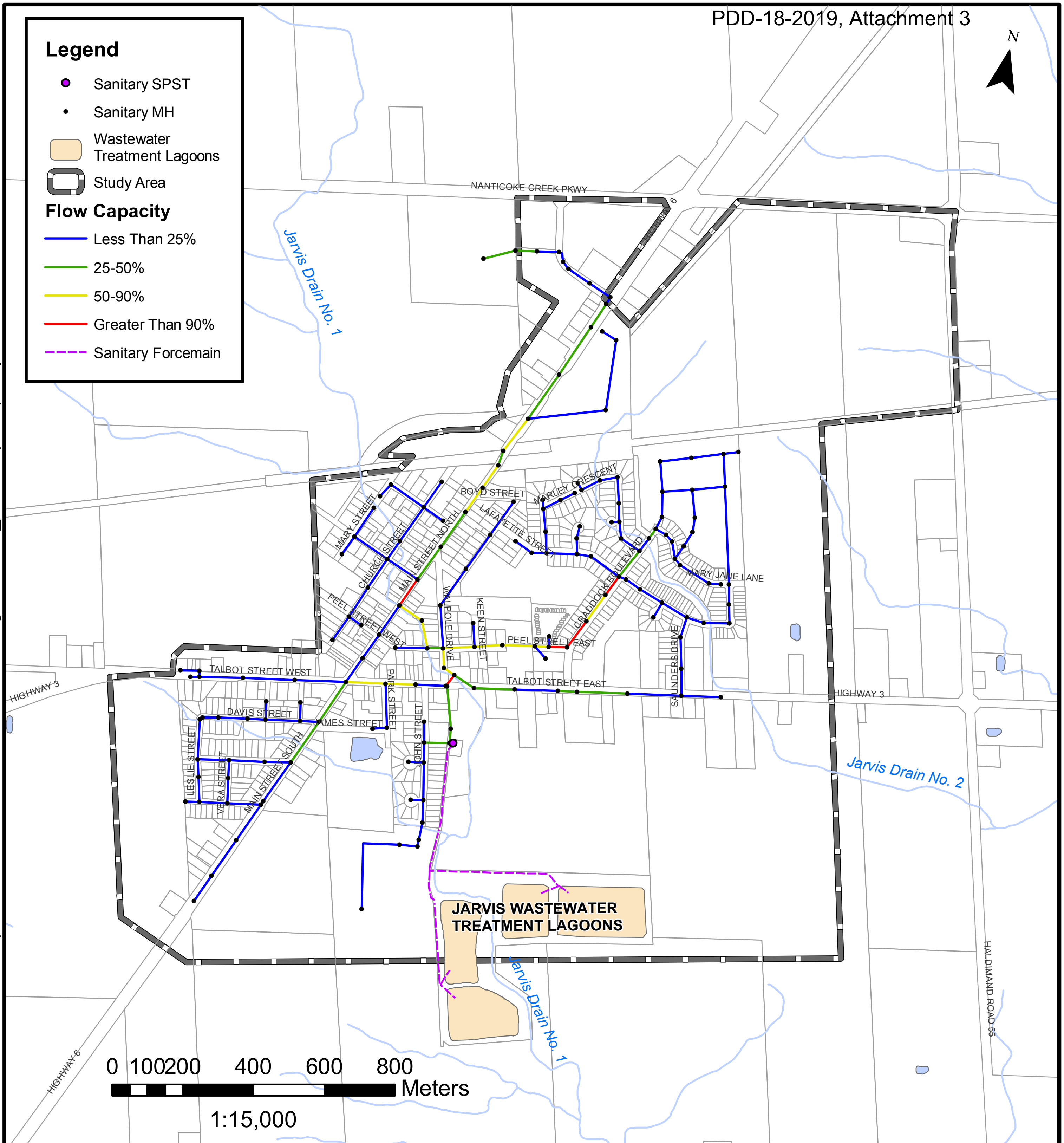
Table 9 Summary of Modelled Wastewater Flow (Future)

Land Use	Average Day Dry Weather (L/s)	Peaked Dry Weather (L/s)	Inflow and Infiltration (L/s)	Total Peaked Wet Weather Flow (L/s)
Total 2017	8.56	31.3	28.7	60.0
Additional Residential to 2038	1.65	5.81	1.70	7.50
Additional ICI to 2038	0.85	1.93	0.57	2.50
Total 2038 Wastewater Flow	**11.1**	**39.0**	**31.0**	**70.0**

Using this approach the updated future peaked wet weather wastewater flow rate is estimated to be 70.0 L/s (6,048 m^3/day).

5.3 Future Wastewater Servicing Conditions and Constraints

In addition to the potential flood risk at Walpole Drive and Talbot Street East intersection for the existing population, there is also potential flooding at the intersection of Craddock Boulevard and Peel Street East in the future. Sewers around this area will be operating at capacity under future population. There will also be capacity constraints at Main Street North just south of Lydia Street. Figure 7 shows the flow to pipe capacity ratio for the future wastewater conveyance system.



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FUTRE (2038) FLOW TO PIPE CAPACITY RATIO

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FIGURE 7

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6.0 STORMWATER

6.1 Future Modelled Stormwater System

The stormwater drainage model was updated to include future population growth to 2038. Future development has been added with reconfiguration of the storm system where required to facilitate the future development (e.g. culverts added for road crossings to new developments) and with servicing for the new developments including downstream water quantity controls. The future stormwater drainage system is shown in Figure 8. Future roads and drainage infrastructure added are highlighted in yellow. Detailed input files are included in Appendix C.

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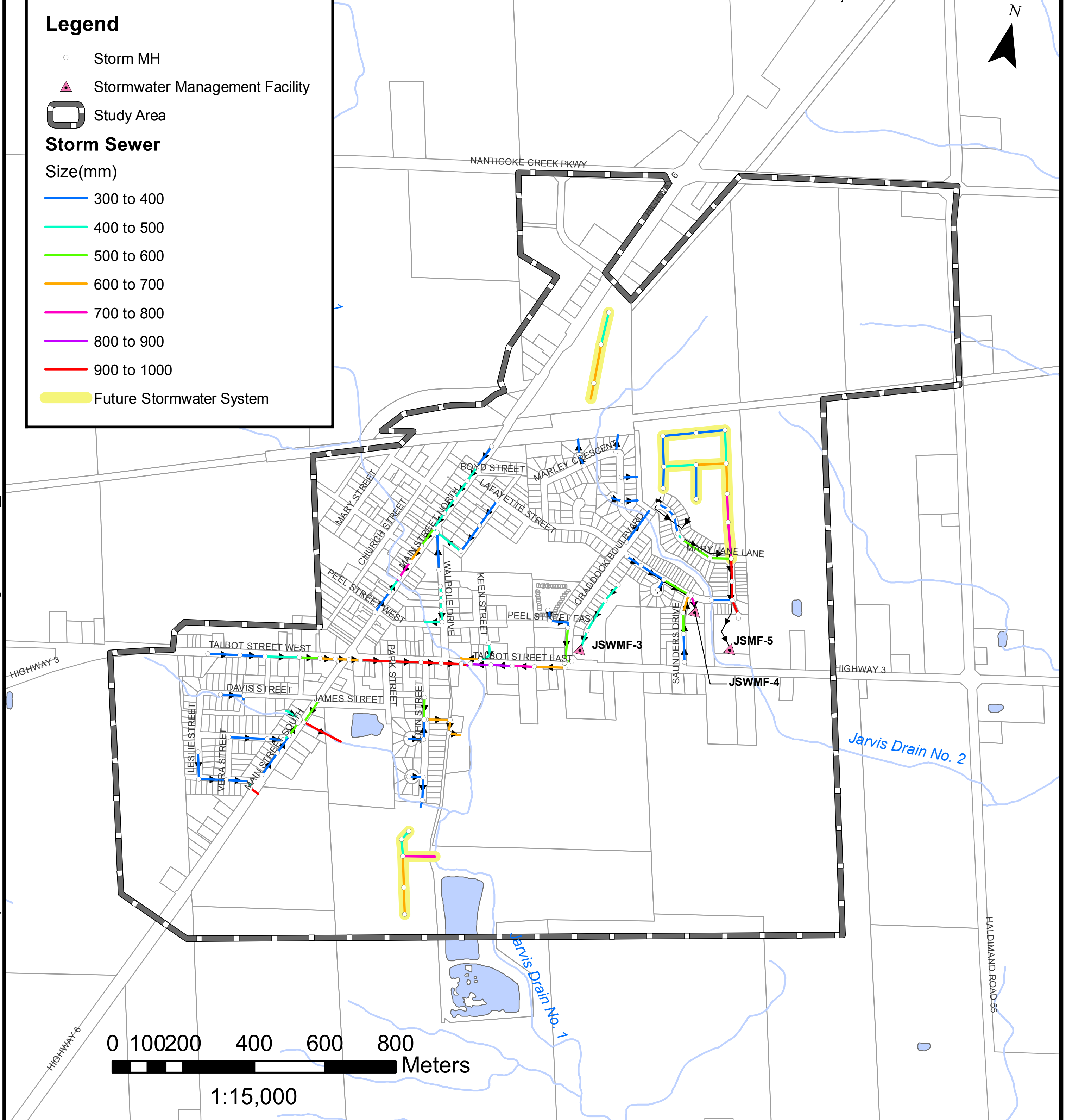

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JARVIS MASTER SERVICING PLAN UPDATE

JARVIS, HALDIMAND COUNTY, ONTARIO

DRAWING:

FUTURE (2038) STORMWATER DRAINAGE SYSTEM

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FIGURE 8

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6.2 Future Stormwater Servicing Conditions and Constraints

6.2.1 Surcharge Under Rainfall Events (5-Year Storm)

There are no changes to the surcharge findings identified under the existing condition when the future population is added to the storm model. In general, the future stormwater servicing system operates as intended under everyday rainfall events. Comparing design rainfall events, the majority of storm sewers are surcharged under the design 5-year event (refer to Figure 9); however, water is mostly contained below ground surface. There are two (2) locations where water surcharges to the surface in the 5-year event, both of which are in the Marley/Craddock sewershed.

6.2.2 Flow to Pipe Capacity Ratio

There are also no changes to the pipe capacity ratios. As shown in Figure 10, two (2) independent inlets and sewers discharging to Jarvis Drain No. 1 on Cabot Court and Craddock Boulevard accept more inflow than the sewer capacity can handle, which causes surcharge to the surface. In the case of Cabot Court, the road grade slopes away from Marley Crescent and traps overland drainage which sits and ponds over the inlet. The water level of Jarvis Drain No. 2 will also influence the ability of this sewer to outlet under extreme events. Surcharge occurs in the 2-year storm at Cabot, but does not flood the surface.

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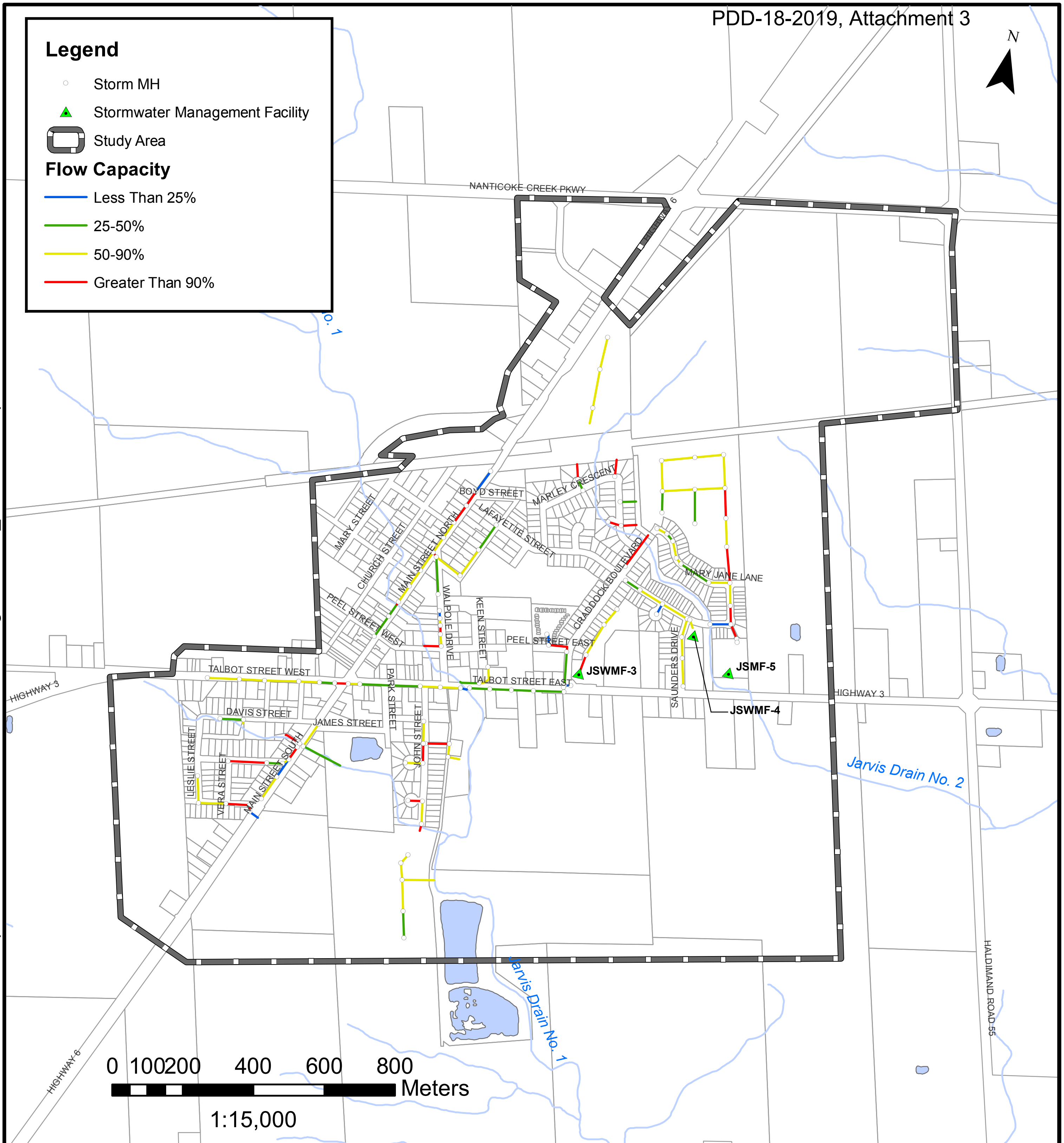

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JARVIS MASTER SERVICING PLAN UPDATE

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DRAWING:

FUTURE (2038) FLOW TO PIPE CAPACITY RATIO

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JLR #:	28176

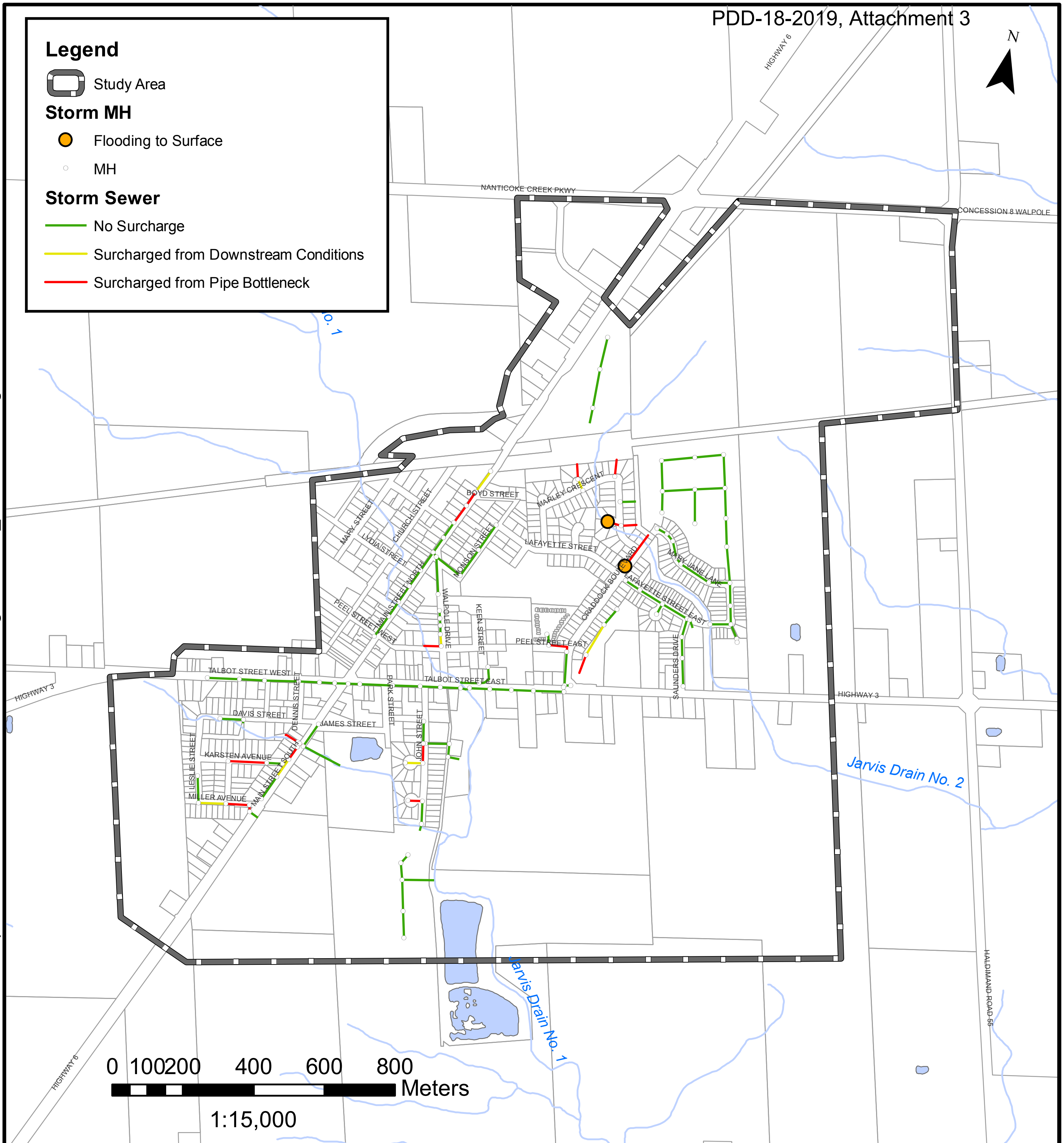
DRAWING #:

FIGURE 10

File Location: V:\28000\28176 Jarvis Water Model Backup\3-JLR DWG\1-Civil\GIS\Work Package 2\28176_FutureStmCapFlow.mxd

Plot Date: March 22, 2019 2:42:29 PM

PDD-18-2019, Attachment 3



File Location: V:\28000\28176 Jarvis Water Model Backup\3-JLR DWG\1-Civil\GIS\Work Package 2\28176_FutureSurcharge.mxd

Plot Date: March 22, 2019 2:39:05 PM

PROJECT:

JARVIS MASTER SERVICING PLAN UPDATE

JARVIS, HALDIMAND COUNTY, ONTARIO

DRAWING:

FUTURE (2038) SURCHARGE TO SURFACE MAP UNDER 5-YEAR

J.L.Richards
ENGINEERS · ARCHITECTS · PLANNERS
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DESIGN:	BP
DRAWN:	KTK
CHECKED:	JW
JLR #:	28176

DRAWING #:

FIGURE 9

7.0 TRANSPORTATION SERVICING

The study area intersections were analyzed under future traffic conditions, using Synchro 9.2 software which implements Highway Capacity Manual (HCM) 2000 procedures. The results indicate the study area intersections are generally operating with acceptable levels of service (LOS) and well within capacity.

Under future conditions there is a decrease in LOS at the intersection of Talbot Street and Main Street and the eastbound approach movement on Nanticoke Creek Parkway. No critical movements are identified at any of the study intersections. In the future, there is potential for remedial measures at the intersections of Nanticoke Creek Parkway at Highway 6 and Main Street and Talbot Street.

Please refer to Appendix D for the full report.

8.0 CONCLUSION

This work package has been prepared for the exclusive use of Haldimand County, for the stated purpose. Its discussions and conclusions are summary in nature and cannot be properly used, interpreted or extended to other purposes without a detailed understanding and discussions with the client as to its mandated purpose, scope and limitations. This report was prepared for the sole benefit and use of Haldimand County and may not be used or relied on by any other party without the express written consent of J.L. Richards & Associates Limited.

J.L. RICHARDS & ASSOCIATES LIMITED

Prepared by:	Reviewed by
Jane Wilson	
Jane Wilson, P.Eng. Environmental Engineer	Michael Troop, P.Eng. Senior Environmental Engineer

9.0 REFERENCES

Haldimand County Services and Planning Division. Design Criteria, Version 4.0, April 2015.

Ministry of the Environment, Conservation and Parks. *Design Guidelines for Sewage Works*, 2008.

Watson & Associates Economists Limited. *Population, Housing and Employment Projections Study Update, 2016-2046 - Preliminary Draft Findings*. October 2018.

Watson & Associates Economists Limited. *Haldimand County Development Charge Background Study*, April 2014.

Appendix A

Water Model Parameters

28176 Jarvis - 20 YEAR - Peak Hour Pressures

		ID	Demand (L/s)	Elevation (m)	Head (m)	Pressure (kPa)
1		NANT_04	0.000000	260.000000	254.223511	-56.605007
2		NANT_03	0.000000	260.000000	254.355270	-55.313957
3		NANT_02	0.000000	260.000000	254.367935	-55.189812
4		NANT_01	0.000000	260.000000	259.987732	-0.120139
5		60V0030-B	0.000000	217.500015	252.838547	346.289856
6		60V0108-B	0.000000	217.000000	252.950272	352.284332
7		60V0050	0.000000	216.484467	252.940643	357.241730
8		60V0108	0.000000	216.121643	252.946640	360.856018
9		60T0102	0.000000	215.500000	252.726425	364.789551
10		60V0067	0.000000	215.500000	252.736389	364.887268
11		60V0060	0.000000	215.645859	252.883804	364.902527
12		60V0008	0.000000	215.500000	252.744583	364.967499
13		60T0101	0.029824	215.500000	252.748215	365.003204
14		60T0104	0.000000	215.565323	252.877289	365.627899
15		60V0068	0.000000	215.000000	252.754486	369.964264
16		FUT118	0.000000	214.500000	252.679810	374.132111
17		60V0030	0.057428	214.500000	252.714340	374.470459
18		60DEPO01	20.999851	209.307343	247.612289	375.358337
19		60D0016	0.525424	213.013535	251.505035	377.186432
20		FUT74	1.318991	213.750000	252.615341	380.849670
21		FUT10	0.525596	212.652039	252.008942	385.666565
22		60T0094	0.040812	212.304474	251.746796	386.503662
23		FUT12	0.525596	212.500000	251.960815	386.684814
24		60V0029	0.277210	212.792007	252.493729	389.045685
25		60T0114	0.149255	212.000015	251.720566	389.230225
26		60V0042	0.000000	212.000015	251.720581	389.230408
27		60V0043	0.000000	212.000015	251.721054	389.234955
28		60T0073	0.263026	212.000015	251.724380	389.267578
29		60V0044	0.000000	212.000015	251.725296	389.276520
30		60T0071	0.199511	211.944672	251.720596	389.772919
31		60T0115	0.170255	211.933945	251.724319	389.914337
32		FUT24	0.525596	212.132401	251.965057	390.328705
33		60V0004	0.000000	209.500000	249.341476	390.415039
34		FUT8	0.525596	212.121536	252.090332	391.662659
35		60CHAM01	0.000000	208.500000	248.514877	392.114288
36		60T0110	0.000000	208.500000	248.514877	392.114288
37		60D0013	0.023168	208.500000	248.514877	392.114288
38		FUT116	1.559989	212.500000	252.575241	392.705811
39		60V0045	0.389853	211.650864	251.733383	392.777100
40		FUT56	1.318991	212.250000	252.417786	393.612671
41		60T0116	0.196119	211.500000	251.680862	393.740784
42		60V0046	0.088523	211.500000	251.743561	394.355133
43		60T0117	0.209351	211.500000	251.745132	394.370605
44		60T0066	0.000000	211.500000	251.745209	394.371338
45		FUT6	0.525596	211.621353	251.970993	395.394592
46		60T0009	0.277510	210.987991	251.485901	396.847565
47		60V0017	0.000000	211.000000	251.506104	396.927887
48		60V0098	0.000000	210.954376	251.485901	397.177002
49		60V0099	0.573160	210.934845	251.485992	397.369263
50		60T0017	0.273888	210.923599	251.506134	397.676910

28176 Jarvis - 20 YEAR - Peak Hour Pressures

		ID	Demand (L/s)	Elevation (m)	Head (m)	Pressure (kPa)
51	☐	60V0016	0.000000	210.902222	251.505600	397.881256
52	☐	60V0037	0.135650	211.000000	251.616867	398.013275
53	☐	60T0063	0.113255	211.000000	251.629456	398.136719
54	☐	60V0038	0.341278	211.000000	251.632339	398.164948
55	☐	60V0047	0.210687	211.116364	251.760345	398.278900
56	☐	60T0050	0.000000	210.668259	251.323364	398.387970
57	☐	60T0049	0.000000	210.651367	251.323364	398.553497
58	☐	60V0039	0.000000	211.000000	251.681000	398.641663
59	☐	60T0068	0.300550	211.000000	251.681030	398.642029
60	☐	FUT22	0.123275	210.930786	251.615662	398.679688
61	☐	60D0004	0.000000	210.773239	251.485550	398.948547
62	☐	FUT98	0.449247	210.757385	251.479050	399.040222
63	☐	60T0065	0.000000	211.020187	251.762589	399.243439
64	☐	60V0005	0.000000	210.582504	251.326004	399.254303
65	☐	FUT14	0.003402	211.059418	251.825729	399.477692
66	☐	60V0041	0.000000	210.945236	251.719330	399.554169
67	☐	60T0069	0.065536	210.950851	251.735916	399.661469
68	☐	60V0048	0.000000	211.000000	251.786240	399.672943
69	☐	60V0040	0.000000	210.926422	251.721451	399.759186
70	☐	60T0052	0.739437	209.935852	250.735046	399.799927
71	☐	FUT30	0.064719	210.500015	251.300964	399.817291
72	☐	60T0118	0.268618	210.912445	251.719269	399.874603
73	☐	60V0006	0.666901	210.500015	251.341202	400.211609
74	☐	FUT92	0.000000	210.500015	251.373764	400.530609
75	☐	60V0065	0.000000	210.509949	251.485580	401.528900
76	☐	60V0095	0.000000	210.474167	251.485901	401.882660
77	☐	60V0066	0.000000	210.466293	251.485550	401.956329
78	☐	60T0006	0.269718	210.453217	251.485550	402.084442
79	☐	FUT20	0.121595	210.557388	251.615677	402.338867
80	☐	J10	0.021852	210.809509	251.897446	402.629303
81	☐	60T0010	0.401197	210.391907	251.485901	402.688721
82	☐	FUT96	0.449247	210.345306	251.479614	403.083771
83	☐	60V0033	0.000000	210.607468	251.773804	403.397827
84	☐	60V0096	0.000000	210.312668	251.485825	403.464478
85	☐	60T0077	0.432645	210.591934	251.776260	403.573975
86	☐	60V0064	0.000000	210.300110	251.485550	403.584839
87	☐	60V0063	0.400913	210.278503	251.485550	403.796692
88	☐	60T0004	0.000000	210.257309	251.485550	404.004211
89	☐	60T0098	0.404153	211.190002	252.454803	404.362549
90	☐	60V0103	0.000000	210.554169	251.869125	404.854034
91	☐	60T0096	0.572064	210.492371	251.808609	404.866760
92	☐	60V0028	0.000000	211.093811	252.411652	404.882202
93	☐	60V0087	0.225046	210.174545	251.495529	404.913300
94	☐	60T0113	0.000000	211.122955	252.453308	405.004791
95	☐	60V0027	0.000000	210.451721	251.803940	405.219330
96	☐	FUT26	0.056265	210.504349	251.866577	405.317444
97	☐	60T0097	0.000000	211.058395	252.460464	405.707611
98	☐	85CHAM01	0.000000	211.054688	252.460464	405.743927
99	☐	60V0026	0.000000	210.392151	251.803497	405.798706
100	☐	60T0014	0.226118	210.042816	251.499710	406.244812

28176 Jarvis - 20 YEAR - Peak Hour Pressures

		ID	Demand (L/s)	Elevation (m)	Head (m)	Pressure (kPa)
101	☐	60V0020	0.000000	210.038116	251.498718	406.281219
102	☐	60T0060	0.000000	210.003021	251.465973	406.304413
103	☐	FUT18	0.065823	210.248367	251.723358	406.422333
104	☐	60D0002	0.000000	210.000000	251.485687	406.527100
105	☐	60V0007	0.000000	211.054688	252.550827	406.629364
106	☐	60V0081	0.000000	210.039459	251.642853	407.680511
107	☐	60D0019	0.000000	209.826233	251.465973	408.036621
108	☐	60D0007	0.079533	210.000000	251.642838	408.066986
109	☐	60V0062	0.000000	209.811752	251.485672	408.371613
110	☐	60D0008	0.000000	210.195251	251.879395	408.471832
111	☐	FUT100	0.000000	209.799026	251.488937	408.528198
112	☐	60T0002	0.313392	209.763763	251.485687	408.842041
113	☐	60T0085	0.199213	209.892593	251.642853	409.119812
114	☐	60V0082	0.000000	209.867691	251.640060	409.336334
115	☐	FUT28	0.126470	209.834488	251.608063	409.348145
116	☐	60V0091	0.000000	209.817917	251.746796	410.869934
117	☐	60D0009	0.072495	209.571365	251.527054	411.132782
118	☐	60T0023	0.098307	209.500000	251.502350	411.589874
119	☐	60V0092	0.000000	209.743240	251.746094	411.594818
120	☐	60V0011	0.000000	209.491943	251.502350	411.668823
121	☐	60T0091	0.179135	209.706726	251.746796	411.959686
122	☐	60V0036	0.259490	209.404602	251.466400	412.172638
123	☐	FUT138	0.249248	209.400009	251.465546	412.209198
124	☐	60V0090	0.000000	209.683838	251.751068	412.225739
125	☐	60T0080	0.131041	209.646225	251.771851	412.797943
126	☐	60V0014	0.000000	209.367783	251.512024	412.980286
127	☐	60V0089	0.000000	209.558136	251.745331	413.401367
128	☐	60T0015	0.000000	209.257446	251.502563	413.968903
129	☐	60T0058	0.000000	209.218567	251.465973	413.991272
130	☐	60T0090	0.215738	209.472870	251.732376	414.109863
131	☐	60T0059	0.000000	209.192245	251.465973	414.249237
132	☐	60V0015	0.000000	209.211105	251.512238	414.517792
133	☐	60V0013-B	0.000000	209.199997	251.513306	414.637024
134	☐	60V0013	0.221216	209.184113	251.516724	414.826385
135	☐	FUT34	0.709245	209.131149	251.464584	414.834412
136	☐	60V0076	0.000000	209.347702	251.731628	415.329132
137	☐	60V0019	0.000000	209.098526	251.487534	415.378906
138	☐	60V0012	0.000000	209.109009	251.512115	415.516998
139	☐	60T0047	0.216938	208.974655	251.448685	416.212097
140	☐	60V0056	0.000000	208.969894	251.449524	416.267090
141	☐	60T0045	0.000000	208.958603	251.463852	416.518097
142	☐	60D0020	0.000000	208.939255	251.465973	416.728333
143	☐	60T0044	1.526909	208.906113	251.465973	417.053101
144	☐	60V0052	0.000000	208.896820	251.465973	417.144287
145	☐	60D0021	0.148371	208.929535	251.502472	417.181244
146	☐	60V0018	0.000000	208.859222	251.503647	417.881927
147	☐	60V0105	0.000000	208.740967	251.502731	419.031647
148	☐	60V0097	0.000000	208.723145	251.487854	419.060425
149	☐	60V0034	0.149855	208.878708	251.699387	419.608978
150	☐	60V0021	0.000000	208.744949	251.603912	419.984161

28176 Jarvis - 20 YEAR - Peak Hour Pressures

		ID	Demand (L/s)	Elevation (m)	Head (m)	Pressure (kPa)
151	☐	60T0013	0.382733	208.588837	251.487961	420.377655
152	☐	60V0022	0.000000	208.706741	251.608795	420.406311
153	☐	60V0106	0.000000	208.597763	251.502716	420.434692
154	☐	60T0016	0.108289	208.595398	251.504105	420.471588
155	☐	60V0023	0.000000	208.613220	251.604721	421.282806
156	☐	60T0021	0.121303	208.500000	251.502380	421.389465
157	☐	60V0107	0.000000	208.500000	251.502396	421.389648
158	☐	60T0036	0.361157	208.601425	251.608017	421.430664
159	☐	60V0093	0.000000	208.294495	251.493546	423.316650
160	☐	60T0038	0.243002	208.248505	251.527084	424.096008
161	☐	60V0069	0.000000	208.019089	251.490891	425.989471
162	☐	60T0087	0.054200	208.223663	251.716766	426.198151
163	☐	65WBS01	34.499756	209.000015	252.506958	426.333832
164	☐	60T0024	0.315340	207.831192	251.492126	427.842773
165	☐	60V0032	0.000000	208.000000	251.716171	428.384033
166	☐	60T0088	0.148523	208.000000	251.716782	428.390045
167	☐	60V0104	0.000000	208.000000	251.717590	428.397888
168	☐	60V0049	0.209247	207.944290	251.729065	429.056305
169	☐	60V0035	0.000000	207.715210	251.559601	429.640533
170	☐	60V0077	0.149999	207.816422	251.723190	430.251831
171	☐	60T0040	0.000000	207.551987	251.561462	431.258209
172	☐	60T0039	0.210691	207.459885	251.560608	432.152344
173	☐	60V0025	0.000000	207.510071	251.713089	433.154724
174	☐	60T0112	0.000000	207.463470	251.719757	433.676788
175	☐	60V0080	0.000000	207.292313	251.555756	433.746826
176	☐	60T0081	0.439407	207.435562	251.709061	433.845459
177	☐	60V0024	0.000000	207.433746	251.709061	433.863220
178	☐	60V0079	0.000000	207.194122	251.563034	434.780334
179	☐	60V0086	0.000000	207.281921	251.709518	435.355530
180	☐	60V0009	0.000000	207.053787	251.491608	435.455811
181	☐	60V0074	0.000000	207.000000	251.458664	435.659851
182	☐	60V0073	0.000000	207.000000	251.461548	435.688110
183	☐	60T0031	0.149799	207.000000	251.461609	435.688629
184	☐	60T0108	0.255054	206.997284	251.461395	435.713257
185	☐	60V0085	0.000000	207.242386	251.710190	435.749359
186	☐	60T0029	0.234978	207.000000	251.475128	435.821167
187	☐	60V0071	0.000000	207.000000	251.475586	435.825745
188	☐	60V0070	0.000000	207.000000	251.475876	435.828461
189	☐	60T0083	0.255014	207.215729	251.709167	436.000549
190	☐	60T0027	0.000000	206.985001	251.479401	436.010071
191	☐	60V0031	0.000000	207.189072	251.707153	436.242249
192	☐	60V0102	0.000000	206.950684	251.478851	436.340912
193	☐	60V0078	0.000000	207.000000	251.572128	436.771698
194	☐	60V0084	0.000000	207.131897	251.709167	436.822052
195	☐	60V0051	0.000000	206.792816	251.488968	437.987091
196	☐	60T0025	0.269240	206.671402	251.491440	439.201050
197	☐	60T0026	0.000000	206.635651	251.489578	439.533173
198	☐	60V0072	0.000000	206.561234	251.431442	439.692719
199	☐	60V0010	0.000000	206.603424	251.497971	439.931213
200	☐	60D0006	0.000000	206.506790	251.431000	440.221832

28176 Jarvis - 20 YEAR - Peak Hour Pressures

		ID	Demand (L/s)	Elevation (m)	Head (m)	Pressure (kPa)
201	☐	60V0072-B	0.000000	206.475525	251.431442	440.532562
202	☐	60V0100-B	0.000000	206.467896	251.431442	440.607361
203	☐	60T0032	0.159695	206.390778	251.441376	441.460388
204	☐	60V0100	0.000000	206.381790	251.440399	441.538818
205	☐	TOWNSEND_01	47.999660	209.000015	254.097809	441.923035
206	☐	60V0101	0.000000	206.339981	251.441345	441.957794
207	☐	60T0107	0.266822	206.270767	251.441193	442.634583
208	☐	FUT4	1.145992	205.250000	251.416580	452.396088
209	☐	FUT94	0.615996	204.500000	251.429993	459.876953

28176 Jarvis - 20 YEAR - Maximum Day + Fire Flow

		ID	Total Demand (L/s)	Design Flow (L/s)	Design Pressure (kPa)	Design Fire Node Pressure (kPa)	Critical Node ID	Critical Node Pressure (kPa)	Critical Node Head (m)
1	☐	60D0019	89.999359	40.007126	137.862915	138.041077	60D0019	137.862915	223.895004
2	☐	60T0060	89.999359	44.298424	137.862915	138.037033	60T0060	137.862915	224.071777
3	☐	60D0020	89.999359	44.642319	137.862915	138.029907	60D0020	137.862915	223.008026
4	☐	FUT4	90.940353	45.172379	137.862915	138.040924	FUT4	137.862915	219.318787
5	☐	60D0002	89.999359	45.180470	137.862915	138.061050	60D0002	137.862915	224.068787
6	☐	60D0013	90.025429	50.112064	137.862915	137.843506	60D0013	137.862915	222.568787
7	☐	60T0059	89.999359	50.356541	137.862915	138.016403	60T0059	137.862915	223.261017
8	☐	60T0110	89.999359	50.361610	137.862915	149.925705	60DEPO01	125.777473	222.142822
9	☐	60CHAM01	89.999359	50.361622	137.862915	144.708923	60DEPO01	131.153168	222.691391
10	☐	60T0058	89.999359	55.304787	137.862915	145.687973	60T0060	130.176041	223.287338
11	☐	60V0072-B	89.999359	56.413589	137.862915	138.084427	60V0072-B	137.862930	220.544312
12	☐	60V0072	89.999359	56.584190	137.862915	138.083527	60V0072	137.862930	220.630020
13	☐	60D0006	89.999359	56.929203	137.862915	138.081131	60D0006	137.862930	220.575562
14	☐	60V0100-B	89.999359	57.183765	137.862915	138.993713	60V0072	136.948288	220.536682
15	☐	FUT94	90.410355	57.340260	137.862915	151.352539	60D0006	124.834267	219.246002
16	☐	60DEPO01	103.999260	57.501480	137.862915	137.902664	60DEPO01	137.862915	223.376114
17	☐	60V0004	89.999359	59.564060	137.862915	143.970627	60DEPO01	131.748734	222.752167
18	☐	60T0107	90.149445	60.507671	137.862915	138.018066	60T0107	137.862930	220.339539
19	☐	60V0100	89.999359	64.355782	137.862915	139.811630	60V0072	136.050858	220.445099
20	☐	60V0101	89.999359	64.542641	137.862915	137.995651	60V0101	137.862930	220.408768
21	☐	60T0032	90.089188	65.399239	137.862915	139.716171	60V0072	136.133041	220.453491
22	☐	60D0004	89.999359	68.711311	137.862915	137.944855	60D0004	137.862930	224.842026
23	☐	60D0016	90.294914	72.495415	137.862915	137.916290	60D0016	137.862930	227.082306
24	☐	60T0108	90.142830	72.587372	137.862915	137.920334	60T0108	137.862930	221.066055
25	☐	60V0066	89.999359	75.166801	137.862915	140.915482	60D0004	134.855103	224.535080
26	☐	60T0094	90.045273	75.494949	137.862915	137.890656	60T0094	137.862930	226.373260
27	☐	60V0052	89.999359	76.045670	137.862915	148.735977	60T0060	127.023041	222.965591
28	☐	60D0009	90.040138	76.450027	137.862915	137.891968	60D0009	137.862930	223.640137
29	☐	60T0002	90.190239	76.795242	137.862915	140.212204	60D0002	135.547989	223.832535
30	☐	60V0062	89.999359	77.194420	137.862915	137.895889	60V0062	137.862930	223.880539
31	☐	60T0006	90.151077	77.491966	137.862915	141.031616	60D0004	134.726974	224.522003
32	☐	60V0065	89.999359	77.829750	137.862915	138.042892	60D0004	137.715897	224.827011
33	☐	60T0116	90.109680	79.666039	137.862915	137.878693	60T0116	137.862930	225.568787
34	☐	60V0064	89.999359	79.796555	137.862915	137.885376	60V0064	137.862930	224.368896
35	☐	60D0021	90.096123	80.095802	137.862915	137.880569	60D0021	137.862930	222.998322

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		ID	Total Demand (L/s)	Design Flow (L/s)	Design Pressure (kPa)	Design Fire Node Pressure (kPa)	Critical Node ID	Critical Node Pressure (kPa)	Critical Node Head (m)
36	☐	60V0063	90.224876	80.161224	137.862915	137.883789	60V0063	137.862930	224.347275
37	☐	60V0074	89.999359	80.248581	137.862915	137.884476	60V0074	137.862930	221.068771
38	☐	60T0004	89.999359	80.323257	137.862915	137.882996	60T0004	137.862930	224.326080
39	☐	60T0115	90.095131	80.604652	137.862915	137.876938	60T0115	137.862930	226.002731
40	☐	60V0073	89.999359	80.884743	137.862915	137.881348	60V0073	137.862930	221.068771
41	☐	60V0096	89.999359	81.013832	137.862915	137.880539	60V0096	137.862930	224.381454
42	☐	60D0007	90.048615	81.973923	137.862915	137.872208	60D0007	137.862930	224.068787
43	☐	60V0098	89.999359	82.142624	137.862915	137.876923	60V0098	137.862930	225.023163
44	☐	60V0095	89.999359	82.367569	137.862915	137.876160	60V0095	137.862930	224.542953
45	☐	60V0019	89.999359	82.458534	137.862915	137.874893	60V0019	137.862930	223.167313
46	☐	60T0009	90.155464	82.717140	137.862915	137.875397	60T0009	137.862930	225.056778
47	☐	60V0099	90.333435	82.979240	137.862915	137.874283	60V0099	137.862930	225.003632
48	☐	60T0010	90.225037	83.001877	137.862915	137.874268	60T0010	137.862930	224.460678
49	☐	60T0031	90.083626	84.156921	137.862915	137.886856	60V0074	137.846970	221.067139
50	☐	60T0114	90.083321	84.574997	137.862915	137.867950	60T0114	137.862930	226.068771
51	☐	60T0087	90.029846	86.350487	137.862915	137.864700	60T0087	137.862930	222.292450
52	☐	60V0097	89.999359	87.524796	137.862915	137.864334	60V0097	137.862930	222.791931
53	☐	60T0013	90.217529	88.293098	137.862915	140.697800	60V0019	135.052200	222.880478
54	☐	60T0117	90.117126	89.131302	137.862915	137.476837	60T0117	137.862930	225.568787
55	☐	60V0044	89.999359	89.257431	137.862915	137.562912	60V0044	137.862930	226.068771
56	☐	60T0073	90.147316	89.594284	137.862915	137.643021	60T0073	137.862930	226.068771
57	☐	FUT98	90.365608	89.751289	137.862915	137.597198	FUT98	137.862930	224.826172
58	☐	60V0087	90.149391	91.644722	137.862915	137.863419	60V0087	137.862930	224.243301
59	☐	60V0045	90.218658	92.134079	137.862915	137.863617	60V0045	137.862930	225.719635
60	☐	60V0042	89.999359	92.167175	137.862915	137.863647	60T0114	137.862854	226.068771
61	☐	60T0052	90.557991	93.064774	137.862915	146.163315	60DEPO01	129.566101	222.529434
62	☐	60V0043	89.999359	94.379562	137.862915	137.866577	60V0043	137.862946	226.068787
63	☐	60T0071	90.111588	95.730606	137.862915	138.411285	60T0114	137.320480	226.013428
64	☐	60V0017	89.999359	96.020317	137.862915	157.606796	60D0016	118.128357	225.068420
65	☐	60V0020	89.999359	97.382408	137.862915	137.875992	60V0020	137.862946	224.106903
66	☐	60T0017	90.164482	97.671944	137.862915	158.360458	60D0016	117.379547	224.992004
67	☐	60V0016	89.999359	98.754585	137.862915	144.680573	60D0016	131.459747	226.428879
68	☐	FUT34	90.625610	99.492355	137.862915	137.880081	FUT34	137.862946	223.199921
69	☐	60V0046	90.049156	99.734024	137.862915	137.881042	60V0046	137.862946	225.568787
70	☐	60T0014	90.126556	99.941452	137.862915	137.886276	60T0014	137.862946	224.111588

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		ID	Total Demand (L/s)	Design Flow (L/s)	Design Pressure (kPa)	Design Fire Node Pressure (kPa)	Critical Node ID	Critical Node Pressure (kPa)	Critical Node Head (m)
71	☐	60V0039	89.999359	100.580551	137.862915	142.785004	60T0116	132.962906	225.068741
72	☐	60V0076	89.999359	101.339363	137.862915	137.885132	60V0076	137.862946	223.416489
73	☐	60T0066	89.999359	101.541641	137.862915	137.890121	60T0117	137.862701	225.568771
74	☐	60T0090	90.120712	101.624626	137.862915	137.885178	60T0090	137.862946	223.541656
75	☐	60V0071	89.999359	102.167435	137.862915	137.899719	60V0071	137.862946	221.068771
76	☐	60T0029	90.131538	102.431938	137.862915	137.984833	60V0074	137.778198	221.060135
77	☐	60V0070	89.999359	102.580215	137.862915	137.903046	60V0070	137.862946	221.068771
78	☐	60V0102	89.999359	102.598228	137.862915	137.901352	60V0102	137.862946	221.019455
79	☐	60V0077	90.089363	102.695122	137.862915	137.888809	60V0077	137.862946	221.885193
80	☐	60T0038	90.136047	102.813065	137.862915	150.861786	60D0009	124.900017	222.317276
81	☐	60T0027	89.999359	102.845184	137.862915	137.902863	60T0027	137.862946	221.053787
82	☐	60T0015	89.999359	103.635994	137.862915	137.907944	60T0015	137.862946	223.326218
83	☐	60V0029	90.275513	104.089729	137.862915	137.875137	60V0029	137.862946	226.860779
84	☐	60V0107	89.999359	104.553154	137.862915	137.912323	60V0107	137.862946	222.568787
85	☐	60V0104	89.999359	104.554138	137.862915	137.898972	60V0104	137.862946	222.068771
86	☐	60T0088	90.082909	104.841904	137.862915	140.091827	60T0087	135.671188	222.068771
87	☐	60T0021	90.088715	104.939285	137.862915	137.913361	60T0021	137.862946	222.568787
88	☐	60V0032	89.999359	105.934959	137.862915	137.907089	60V0032	137.862946	222.068771
89	☐	60V0091	89.999359	106.371506	137.862915	162.282318	60T0094	113.496529	223.886688
90	☐	60V0081	89.999359	106.534821	137.862915	137.917465	60V0081	137.862946	224.108246
91	☐	60T0085	90.132538	110.214943	137.862915	139.383118	60V0081	136.423630	223.961365
92	☐	60V0082	89.999359	111.080643	137.862915	137.954834	60V0082	137.862961	223.936478
93	☐	60V0014	89.999359	111.122536	137.862915	170.462158	60D0016	105.883408	223.818848
94	☐	60V0018	89.999359	111.520142	137.862915	137.981735	60V0018	137.862961	222.927994
95	☐	60T0044	90.858246	111.659233	137.862915	148.713379	60T0060	127.114265	222.974899
96	☐	60T0091	90.100121	111.663803	137.862915	163.414063	60T0094	112.406799	223.775482
97	☐	60V0105	89.999359	111.768433	137.862915	151.081238	60T0009	125.283272	223.773026
98	☐	60T0068	90.168419	111.882103	137.862915	142.864166	60T0116	132.962769	225.068726
99	☐	60V0092	89.999359	111.973930	137.862915	155.090668	60T0094	121.300934	224.683121
100	☐	60V0089	89.999359	112.195351	137.862915	157.856003	60T0094	118.552582	224.402664
101	☐	60V0106	89.999359	112.340607	137.862915	143.152359	60T0009	133.101608	224.570892
102	☐	60V0090	89.999359	112.549309	137.862915	160.347595	60T0094	115.801361	224.121887
103	☐	60T0016	90.080597	113.577446	137.862915	155.456497	60T0009	120.888458	223.324554
104	☐	60V0049	90.117065	115.036110	137.862915	137.976730	60V0049	137.862961	222.013077
105	☐	60V0030	90.035599	115.341118	137.862915	137.898056	60V0030	137.862961	228.568787

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		ID	Total Demand (L/s)	Design Flow (L/s)	Design Pressure (kPa)	Design Fire Node Pressure (kPa)	Critical Node ID	Critical Node Pressure (kPa)	Critical Node Head (m)
106	☐	60V0015	89.999359	116.182213	137.862915	167.971069	60D0016	108.933266	224.130081
107	☐	60V0013-B	90.000053	116.327026	137.862915	175.325714	60D0016	100.636284	223.283371
108	☐	60V0012	89.999359	116.940720	137.862915	171.894012	60D0016	104.721840	223.700302
109	☐	60V0013	90.248230	117.042084	137.862915	174.171844	60D0016	102.018555	223.424423
110	☐	60V0034	90.083656	117.735367	137.862915	138.006378	60V0034	137.862961	222.947495
111	☐	60T0112	89.999359	117.848923	137.862915	138.010254	60T0112	137.862961	221.532242
112	☐	FUT96	90.365608	118.305473	137.862915	142.121643	FUT98	133.821198	224.413712
113	☐	60V0041	89.999359	118.443504	137.862915	138.040466	60V0041	137.862961	225.014008
114	☐	60T0069	90.036224	118.792534	137.862915	138.034592	60T0069	137.862961	225.019623
115	☐	60V0011	89.999359	120.152191	137.862915	144.492050	60D0016	132.258179	226.510361
116	☐	60V0040	89.999359	120.335396	137.862915	138.066238	60V0040	137.862961	224.995193
117	☐	60T0023	90.109962	120.799179	137.862915	157.283310	60D0016	119.973106	225.256668
118	☐	60T0118	90.150459	121.013115	137.862915	138.070740	60T0118	137.862961	224.981232
119	☐	60V0085	89.999359	122.118317	137.862915	160.202667	60T0094	118.074509	224.353867
120	☐	60V0086	89.999359	122.301064	137.862915	157.118103	60T0094	121.018471	224.654297
121	☐	60V0078	89.999359	122.356827	137.862915	138.107498	60V0078	137.862976	221.068771
122	☐	60T0083	90.142807	122.908783	137.862915	164.549606	60T0094	113.799011	223.917557
123	☐	60V0031	89.999359	123.247559	137.862915	157.298096	60T0094	120.918251	224.644058
124	☐	FUT138	90.165611	123.271553	137.862915	138.180069	FUT138	137.862976	223.468781
125	☐	60V0084	89.999359	123.401505	137.862915	161.013367	60T0094	117.390068	224.284027
126	☐	FUT26	90.036873	124.753479	137.862915	138.112778	FUT26	137.862976	224.573120
127	☐	60T0050	89.999359	125.705315	137.862915	137.864838	60T0050	137.862976	224.737045
128	☐	60T0049	89.999359	125.975914	137.862915	138.030273	60T0050	137.697449	224.720154
129	☐	FUT30	90.042511	125.983063	137.862915	143.276825	60DEPO01	132.451645	222.823914
130	☐	60V0005	89.999359	126.157784	137.862915	137.865067	60V0005	137.862976	224.651276
131	☐	60V0069	89.999359	126.196709	137.862915	138.233459	60V0069	137.862976	222.087860
132	☐	FUT100	89.999359	126.892563	137.862915	139.246552	FUT98	136.950409	224.733032
133	☐	60V0006	90.671356	126.974236	137.862915	137.864792	60V0006	137.862976	224.568787
134	☐	60V0093	89.999359	127.040993	137.862915	156.319489	60D0016	121.461296	225.408554
135	☐	60V0027	89.999359	127.280647	137.862915	143.445740	60T0094	132.919052	225.868729
136	☐	FUT92	89.999359	127.334038	137.862915	137.865372	FUT92	137.862976	224.568787
137	☐	60T0024	90.196899	128.255859	137.862915	160.222565	60D0016	118.046684	225.060089
138	☐	60V0033	89.999359	129.032974	137.862915	138.164322	60V0033	137.862976	224.676239
139	☐	60V0023	89.999359	129.190186	137.862915	138.240829	60V0023	137.862976	222.682007
140	☐	60V0026	89.999359	129.206543	137.862915	143.285446	60T0094	133.122757	225.889526

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		ID	Total Demand (L/s)	Design Flow (L/s)	Design Pressure (kPa)	Design Fire Node Pressure (kPa)	Critical Node ID	Critical Node Pressure (kPa)	Critical Node Head (m)
141		60V0036	90.145325	129.324738	137.862915	138.322784	60V0036	137.862976	223.473373
142		60T0096	90.321144	129.553268	137.862915	146.135895	60T0094	130.308060	225.602295
143		60V0021	89.999359	129.738647	137.862915	158.443848	60D0016	119.255104	225.183411
144		FUT22	90.081543	129.824371	137.862915	137.864700	FUT22	137.862976	224.999573
145		60V0024	89.999359	129.868729	137.862915	154.224136	60T0094	123.810562	224.939224
146		60V0009	89.999359	130.368118	137.862915	165.674118	60D0016	113.423996	224.588333
147		60V0025	89.999359	130.493317	137.862915	156.566895	60T0094	121.566780	224.710251
148		60V0022	89.999359	130.683228	137.862915	153.460678	60D0016	124.073334	225.675110
149		60T0036	90.331573	130.807419	137.862915	159.561325	60D0016	118.275246	225.083420
150		60T0081	90.261124	130.813248	137.862915	158.877945	60T0094	119.373337	224.486404
151		60T0077	90.242722	130.859863	137.862915	138.178360	60T0077	137.862976	224.660721
152		60V0051	89.999359	131.071487	137.862915	143.213043	60D0016	133.588028	226.646057
153		60T0025	90.172752	131.242584	137.862915	171.254944	60D0016	108.297935	224.065231
154		60T0026	89.999359	131.406036	137.862915	169.452057	60D0016	110.131569	224.252365
155		60T0080	90.087669	131.469559	137.862915	138.192429	60T0080	137.862976	223.715012
156		60V0010	89.999359	132.147385	137.862915	155.854172	60D0016	122.916122	225.557007
157		60V0103	89.999359	132.600784	137.862915	138.232330	60V0103	137.862976	224.622955
158		60V0047	90.117874	133.158813	137.862915	138.310593	60V0047	137.862976	225.185135
159		60V0079	89.999359	133.480057	137.862915	138.346024	60V0079	137.862976	221.262909
160		60V0035	89.999359	133.687683	137.862915	138.362366	60V0035	137.862976	221.783997
161		60T0045	89.999359	136.023941	137.862915	142.735123	FUT98	133.234909	224.353882
162		60V0080	89.999359	136.149017	137.862915	137.864532	60V0080	137.862976	221.361099
163		60T0040	89.999359	137.668564	137.862915	138.336380	60V0035	137.393295	221.736069
164		FUT24	90.349754	138.232681	137.862915	137.864624	FUT24	137.862976	226.201172
165		60T0039	90.117874	138.509521	137.862915	137.864777	60T0039	137.862976	221.528671
166		60V0037	90.089790	139.336105	137.862915	137.865997	60V0037	137.862976	225.068771
167		60V0038	90.191330	139.682465	137.862915	137.865524	60V0038	137.862976	225.068771
168		60V0056	89.999359	140.528168	137.862915	137.866562	60V0056	137.862976	223.038666
169		60T0047	90.148582	140.997772	137.862915	137.866455	60T0047	137.862976	223.043442
170		60T0065	89.999359	142.694199	137.862915	137.865265	60T0065	137.862976	225.088974
171		60V0048	89.999359	143.344849	137.862915	137.865646	60V0048	137.862976	225.068771
172		FUT20	90.080421	143.927185	137.862915	141.526154	FUT22	134.203934	224.626160
173		60T0063	90.074867	147.540176	137.862915	137.867599	60T0063	137.862991	225.068771
174		FUT18	90.043243	147.724533	137.862915	137.866989	FUT18	137.862991	224.317139
175		FUT28	90.083679	147.920624	137.862915	143.732895	60DEPO01	132.220901	222.800354

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		ID	Total Demand (L/s)	Design Flow (L/s)	Design Pressure (kPa)	Design Fire Node Pressure (kPa)	Critical Node ID	Critical Node Pressure (kPa)	Critical Node Head (m)
176	☐	FUT14	90.001633	150.066940	137.862915	137.866989	FUT14	137.862991	225.128189
177	☐	FUT10	90.349754	152.507370	137.862915	137.866638	FUT10	137.862991	226.720825
178	☐	FUT12	90.349754	152.802658	137.862915	137.866730	FUT12	137.862991	226.568771
179	☐	60D0008	89.999359	156.692078	137.862915	137.867889	60D0008	137.863007	224.264038
180	☐	J10	90.013931	159.313385	137.862915	137.868713	J10	137.863007	224.878311
181	☐	FUT6	90.349754	164.944748	137.862915	137.870132	FUT6	137.863007	225.690140
182	☐	FUT74	90.878357	173.281158	137.862915	137.865005	FUT74	137.863022	227.818787
183	☐	FUT8	90.349754	174.803253	137.862915	141.280106	FUT10	134.495605	226.377182
184	☐	60V0028	89.999359	175.556870	137.862915	137.866745	60V0028	137.863022	225.162598
185	☐	60V0008	89.999359	187.309586	137.862915	137.865158	60V0008	137.863037	229.568802
186	☐	85CHAM01	89.999359	189.170105	137.862915	137.869049	85CHAM01	137.863037	225.123474
187	☐	60T0098	90.226692	190.216949	137.862915	137.868973	60T0098	137.863037	225.258789
188	☐	60T0113	89.999359	208.564667	137.862915	137.876785	60T0113	137.863068	225.191742
189	☐	60T0104	89.999359	211.659500	137.862915	137.866806	60T0104	137.863068	229.634109
190	☐	60V0060	89.999359	213.699860	137.862915	137.867142	60V0060	137.863083	229.714645
191	☐	FUT56	90.878357	214.305847	137.862915	138.527435	FUT10	137.240356	226.657288
192	☐	60T0097	89.999359	217.128799	137.862915	146.967331	60D0016	129.441330	226.222900
193	☐	60V0068	89.999359	221.077118	137.862915	137.870316	60V0068	137.863098	229.068787
194	☐	60T0101	90.016136	221.898056	137.862915	137.871201	60T0101	137.863098	229.568802
195	☐	60V0067	89.999359	236.223953	137.862915	137.877228	60V0067	137.863113	229.568802
196	☐	60V0007	89.999359	239.605957	137.862915	155.986603	60D0016	120.097435	225.269363
197	☐	FUT116	91.559349	251.094406	137.862915	147.109619	60D0016	128.656052	226.142761
198	☐	65WBS01	124.499115	261.969879	137.862915	137.884308	65WBS01	137.863113	223.068802
199	☐	FUT118	89.999359	262.433807	137.862915	137.899689	FUT118	137.863159	228.568802
200	☐	60V0050	89.999359	264.130463	137.862915	137.881653	60V0050	137.863159	230.553284
201	☐	60T0102	89.999359	264.725403	137.862915	137.899307	60T0102	137.863174	229.568802
202	☐	60V0030-B	89.999359	273.510315	137.862915	137.900467	60V0030-B	137.863190	231.568802
203	☐	60V0108	89.999359	280.523041	137.862915	141.100006	60V0050	134.659683	230.226364
204	☐	60V0108-B	89.999359	285.728546	137.862915	143.546768	60V0030-B	132.213165	230.992233

Appendix B

Wastewater Model Parameters

Appendix B – PCSWMM Model Parameters

The following sets out a description of each of the parameters used in the steady state wastewater conveyance system modelling for the Jarvis Master Plan. Any differences from the below at any of the specific elements are noted in the description in the model. The PCSWMM model has been based on the previous H2OMAP modelling completed for the 2010 Master Plan.

A1.0 Link Elements

A1.1 Conduits

Conduits represent sanitary sewers.

Parameter	Units	Description / Values
Name	-	Conduits taken from the 2010 Master Plan maintain the same name which appears to be linked to one of the connecting nodes. New conduits are named based on the supplied GIS data.
Inlet Node	-	Upstream node of the link element.
Outlet Node	-	Downstream node of the link element.
Tag	-	No tags were used in the model.
Length	m	Length is auto-calculated in PCSWMM and is consistent with the 2010 Master Plan except for new links.
Roughness	-	For links from the 2010 Master Plan the roughness coefficient is maintained. For new sections a roughness coefficient of 0.013 is used.
Inlet Offset	m	Inlet elevation of the conduit element. Consistent with the 2010 Master Plan or the supplied GIS data for new links.
Outlet Offset	m	Outlet elevation of the conduit element. Consistent with the 2010 Master Plan or the supplied GIS data for new links.
Initial Flow	m^3/s	No initial flows are set in the model
Flow Limit	m^3/s	No flow limits are set in the model
Entry Loss Coeff.	-	No losses are used in a steady state conveyance model.

Parameter	Units	Description / Values
Exit Loss Coeff.	-	No losses are used in a steady state conveyance model.
Ave. Loss Coeff.	-	No losses are used in a steady state conveyance model.
Seepage Rate	mm/hr	There is no seepage applied to conduits in this model.
Flap Gate	-	No flapgates are used in the model.
Cross Section	-	Cross sections are generally circular for sewers, rectangular for streets, trapezoidal for open channel flow and either circular, elliptical or rectangular for cuvlerts. Cross sections are consistent with the 2010 Master Plan.
Geom1	m	**Type** / **Description** Circular: Pipe diameter Ellipse: Maximum Depth or Standard Size ID
Geom2	m	**Type** / **Description** Circular: Not used Ellipse: Maximum Width or not used
Barrels	-	The number of identical sewers within the conduit, usually 1.
Transect	-	Refers to transect data, if used, for the open channel links.
Shape Curve	-	Not used in this model.
Culvert Code	-	Not used in this model.

A2.0 Node elements

A2.1 Storage

Storage nodes are used to represent manholes in the system.

Parameter	Units	Description / Values
Name	-	Naming is as per 2010 Master Plan.
Tag	-	No tags were used.

Parameter	Units	Description / Values
Inflows	-	Sanitary sewer flows are included as inflows as per Section A2.3.
Treatment	-	No treatment is modelled
Invert Elevation	m	Invert elevations are taken from the 2010 Master Plan except new nodes where it is based on GIS data.
Rim Elevation	m	Elevation at the lid of the node taken from the 2010 Master Plan except new nodes where it is based on GIS data..
Depth	m	The depth is internally calculated in PCSWMM as the difference between the invert and rim elevations.
Initial Depth	m	Initial depths are used if there is backwater in the system at the start of the simulation. It is not used here.
Ponded Area	m^2	No ponded areas are set in the model.
Evaporation Factor	fraction	No evaporation is considered in design event analysis.
Storage Curve	-	Manholes have an assumed storage of 1.13 m^2 representing a 1200 mm diameter manhole.

A2.2 Outfalls

A single outfall is present in the model at the pump station location. Since only a steady state analysis is being carried out the downstream boundary condition does not impact results.

Parameter	Units	Description / Values
Name	-	Outfalls are named as per the 2010 Master Plan.
Tag	-	No tags were used for the outfalls.
Inflows	-	No external inflows are applied at outfall nodes
Treatment	-	No treatment is modelled
Invert Elevation	m	Invert elevation of the node is as per the 2010 Master Plan.

Parameter	Units	Description / Values
Rim Elevation	m	Elevation at the lid of the node as per the 2010 Master Plan.
Tide Gate	-	No backflow is prevented in the model outfalls and therefore 'No' is selected.
Route To	-	If flow from the outfall is directed to another subcatchment but this is not done in the model and this parameter is left blank.
Type	-	All outfalls have NORMAL outfall type which means depth of flow at the outlet is not affected by downstream conditions.

A2.3 Inflows

Parameter	Units	Description / Values
Baseline	m^3/s	For direct flow into a drainage system, not used in the model.
Baseline Pattern	-	For direct flow into a drainage system, not used in the model.
Timeseries	-	For direct flow into a drainage system, not used in the model.
Scale Factor	-	For direct flow into a drainage system, not used in the model.
Average Value	m^3/s	The average value represents the DWF into the system at the node. It consists of the base flow multiplied by the peaking factor and the infiltration component.
Time Patterns	-	Where no time patterns are applied to the average value the time value is 1.0.
Hydrograph	-	Used for wet weather flows and not included in the model.
Sewershed Area	ha	The sewershed areas contributing to the node.

Appendix C

Stormwater Model Parameters

Appendix A – PCSWMM Model Parameters

The following sets out a description of each of the parameters used in the dual drainage modelling for the Jarvis Master Plan. Any differences from the below at any of the specific elements are noted in the description in the model. The PCSWMM model has been based on the previous Infoworks CS modelling completed for the 2010 Master Plan.

A1.0 Subcatchments

Parameter	Units	Description
Name	-	The name of the subcatchment as per the 2010 Master Plan and is based on the receiving node ID. New areas have a name based on the downstream receiving node ID.
Tag	-	The catchments are tagged by one of the land use covers identified in the 2010 Master Plan. The catchments representing the most recent development occurred in 2010 were tagged as 'Recent_Development'. The catchments representing the future development that will occur by 2020 were tagged as 'Future_Development'.
Rain Gauge	-	The storm type selected for the model run. The following IDF parameters, as per the 2010 Master Plan, were used to create the 3-hour Chicago design storms: **Return Period** / **a** / **b** / **c** / **Depth (mm)** 1:2 year / 646.0 / 6.0 / 0.781 / 32.6 1:5 year / 1,049.5 / 8.0 / 0.803 / 47.0 1:100 year / 2,317.4 / 11.0 / 0.836 / 86.1
Outlet	-	The subcatchment runoff receiving node which is the same location as per the 2010 Master Plan. New areas have been allocated to the lowest elevation major system node in the catchment.
Area	ha	The area is calculated internally by PCSWMM through GIS and is the same as the 2010 Master Plan value used.

Parameter	Units	Description
Width / Flow Length	m	The width parameter has been taken from the 2010 Master Plan where the catchment has remained unchanged from 2010. For the regular shaped new subcatchments the width parameter has been calculated as the length perpendicular to overland flow direction within subcatchment. The width parameter of any new irregular shaped subcatchment are calculated to take in the account for skew within the subcatchment using the approach proposed by Guo and Urbonas (2007) (refer to EPA Storm Water Management Model Reference Manual Vol I – Hydrology (EPA, 2016)).
Slope	%	Slopes are from the 2010 Master Plan except where noted in the comments. Some subcatchments had 0 slope in 2010 and a shallow slope of 0.2 has been used in the PCSWMM model to obtain similar peak flows as 2010. Three of the large agricultural subcatchments, noted in the model descriptions, have had slopes altered to provide similar flows to the 2010 model.
Imperv	%	For subcatchments from the 2010 Master Plan the Imperv is the directly and indirectly connected imperviousness used in the model. For new areas this value has been calculated based on impervious land cover. **Land Cover** — **IMP %** Agricultural — 8 EXTERNAL W/ SOME URBAN — 13 ICI - Heavy Clay — 94 Mixed LD RES with Commercial. — 40 Open Spaces — 8 Residential - LD Cul-Sac — 67 Residential - LD Heavy Clay — 70 School — 64
N Imperv	-	A constant of 0.013 is selected as the Manning's N for impervious surfaces such as roads, sidewalk and parking areas. The value is representative of smooth impervious surface as per Table 3-5 of the EPA Storm Water Management Model Reference Manual Vol I – Hydrology (EPA, 2016).
N Perv	-	A constant of 0.25 is used as the Manning's N for pervious areas. The value is representative of light to tense turf land cover as per Table 3-5 of the EPA Storm Water Management Model Reference Manual Vol I – Hydrology (EPA, 2016).

<table>
<tr><th>Parameter</th><th>Units</th><th>Description</th></tr>
<tr><td>DStore Imperv</td><td>mm</td><td>A standard value of 1.57 mm is used as the impervious depression storage.</td></tr>
<tr><td>DStore Perv</td><td>mm</td><td>The pervious depression storage is linked to the Curve Number (CN) and Soil Storage (S) using the following relationship:

CN | DStore Perv
≤ 70 | 0.075*S
> 70 ≤ 80 | 0.10*S
> 80 ≤ 90 | 0.155*S
> 90 | 0.2*S

Note: $S = \frac{25400}{CN} - 254$</td></tr>
<tr><td>Zero Imperv</td><td>%</td><td>Across areas of water it is considered that there is no depression storage. This value has been set to 0.</td></tr>
<tr><td>Subarea Routing</td><td>-</td><td>For subcatchments in the 2010 Master Plan the subrouting is either to PERVIOUS or IMPERVIOUS in accordance with the pervious model. The value is the receiving subarea of flow from other subareas in the catchment.

For new subcatchments the constant ‘PERVIOUS’ is entered to simulate the subarea of impervious surface which may flow over pervious areas prior to discharging to the outlet of the subcatchment.</td></tr>
<tr><td>Percent Routed</td><td>%</td><td>The percent of routed subarea is taken from the 2010 Master Plan for each catchment. For new subcatchments this is estimated based on direction of runoff from impervious areas in the new development areas.

Land Cover | %IMP to PERVIOUS | % PERV. to IMP
Agricultural | 62.5 | 0
EXTERNAL W/ SOME URBAN | 0 | 17.2
ICI - Heavy Clay | 0 | 100
Mixed LD RES with Commercial. | 15 | 0
Open Spaces | 75 | 0
Residential - LD Cul-Sac | 15 | 0
Residential - LD Heavy Clay | 6 | 0
School | 0 | 100</td></tr>
</table>

Parameter	Units	Description
CN Value	-	The following CN values have been used based on the soil type from the OMAFRA mapping and the land cover. The OMAFRA mapping indicated that soils of hydrologic soil group C and D are prevalent in the area. In the urban areas a soil class D was assumed. **Land Cover** / **C CN Value** / **D CN Value** Agricultural: 79 / 84 EXTERNAL W/ SOME URBAN: 79 / 84 ICI - Heavy Clay: 76 / 81 Mixed LD RES with Commercial.: 71 / 78 Open Spaces: 71 / 78 Residential - LD Cul-Sac: 71 / 78 Residential - LD Heavy Clay: 71 / 78 School: 71 / 78 The CN value was area weighted based on the percentage of soil class in the subcatchment. A modified CN value (CN*) was calculated for each subcatchment to account for the difference in initial abstraction from the standard value of 0.2S.
Drying Time	days	The time for a fully saturated soil to completely dry is set at 7 days though this is not used in design event analysis.

The parameters Curb Length, Snow Pack, LID Controls, Groundwater and Erosion are not used in the model.

A2.0 Link Elements

A2.1 Conduits

Conduits represent either open channels or culverts.

Parameter	Units	Description / Values
Name	-	Conduits taken from the 2010 Master Plan maintain the same name which appears to be linked to one of the connecting nodes. New conduits are named based on the supplied GIS data.
Inlet Node	-	Upstream node of the link element.
Outlet Node	-	Downstream node of the link element.

Parameter	Units	Description / Values
Tag	-	Conduits are tagged as follows which is consistent with the type in the 2010 Master Plan model: **Tag** — **Description** Storm_Sewer — Underground piped infrastructure FUT_Storm_Sewer — Underground piped infrastructure of future development Street — Flow through streets Culvert — Piped flow with open channel flow either side SWMF_Outlet — Outlet Pipe from Stormwater Management Facility (SWMF) Overland — Open channel flow
Length	m	Length is auto-calculated in PCSWMM and is consistent with the 2010 Master Plan except for new links.
Roughness	-	For links from the 2010 Master Plan the roughness coefficient is maintained. For new sections the roughness coefficient of 0.013 is used for all sewer and culverts links. For channels the roughness coefficient of 0.035 is used for the channel.
Inlet Offset	m	Inlet elevation of the conduit element. Consistent with the 2010 Master Plan or the supplied GIS data for new links.
Outlet Offset	m	Outlet elevation of the conduit element. Consistent with the 2010 Master Plan or the supplied GIS data for new links.
Initial Flow	m^3/s	No initial flows are set in the model
Flow Limit	m^3/s	No flow limits are set in the model
Entry Loss Coeff.	-	Culvert entry losses are dependent on the type of inlet used and are consistent with the 2010 Master Plan.

Parameter	Units	Description / Values
Exit Loss Coeff.	-	Exit loss coefficients are applied to culverts to simulate the losses to open channel flow and are consistent with the losses applied in the 2010 Master Plan. Sewer losses are dependent on the change in direction of flow **Angle (deg)** **Loss Coef.** 0 0.02 10 0.045 20 0.118 30 0.21 40 0.325 50 0.46 60 0.635 70 0.84 80 1.065 90 1.32 No losses are applied to overland or street flow.
Ave. Loss Coeff.	-	The average loss coefficient is not used in this model.
Seepage Rate	mm/hr	There is no seepage applied to conduits in this model.
Flap Gate	-	No flapgates are used in the model.
Cross Section	-	Cross sections are generally circular for sewers, rectangular for streets, trapezoidal for open channel flow and either circular, elliptical or rectangular for cuvlerts. Cross sections are consistent with the 2010 Master Plan.
Geom1	m	**Type** **Description** Circular Pipe diameter Rectangular Maximum Depth Trapezoidal Maximum Depth Ellipse Maximum Depth or Standard Size ID
Geom2	m	**Type** **Description** Circular Not used Rectangular Bottom Width Trapezoidal Bottom Width Ellipse Maximum Width or not used

Parameter	Units	Description / Values
Geom3	m/m	**Type** / **Description** Circular: Not used Rectangular: Not used Trapezoidal: Left slope Ellipse: Not used
Geom4	m/m	**Type** / **Description** Circular: Not used Rectangular: Not used Trapezoidal: Right slope Ellipse: Not used
Barrels	-	The number of identical sewers within the conduit, usually 1.
Transect	-	Refers to transect data, if used, for the open channel links.
Shape Curve	-	Not used in this model
Culvert Code	-	The culvert code is used for culvert inlet links to ensure that the model treats the link as a culvert opening. Culvert codes have been selected to maintain consistency with the culvert coefficients used in the 2010 Master Plan.

A2.2 Weirs

Weirs have been used to carry overland flow through urban flow routes and across roads where culverts are overtopped. They are consistent in location with the 2010 Master Plan.

Parameter	Units	Description / Values
Name	-	Weirs maintain the same name as per the 2010 Master Plan which appears to be linked to one of the connecting nodes.
Inlet Node	-	Upstream node of the link element.
Outlet Node	-	Downstream node of the link element.
Tag	-	No tags used.
Type	-	All weirs links are transverse weirs where a rectangular cross section is perpendicular to the direction of flow.

Parameter	Units	Description / Values
Height	m	Maximum height of weir flow, consistent with Rim Elevation of the Inlet Node.
Length	m	Opening width of the weir.
Side Slope	m/m	Not used for rectangular transverse weirs
Inlet Elevation	m	Elevation of the crest of the weir.
Discharge Coefficient	-	Standard value of 0.85 in SI units used to represent a broad crested weir structure.
Flap Gate	-	No flap gates are applied.
End Contractions	-	Not used as consistent with the 2010 Master Plan.
End Coefficient	m^3/s	Not used as consistent with the 2010 Master Plan.
Can surcharge	-	Weirs have not been allowed to surcharge in order to represent free flow conditions in open channel flow.

A2.3 Outlets

These have been added in the model from the 2010 Master Plan. In Infoworks CS the major and minor system can be connected at the same node. In SWMM models the major and minor system must have separate nodes and be connected via an outlet link which represents catchbasin or multiple catchbasin inflows. The flows into the minor system are therefore under greater control in the updated SWMM model and may affect the behaviour of the system.

Parameter	Units	Description / Values
Name	-	Naming is based on the inlet node.
Inlet Node	-	Inlet node of the outlet link (the major system).
Outlet Node	-	Receiving node of the outlet link (minor system).
Tag	-	No tags used.
Inlet Elevation	m	The inlet elevation is set as the invert of the major system node.

Parameter	Units	Description / Values
Flap Gate	-	No flapgate restrictions are set so that backflow from the minor system into the major is allowed.
Rating Curve	-	All rating curves are set as TABULAR/HEAD in order that the minor system HGL affects the inlet capacity of the system. The curves are created using the inlet rating curve of a standard catchbasin grate and/or 600mm x 600mm ditch inlet grate. The curve data contains the number of catchbasins and ditch inlets lumped in each rating curve.

Head above grate (m)	Catchbasin Inlet Capacity (m^3/s)	Ditch Inlet Capacity (m^3/s)
0	0	0
0.01	0.002	0.012
0.015	0.002	0.013
0.021	0.003	0.016
0.03	0.005	0.018
0.04	0.006	0.023
0.05	0.008	0.027
0.054	0.010	0.028
0.06	0.013	0.03
0.08	0.022	0.04
0.09	0.034	0.045
0.1	0.048	0.053
0.104	0.052	0.054
0.11	0.06	0.06
0.14	0.08	0.081
0.15	0.085	0.09
0.16	0.09	0.099
0.17	0.095	0.105
0.2	0.097	0.12
0.3	0.1	0.237
1	0.1	0.9

Rating curve for 1200mm x 600mm ditch inlet representing the outlet structure at JM_Pond_2 was obtained for as-built information (DWG: 0674-SWM2 - Phase 2 Development-Upper Canada Consultants) and Chart 4.20 ‘Ditch Inlet Capacity’ from MTO Drainage Manual:

Head above grate (m)	Ditch Inlet Capacity (m^3/s)
0	0.0000
0.02	0.0216
0.06	0.0540

Parameter	Units	Description / Values
		0.1 0.1080 0.2 0.3360 0.3 0.7200 0.4 1.3200 0.5 2.0400
Curve Name	-	The name of the lumped curve used for the outlet link.

A3.0 Node elements

A3.1 Junctions

Junctions are used to connect the links and have no hydraulic properties associated with them.

Parameter	Units	Description / Values
Name	-	Naming as per 2010 Master Plan or standard naming convention for new nodes.
Tag	-	No tags used for junction nodes.
Inflows	-	No additional inflows to the system are modelled.
Treatment	-	No treatment is modelled
Invert Elevation	m	Invert elevation of the node taken from 2010 Master Plan. For new nodes the invert elevation is based on grading for major system nodes.
Rim Elevation	m	Elevation at the top of the node based on the depth of the connecting links, generally taken from the 2010 Master Plan or updated for connectivity. New nodes it is set on the depth of the adjoining conduits.
Depth	m	The depth is internally calculated in PCSWMM as the difference between the invert and rim elevations.
Initial Depth	m	Initial depths are used if there is backwater in the system at the start of the simulation. It is not used in this model as there is no downstream backwater control.
Surcharge Depth	m	No surcharge depth is applied.

Parameter	Units	Description / Values
Ponded Area	m^2	No ponded areas are set in the model.

A3.2 Storage

Storage nodes are used to represent manholes in the system, sag storage in the surface along street sections or natural/man-made storage facilities.

Parameter	Units	Description / Values
Name	-	Naming is as per 2010 Master Plan except the major and minor nodes have been separated so the minor system storage nodes have an STM- prefix.
Tag	-	Minor system manholes are tagged.
Inflows	-	No additional inflows to the system are modelled.
Treatment	-	No treatment is modelled
Invert Elevation	m	Invert elevations are taken from the 2010 Master Plan except new nodes where it is based on GIS data or surface topography.
Rim Elevation	m	Elevation at the top of the node based on the depth of the connecting links. Taken from the 2010 Master Plan but updated at some locations to maintain connectivity.
Depth	m	The depth is internally calculated in PCSWMM as the difference between the invert and rim elevations.
Initial Depth	m	Initial depths are used if there is backwater in the system at the start of the simulation. It is not used here.
Ponded Area	m^2	No ponded areas are set in the model.
Evaporation Factor	fraction	No evaporation is considered in design event analysis.

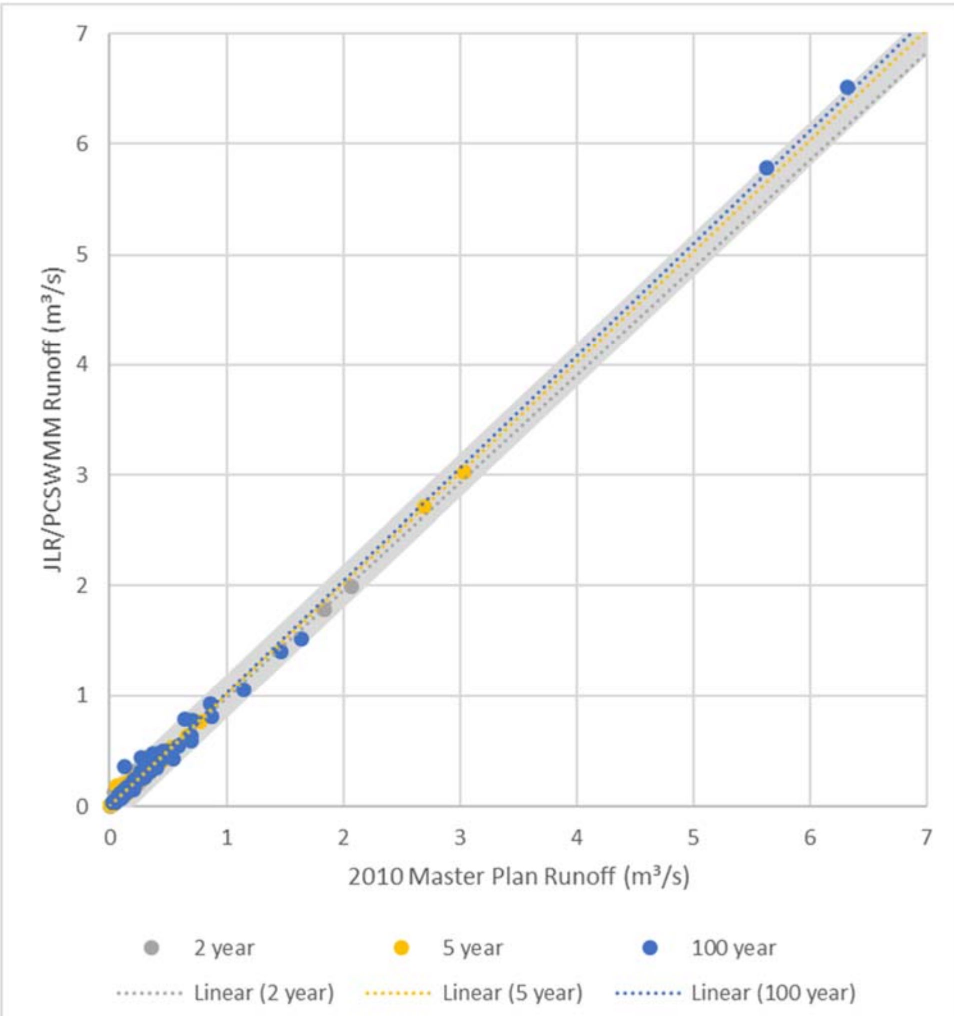
Parameter	Units	Description / Values
Storage Curve	-	For sag storage and manholes a FUNCTIONAL storage curve is selected where the constant value is the footprint of the storage. Manholes have an assumed storage of 1.13 m² representing a 1200 mm diameter manhole. Sag storage has a constant of 10m² as per the 2010 Master Plan. New areas use similar values. For natural or man-made storage facilities such as SWM facilities the storage curve is TABULAR and the curve is based on the area – depth relationship of the facility.

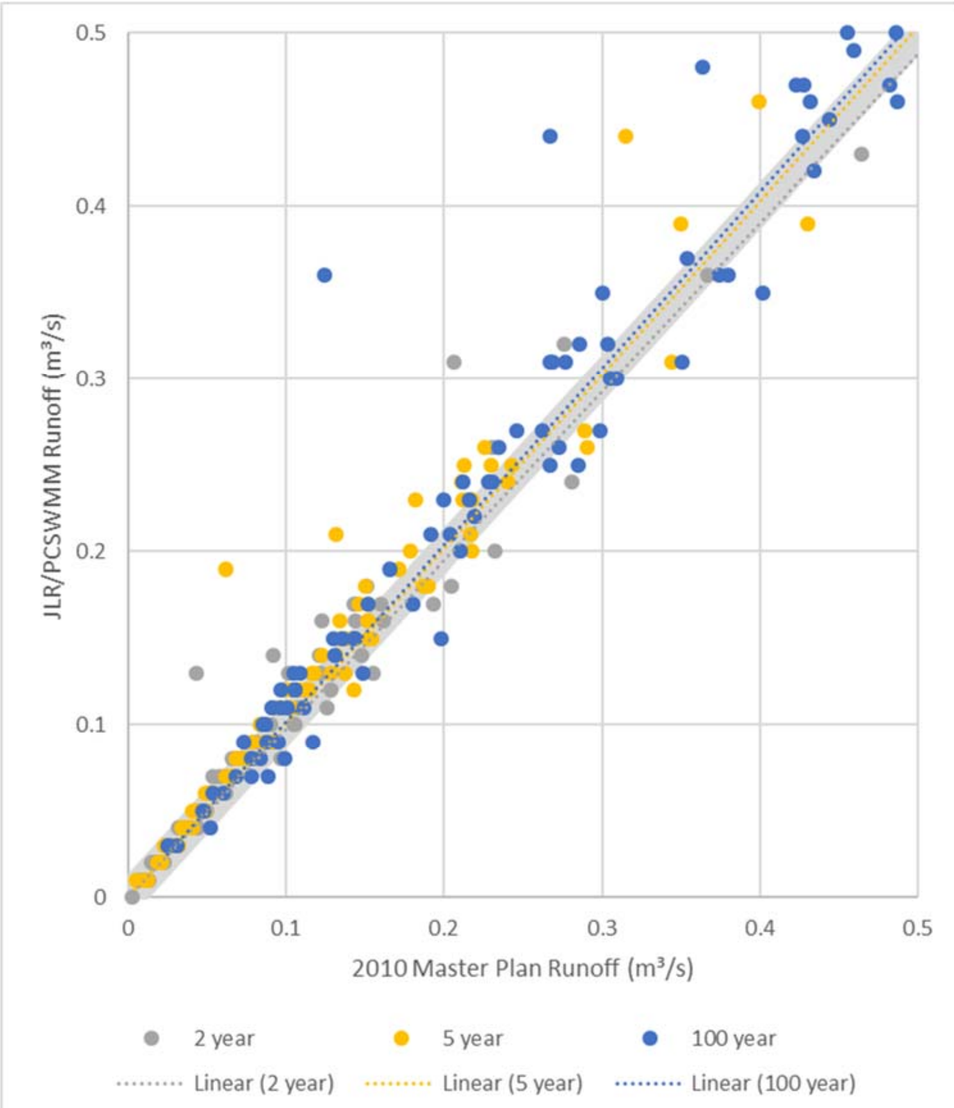
A3.3 Outfalls

Parameter	Units	Description / Values
Name	-	Outfalls are named as per the 2010 Master Plan.
Tag	-	No tags were used for the outfalls.
Inflows	-	No external inflows are applied at outfall nodes
Treatment	-	No treatment is modelled
Invert Elevation	m	Invert elevation of the node is as per the 2010 Master Plan.
Rim Elevation	m	Elevation at the top of the node based on the depth of the connecting links.
Tide Gate	-	No backflow is prevented in the model outfalls and therefore 'No' is selected.
Route To	-	If flow from the outfall is directed to another subcatchment but this is not done in the model and this parameter is left blank.
Type	-	All outfalls have NORMAL outfall type which means depth of flow at the outlet is not affected by downstream conditions.

A4.0 Model Comparison

The results of the PCSWMM model can be compared to the 2010 Master Plan results for each subcatchment to confirm the appropriateness of the PCSWMM simulation. The graph in the figure below shows the runoff for each subcatchment in the 2010 Master Plan against the runoff in the PCSWMM model. The majority of the subcatchments have runoff values similar (within the grey line) to the previous model. The graph confirms that the PCSWMM model represents the runoff within the study area to a similar degree as the 2010 Master Plan.




0.5
0.4
0.3
0.2
0.1
0
JLR/PCSWMM Runoff (m³/s)
0
0.1
0.2
0.3
0.4
0.5
2010 Master Plan Runoff (m³/s)
2 year
5 year
100 year
Linear (2 year)
Linear (5 year)
Linear (100 year)

Existing Condition Storm Subcatchment Hydrologic Parameters

Name	Receiving Node	Area (ha)	%Imp	Width (m)	Slope (m/m)	Land Use and Soil	Model Peak Runoff Results (m³/s)		
							1:2 year	1:5 year	1:100 year
60CBMH0018	60CBMH0018_OUT	0.86	70	52.4	0.0002	Residential - LD Heavy Clay	0.09	0.13	0.26
60CBMH0026	60CBMH0026_OUT	0.83	70	51.3	0.0006	Residential - LD Heavy Clay	0.1	0.14	0.27
60CBMH0037	60CBMH0037_OUT	2.48	70	88.8	0.0007	Residential - LD Heavy Clay	0.26	0.39	0.78
60CBMH0069	60CBMH0069_OUT	0.07	70	14.9	0.0027	Residential - LD Heavy Clay	0.01	0.01	0.03
60CBMH0070	60CBMH0070_OUT	1.03	70	83.85	0.0007	Residential - LD Heavy Clay	0.13	0.19	0.36
60CBMH0072	60CBMH0072_OUT	0.2	70	25	0.0027	Residential - LD Heavy Clay	0.03	0.04	0.07
60CBMH0074	60CBMH0074_OUT	0.41	70	36.1	0.0022	Residential - LD Heavy Clay	0.05	0.08	0.15
60CBMH0075	60CBMH0075_OUT	0.23	70	26.9	0.0004	Residential - LD Heavy Clay	0.03	0.04	0.08
60CBMH0077	60CBMH0077_OUT	0.36	67	33.6	0.0024	Residential - LD Cul-Sac	0.04	0.06	0.13
60CBMH0079	60CBMH0079_OUT	0.07	70	14.8	0.0052	Residential - LD Heavy Clay	0.01	0.01	0.03
60CBMH0082	60CBMH0082_OUT	0.62	70	44.4	0.0026	Residential - LD Heavy Clay	0.08	0.12	0.23
60CBMH0082.1	60STCB0082_OUT	0.74	70	48.4	0.0008	Residential - LD Heavy Clay	0.09	0.13	0.26
60CBMH0142	60CBMH0142_OUT	1.06	94	58.1	0.0005	ICI - Heavy Clay	0.16	0.23	0.46
60CBMH2000	60CBMH2000_OUT	1.5	70	59.083	0.0007	Residential - LD Heavy Clay	0.16	0.24	0.47
60CULV2002.4	60CULV2002d	0.14	70	20.8	0.0015	Residential - LD Heavy Clay	0.02	0.03	0.05
60CULV2013.1	60STOF2008	0.71	70	47.6	0.0005	Residential - LD Heavy Clay	0.08	0.12	0.24
60DICB0080	60DICB0080_OUT	0.29	70	30.1	0.0014	Residential - LD Heavy Clay	0.04	0.05	0.11
60DICB0081	60DICB0081_OUT	0.66	70	45.7	0.0013	Residential - LD Heavy Clay	0.08	0.12	0.24
60DICB0128	60DICB0128_OUT	0.45	67	37.6	0.0013	Residential - LD Cul-Sac	0.05	0.07	0.15
60DICB0198	60DICB0198_OUT	0.37	67	34.3	0.0013	Residential - LD Cul-Sac	0.04	0.06	0.13
60RYCB2000	60RYCB2000_OUT	0.86	8	52.4	0.0004	Open Spaces	0	0.01	0.03
60STCB0002	60STCB0002_OUT	3.29	13	102.3	0.0006	EXTERNAL DRAINAGE W/ SOME URBAN	0.09	0.12	0.25
60STCB0008	60STCB0008_OUT	2.5	13	89.3	0.0008	EXTERNAL DRAINAGE W/ SOME URBAN	0.07	0.09	0.2
60STCB0023	60STCB0023_OUT	1.61	40	71.5	0.0011	Mixed LD RES with Commercial.	0.11	0.15	0.31
60STCB0038	60STCB0038_OUT	6.48	13	143.6	0.0004	EXTERNAL DRAINAGE W/ SOME URBAN	0.16	0.23	0.46
60STCB0044	60STCB0044_OUT	1.13	94	60.1	0.0005	ICI - Heavy Clay	0.16	0.25	0.49
60STCB0045	60STCB0045_OUT	1.56	40	70.4	0.002	Mixed LD RES with Commercial.	0.11	0.15	0.31
60STCB0049	60STCB0049_OUT	0.29	70	30.2	0.0045	Residential - LD Heavy Clay	0.04	0.06	0.12
60STCB0051	60STCB0051_OUT	0.13	70	20.7	0.0004	Residential - LD Heavy Clay	0.02	0.03	0.05
60STCB0055	60STCB0055_OUT	0.58	40	42.8	0.0013	Mixed LD RES with Commercial.	0.04	0.06	0.12
60STCB0057	60STCB0057_OUT	0.45	40	38	0.0018	Mixed LD RES with Commercial.	0.03	0.05	0.1
60STCB0059	60STCB0059_OUT	0.39	40	35.1	0.0017	Mixed LD RES with Commercial.	0.03	0.04	0.09
60STCB0060	60STCB0060_OUT	0.6	40	43.8	0.0002	Mixed LD RES with Commercial.	0.04	0.06	0.11
60STCB0061	60STCB0061_OUT	0.55	40	41.7	0.0013	Mixed LD RES with Commercial.	0.04	0.05	0.11
60STCB0064	60STCB0054	0.68	94	46.4	0.0012	ICI - Heavy Clay	0.12	0.17	0.32
60STCB0068	60STCB0068_OUT	0.47	40	38.6	0.0005	Mixed LD RES with Commercial.	0.03	0.05	0.09
60STCB0073	60STCB0073_OUT	1.8	40	75.8	0.0002	Mixed LD RES with Commercial.	0.1	0.15	0.3
60STCB0075	60STCB0075_OUT	1.19	64	61.7	0.0008	School	0.14	0.2	0.37
60STCB0078	60STCB0064_OUT	0.35	94	33.2	0.0025	ICI - Heavy Clay	0.07	0.09	0.17
60STCB0079	60STCB0079_OUT	0.57	40	42.7	0.0021	Mixed LD RES with Commercial.	0.04	0.06	0.12
60STCB0082	60STCB0082_OUT	0.39	70	35.4	0.0008	Residential - LD Heavy Clay	0.05	0.07	0.14
60STCB0083	60STCB0078_OUT	0.33	94	32.2	0.0006	ICI - Heavy Clay	0.06	0.08	0.15
60STCB0088	60STCB0088_OUT	1.24	70	62.7	0.0002	Residential - LD Heavy Clay	0.12	0.18	0.36
60STCB0090	60STCB0097_OUT	0.59	70	43.4	0.0015	Residential - LD Heavy Clay	0.08	0.11	0.21
60STCB0097	60STCB0103	0.67	70	46.2	0.0013	Residential - LD Heavy Clay	0.09	0.12	0.23
60STCB0098	60STCB0098_OUT	1.4	70	66.8	0.0005	Residential - LD Heavy Clay	0.15	0.23	0.44
60STCB0101	60STCB0101_OUT	0.51	70	40.2	0.0083	Residential - LD Heavy Clay	0.07	0.1	0.19
60STCB2000	60STCB2000_OUT	0.72	70	47.9	0.001	Residential - LD Heavy Clay	0.09	0.13	0.24
60STMH0008	60STMH0008_OUT	0.28	40	29.7	0.002	Mixed LD RES with Commercial.	0.02	0.03	0.06
60STMH0009	60STMH0009_OUT	0.26	70	28.6	0.0019	Residential - LD Heavy Clay	0.03	0.05	0.1
60STMH0010	60STMH0010_OUT	0.44	70	37.2	0.0003	Residential - LD Heavy Clay	0.05	0.08	0.15
60STMH0011	60STMH0011_OUT	0.27	70	29.2	0.0124	Residential - LD Heavy Clay	0.04	0.05	0.11
60STMH0014	60STMH0014_OUT	0.97	70	55.5	0.001	Residential - LD Heavy Clay	0.12	0.17	0.32
60STMH0015	60STMH0015_OUT	0.63	70	44.9	0.0005	Residential - LD Heavy Clay	0.08	0.11	0.21
60STMH0016	60STMH0016_OUT	0.71	70	47.6	0.0005	Residential - LD Heavy Clay	0.08	0.12	0.24
60STMH0017	60STMH0017_OUT	0.68	70	46.6	0.0005	Residential - LD Heavy Clay	0.08	0.12	0.22
60STMH0019	60STMH0019_OUT	0.46	40	38.1	0.0011	Mixed LD RES with Commercial.	0.03	0.04	0.1
60STMH0020	60STMH0020_OUT	0.84	70	51.8	0.0022	Residential - LD Heavy Clay	0.11	0.16	0.31
60STMH0193	60STMH0193_OUT	0.95	70	55.1	0.0053	Residential - LD Heavy Clay	0.13	0.18	0.35
60STMH2000	60STMH2000_OUT	1.5	70	69.2	0.001	Residential - LD Heavy Clay	0.18	0.26	0.5
DICB026	DICB026_OUT	0.17	70	23.5	0.0006	Residential - LD Heavy Clay	0.02	0.03	0.06
60CULV2003.1	60CULV2004c	1.54	70	70	0.0002	Residential - LD Heavy Clay	0.14	0.21	0.44
60CULV2004.1	60CULV2004a	16.73	13	230.8	0.0002	EXTERNAL DRAINAGE W/ SOME URBAN	0.36	0.53	1.05
60CULV2006.1	60CULV2006	370.79	8	1086.4	0.0015	Agricultural	1.79	2.71	5.78
60CULV2000.1	60CULV2000	21.39	8	260.9	0.0009	Agricultural	0.13	0.19	0.45
60CULV2000.4	60SWALE2001b	1.41	70	66.9	0.0017	Residential - LD Heavy Clay	0.17	0.25	0.47
60CULV2001.2	60CULV2001	1.22	70	62.2	0.0002	Residential - LD Heavy Clay	0.11	0.18	0.36
60CULV2005.1	60CULV2005b	1.64	94	72.1	0.0209	ICI - Heavy Clay	0.31	0.44	0.79
60CULV2005.4	60STOV2009	1.18	70	61.2	0.0209	Residential - LD Heavy Clay	0.16	0.23	0.48
60CULV2007.1	60CULV2006d	4.48	13	119.4	0.0002	EXTERNAL DRAINAGE W/ SOME URBAN	0.11	0.16	0.31
60CULV2008.1	60CULV2007d	2.6	40	91	0.0002	Mixed LD RES with Commercial.	0.14	0.21	0.42
60CULV2009.1	60CULV2008d	1.78	40	75.3	0.0002	Mixed LD RES with Commercial.	0.1	0.15	0.3
60CULV2011.4	60CULV2011d	9.22	8	171.3	0.0002	Open Spaces	0.04	0.05	0.13
60CULV2012.4	60CULV2012d	3.23	64	101.4	0.0002	School	0.24	0.39	0.81
60CULV2013.4	60STOF2009_OUT	1.85	8	76.7	0.0001	Open Spaces	0.01	0.01	0.04
60STOF2000a	J4	1.04	13	57.6	0.0003	EXTERNAL DRAINAGE W/ SOME URBAN	0.03	0.04	0.08
60STOF2004a	60STOF2004a_OUT	0.51	40	40.3	0.0002	Mixed LD RES with Commercial.	0.03	0.05	0.09

Existing Condition Storm Subcatchment Hydrologic Parameters

Name	Receiving Node	Area (ha)	%Imp	Width (m)	Slope (m/m)	Land Use and Soil	Model Peak Runoff Results (m³/s)		
							1:2 year	1:5 year	1:100 year
60STOF2007	60CULV2010d	1.21	94	62	0.0004	ICI - Heavy Clay	0.17	0.25	0.5
60STOF2009	60STOF2009_OUT	27.28	8	294.7	0.0001	Agricultural	0.13	0.2	0.43
60STOV2001	60STOV2001_OUT	2.01	70	79.9	0.0002	Residential - LD Heavy Clay	0.17	0.26	0.55
60STOV2002	60STOV2002_OUT	6.41	8	142.8	0.0002	Open Spaces	0.03	0.04	0.09
60STOV2011	60STOV2011_OUT	0.91	70	53.7	0.0001	Residential - LD Heavy Clay	0.08	0.12	0.25
60STOV2016	60STOV2016_OUT	0.77	70	49.5	0.0011	Residential - LD Heavy Clay	0.1	0.14	0.27
60SWALE2002.1	60SWALE2002	3.49	8	105.5	0.0002	Open Spaces	0.01	0.02	0.07
60SWALE2003a	60SWALE2003a_OUT	0.91	13	53.9	0.0002	EXTERNAL DRAINAGE W/ SOME URBAN	0.02	0.03	0.07
60SWALE2004.1	60SWALE2004a	7.68	8	156.4	0.0002	Agricultural	0.04	0.07	0.15
60SWALE2004.1.9	60SWALE2004a	0.55	70	41.9	0.0002	Residential - LD Heavy Clay	0.06	0.09	0.17
CA_314,_315,_316	CA_314,_315,_316_OUT	231.21	8	857.9	0.0015	Agricultural	1.19	1.79	3.85
CULV025.1	60CULV2002e	3.86	8	110.8	0.0002	Open Spaces	0.02	0.02	0.08
EAST_OUTFALL	60CULV2012d	36.23	8	339.6	0.0002	Agricultural	0.18	0.27	0.59
north_culvert	north_culvert_a	12.24	13	197.4	0.0035	EXTERNAL DRAINAGE W/ SOME URBAN	0.32	0.46	0.93
Ultimate_Outlet_SE	CA_314,_315,_316_OUT	421.32	8	1158.1	0.0015	Agricultural	1.99	3.03	6.51
60STCB0107	60STCB0103	0.49	40	89.8	0.0023	Mixed LD RES with Commercial.	0.03	0.05	0.13
60STOF2000.4.1	60SWALE2003b	5.32	8	540	0.0003	Agricultural	0.03	0.06	0.3
60STOF2003-ex	60STOF2003	3.56	13	109.2	0.0002	EXTERNAL DRAINAGE W/ SOME URBAN	0.09	0.13	0.25
60STOV2006	60STOV2006.1	2.6	40	117.3	0.0002	Mixed LD RES with Commercial.	0.15	0.22	0.42
60UNCON0001	60UNCON0001_OUT	83.79	8	516.7	0.0005	Agricultural	0.43	0.64	1.4
CNR_culv_a	CNR_culv_a_OUT	25.1	13	282.4	0.0002	EXTERNAL DRAINAGE W/ SOME URBAN	0.5	0.76	1.52
JM'1'	60STMH0272_OUT	0.27	40	29.2	0.0004	Mixed LD RES with Commercial.	0.02	0.03	0.05
JM'2'	JM'2'_OUT	0.41	40	36	0.0001	Mixed LD RES with Commercial.	0.03	0.04	0.07
JM'3'	60STMH0279_OUT	0.29	40	30.4	0.0005	Mixed LD RES with Commercial.	0.02	0.03	0.05
JM'3b'	60STMH0279_OUT	0.44	40	37.5	0.0005	Mixed LD RES with Commercial.	0.03	0.04	0.08
JM'4'	60STMH0282_OUT	0.25	8	28.2	0.0008	Open Spaces	0	0	0.01
JM'5'	60STMH0289_OUT	0.3	40	31	0.0006	Mixed LD RES with Commercial.	0.02	0.03	0.06
JM'6'	60STMH0303_OUT	0.45	40	37.7	0.0003	Mixed LD RES with Commercial.	0.03	0.04	0.08
JM'7'	60STMH0300_OUT	0.2	40	25.1	0.0004	Mixed LD RES with Commercial.	0.01	0.02	0.04
JM'7'comm	60STMH0300_OUT	0.67	70	46	0.0004	Residential - LD Heavy Clay	0.08	0.11	0.22
JM'8'	60STMH0296_OUT	0.75	40	48.8	0.0001	Mixed LD RES with Commercial.	0.04	0.06	0.12
JM11	60STMH0339_OUT	0.6	40	43.6	0.0004	Mixed LD RES with Commercial.	0.04	0.06	0.11
JM12	60STMH0338_OUT	0.42	40	36.7	0.0004	Mixed LD RES with Commercial.	0.03	0.04	0.08
JM16	60STMH0336_OUT	0.51	40	40.2	0.0002	Mixed LD RES with Commercial.	0.03	0.05	0.09
JM17	60STMH0335_OUT	0.62	40	44.2	0.0004	Mixed LD RES with Commercial.	0.04	0.06	0.11
JM18	60STMH0334_OUT	0.47	40	38.5	0.0001	Mixed LD RES with Commercial.	0.03	0.04	0.08
JM19	60STMH0332_OUT	0.63	40	44.8	0.0023	Mixed LD RES with Commercial.	0.04	0.06	0.12
JM8	60STMH0341_OUT	0.43	40	37	0.0002	Mixed LD RES with Commercial.	0.03	0.04	0.08
JM_Pond_1	JSWMF-4	0.31	70	31.2	0.0001	Residential - LD Heavy Clay	0.03	0.05	0.1
JM_Pond_2	JSMF-5	1.07	70	58.4	0.0001	Residential - LD Heavy Clay	0.09	0.14	0.29
w1	w1_OUT	0.87	70	52.7	0.0008	Residential - LD Heavy Clay	0.11	0.15	0.29
w2	w2_OUT	0.5	70	39.7	0.0009	Residential - LD Heavy Clay	0.06	0.09	0.17
w3	w3_OUT	0.6	70	43.5	0.004	Residential - LD Heavy Clay	0.08	0.11	0.22
walker_SWM_FACILITY	JSWMF-3	0.63	70	44.8	0.0001	Residential - LD Heavy Clay	0.06	0.09	0.19
DN_8	J3	2.4	13	87.3	0.0001	EXTERNAL DRAINAGE W/ SOME URBAN	0.06	0.08	0.16
EX_S1	St_EX_S1	3.68	8	150	0.00211	Agricultural	0.02	0.05	0.24
60STOF2000.4.1_1	60CULV2012b	4.48	8	245	0.0003	Agricultural	0.03	0.04	0.17

Future Population Storm Subcatchment Hydrologic Parameters

Name	Receiving Node	Area (ha)	%Imp	Width (m)	Slope (m/m)	Land Use and Soil	Model Peak Runoff Results (m³/s)		
							1:2 year	1:5 year	1:100 year
60CBMH0018	60CBMH0018_OUT	0.863	70	52.4	0.2	Residential_-_LD_Heavy_Clay	0.09	0.13	0.26
60CBMH0026	60CBMH0026_OUT	0.827	70	51.3	0.6	Residential_-_LD_Heavy_Clay	0.1	0.14	0.27
60CBMH0037	60CBMH0037_OUT	2.477	70	88.8	0.7	Residential_-_LD_Heavy_Clay	0.26	0.39	0.78
60CBMH0069	60CBMH0069_OUT	0.07	70	14.9	2.7	Residential_-_LD_Heavy_Clay	0.01	0.01	0.03
60CBMH0070	60CBMH0070_OUT	1.032	70	83.85	0.7	Residential_-_LD_Heavy_Clay	0.13	0.19	0.36
60CBMH0072	60CBMH0072_OUT	0.197	70	25	2.7	Residential_-_LD_Heavy_Clay	0.03	0.04	0.07
60CBMH0074	60CBMH0074_OUT	0.41	70	36.1	2.2	Residential_-_LD_Heavy_Clay	0.05	0.08	0.15
60CBMH0075	60CBMH0075_OUT	0.227	70	26.9	0.4	Residential_-_LD_Heavy_Clay	0.03	0.04	0.08
60CBMH0077	60CBMH0077_OUT	0.355	67	33.6	2.4	Residential_-_LD_Cul-Sac	0.04	0.06	0.13
60CBMH0079	60CBMH0079_OUT	0.069	70	14.8	5.2	Residential_-_LD_Heavy_Clay	0.01	0.01	0.03
60CBMH0082	60CBMH0082_OUT	0.618	70	44.4	2.6	Residential_-_LD_Heavy_Clay	0.08	0.12	0.23
60CBMH0082.1	60STCB0082_OUT	0.736	70	48.4	0.8	Residential_-_LD_Heavy_Clay	0.09	0.13	0.26
60CBMH0142	60CBMH0142_OUT	1.06	94	58.1	0.5	ICI_-_Heavy_Clay	0.16	0.23	0.46
60CBMH2000	60CBMH2000_OUT	1.499	70	59.083	0.7	Residential_-_LD_Heavy_Clay	0.16	0.24	0.47
60CULV2002.4	60CULV2002d	0.135	70	20.8	1.5	Residential_-_LD_Heavy_Clay	0.02	0.03	0.05
60CULV2013.1	M_CULV_c	0.712	70	47.6	0.5	Residential_-_LD_Heavy_Clay	0.08	0.12	0.24
60DICB0080	60DICB0080_OUT	0.285	70	30.1	1.4	Residential_-_LD_Heavy_Clay	0.04	0.05	0.11
60DICB0081	60DICB0081_OUT	0.657	70	45.7	1.3	Residential_-_LD_Heavy_Clay	0.08	0.12	0.24
60DICB0128	60DICB0128_OUT	0.445	67	37.6	1.3	Residential_-_LD_Cul-Sac	0.05	0.07	0.15
60DICB0198	60DICB0198_OUT	0.369	67	34.3	1.3	Residential_-_LD_Cul-Sac	0.04	0.06	0.13
60RYCB2000	60RYCB2000_OUT	0.861	8	52.4	0.4	Open_Spaces	0	0.01	0.03
60STCB0002	60STCB0002_OUT	3.29	13	102.3	0.6	EXTERNAL_DRAINAGE_W/_SOME_URBAN	0.09	0.12	0.25
60STCB0008	60STCB0008_OUT	2.503	13	89.3	0.8	EXTERNAL_DRAINAGE_W/_SOME_URBAN	0.07	0.09	0.2
60STCB0023	60STCB0023_OUT	1.606	40	71.5	1.1	Mixed_LD_RES_with_Commercial.	0.11	0.15	0.31
60STCB0038	60STCB0038_OUT	6.476	13	143.6	0.4	EXTERNAL_DRAINAGE_W/_SOME_URBAN	0.16	0.23	0.46
60STCB0044	60STCB0044_OUT	1.134	94	60.1	0.5	ICI_-_Heavy_Clay	0.16	0.25	0.49
60STCB0045	60STCB0045_OUT	1.556	40	70.4	2	Mixed_LD_RES_with_Commercial.	0.11	0.15	0.31
60STCB0049	60STCB0049_OUT	0.286	70	30.2	4.5	Residential_-_LD_Heavy_Clay	0.04	0.06	0.12
60STCB0051	60STCB0051_OUT	0.134	70	20.7	0.4	Residential_-_LD_Heavy_Clay	0.02	0.03	0.05
60STCB0055	60STCB0055_OUT	0.575	40	42.8	1.3	Mixed_LD_RES_with_Commercial.	0.04	0.06	0.12
60STCB0057	60STCB0057_OUT	0.453	40	38	1.8	Mixed_LD_RES_with_Commercial.	0.03	0.05	0.1
60STCB0059	60STCB0059_OUT	0.386	40	35.1	1.7	Mixed_LD_RES_with_Commercial.	0.03	0.04	0.09
60STCB0060	60STCB0060_OUT	0.603	40	43.8	0.2	Mixed_LD_RES_with_Commercial.	0.04	0.06	0.11
60STCB0061	60STCB0061_OUT	0.547	40	41.7	1.3	Mixed_LD_RES_with_Commercial.	0.04	0.05	0.11
60STCB0064	60STCB0054	0.678	94	46.4	1.2	ICI_-_Heavy_Clay	0.12	0.17	0.32
60STCB0068	60STCB0068_OUT	0.467	40	38.6	0.5	Mixed_LD_RES_with_Commercial.	0.03	0.05	0.09
60STCB0073	60STCB0073_OUT	1.803	40	75.8	0.2	Mixed_LD_RES_with_Commercial.	0.1	0.15	0.3
60STCB0075	60STCB0075_OUT	1.194	64	61.7	0.8	School	0.14	0.2	0.37
60STCB0078	60STCB0064_OUT	0.346	94	33.2	2.5	ICI_-_Heavy_Clay	0.07	0.09	0.17
60STCB0079	60STCB0079_OUT	0.572	40	42.7	2.1	Mixed_LD_RES_with_Commercial.	0.04	0.06	0.12
60STCB0082	60STCB0082_OUT	0.393	70	35.4	0.8	Residential_-_LD_Heavy_Clay	0.05	0.07	0.14
60STCB0083	60STCB0078_OUT	0.325	94	32.2	0.6	ICI_-_Heavy_Clay	0.06	0.08	0.15
60STCB0088	60STCB0088_OUT	1.237	70	62.7	0.2	Residential_-_LD_Heavy_Clay	0.12	0.18	0.36
60STCB0090	60STCB0097_OUT	0.592	70	43.4	1.5	Residential_-_LD_Heavy_Clay	0.08	0.11	0.21
60STCB0097	60STCB0103	0.67	70	46.2	1.3	Residential_-_LD_Heavy_Clay	0.09	0.12	0.23
60STCB0098	60STCB0098_OUT	1.402	70	66.8	0.5	Residential_-_LD_Heavy_Clay	0.15	0.23	0.44
60STCB0101	60STCB0101_OUT	0.508	70	40.2	8.3	Residential_-_LD_Heavy_Clay	0.07	0.1	0.19
60STCB2000	60STCB2000_OUT	0.719	70	47.9	1	Residential_-_LD_Heavy_Clay	0.09	0.13	0.24
60STMH0008	60STMH0008_OUT	0.278	40	29.7	2	Mixed_LD_RES_with_Commercial.	0.02	0.03	0.06
60STMH0009	60STMH0009_OUT	0.257	70	28.6	1.9	Residential_-_LD_Heavy_Clay	0.03	0.05	0.1
60STMH0010	60STMH0010_OUT	0.435	70	37.2	0.3	Residential_-_LD_Heavy_Clay	0.05	0.08	0.15
60STMH0011	60STMH0011_OUT	0.268	70	29.2	12.4	Residential_-_LD_Heavy_Clay	0.04	0.05	0.11
60STMH0014	60STMH0014_OUT	0.969	70	55.5	1	Residential_-_LD_Heavy_Clay	0.12	0.17	0.32
60STMH0015	60STMH0015_OUT	0.632	70	44.9	0.5	Residential_-_LD_Heavy_Clay	0.08	0.11	0.21
60STMH0016	60STMH0016_OUT	0.713	70	47.6	0.5	Residential_-_LD_Heavy_Clay	0.08	0.12	0.24
60STMH0017	60STMH0017_OUT	0.682	70	46.6	0.5	Residential_-_LD_Heavy_Clay	0.08	0.12	0.22
60STMH0019	60STMH0019_OUT	0.455	40	38.1	1.1	Mixed_LD_RES_with_Commercial.	0.03	0.04	0.1
60STMH0020	60STMH0020_OUT	0.843	70	51.8	2.2	Residential_-_LD_Heavy_Clay	0.11	0.16	0.31
60STMH0193	60STMH0193_OUT	0.954	70	55.1	5.3	Residential_-_LD_Heavy_Clay	0.13	0.18	0.35
60STMH2000	60STMH2000_OUT	1.504	70	69.2	1	Residential_-_LD_Heavy_Clay	0.18	0.26	0.5
DICB026	DICB026_OUT	0.173	70	23.5	0.6	Residential_-_LD_Heavy_Clay	0.02	0.03	0.06
60CULV2003.1	60CULV2004c	1.54	70	70	0.2	Residential_-_LD_Heavy_Clay	0.14	0.21	0.44
60CULV2004.1	60CULV2004a	16.733	13	230.8	0.2	EXTERNAL_DRAINAGE_W/_SOME_URBAN	0.36	0.53	1.05
60STOV2011	60STOV2011_OUT	0.906	70	53.7	0.1	Residential_-_LD_Heavy_Clay	0.08	0.12	0.25
60STOV2016	60STOV2016_OUT	0.77	70	49.5	1.1	Residential_-_LD_Heavy_Clay	0.1	0.14	0.27
w1	w1_OUT	0.8723	70	52.7	0.8	Recent_Development	0.11	0.15	0.29
w2	w2_OUT	0.4962	70	39.7	0.9	Recent_Development	0.06	0.09	0.17
w3	w3_OUT	0.5954	70	43.5	4	Recent_Development	0.08	0.11	0.22
walker_SWM_FACILITY	JSWMF-3	0.6298	70	44.8	0.1	Recent_Development	0.06	0.09	0.19
60CULV2000.1	60CULV2000	21.387	8	260.9	0.9	Agricultural	0.13	0.19	0.45
60CULV2000.4	60SWALE2001b	1.407	70	66.9	1.7	Residential_-_LD_Heavy_Clay	0.17	0.25	0.47
60CULV2001.2	60CULV2001	1.215	70	62.2	0.2	Residential_-_LD_Heavy_Clay	0.11	0.18	0.36
60CULV2005.1	60CULV2005b	1.635	94	72.1	20.9	ICI_-_Heavy_Clay	0.31	0.44	0.79
60CULV2005.4	60STOV2009	1.177	70	61.2	20.9	Residential_-_LD_Heavy_Clay	0.16	0.23	0.48
60CULV2007.1	60CULV2006d	4.478	13	119.4	0.2	EXTERNAL_DRAINAGE_W/_SOME_URBAN	0.11	0.16	0.31
60CULV2008.1	60CULV2007d	2.603	40	91	0.2	Mixed_LD_RES_with_Commercial.	0.14	0.21	0.42
60CULV2009.1	60CULV2008d	1.781	40	75.3	0.2	Mixed_LD_RES_with_Commercial.	0.1	0.15	0.3

Future Population Storm Subcatchment Hydrologic Parameters

Name	Receiving Node	Area (ha)	%Imp	Width (m)	Slope (m/m)	Land Use and Soil	Model Peak Runoff Results (m^3/s)		
							1:2 year	1:5 year	1:100 year
60CULV2011.4	60CULV2011d	8.493	8	164.4	0.2	Open_Spaces	0.03	0.05	0.13
60CULV2013.4	60STOF2009_OUT	1.846	8	76.7	0.1	Open_Spaces	0.01	0.01	0.04
60STOF2000a	J4	1.041	13	57.6	0.3	EXTERNAL_DRAINAGE_W/_SOME_URBAN	0.03	0.04	0.08
60STOF2002.1	60STOF2002	0.374	13	34.5	0.2	EXTERNAL_DRAINAGE_W/_SOME_URBAN	0.01	0.01	0.03
60STOF2004a	60STOF2004a_OUT	0.511	40	40.3	0.2	Mixed_LD_RES_with_Commercial.	0.03	0.05	0.09
60STOF2007	60CULV2010d	1.207	94	62	0.4	ICI_-_Heavy_Clay	0.17	0.25	0.5
60STOV2001	60STOV2001_OUT	2.005	70	79.9	0.2	Residential_-_LD_Heavy_Clay	0.17	0.26	0.55
60STOV2002	60STOV2002_OUT	6.405	8	142.8	0.2	Open_Spaces	0.03	0.04	0.09
60SWALE2002.1	60SWALE2002	3.494	8	105.5	0.2	Open_Spaces	0.01	0.02	0.07
60SWALE2003a	60SWALE2003a_OUT	0.912	13	53.9	0.2	EXTERNAL_DRAINAGE_W/_SOME_URBAN	0.02	0.03	0.07
60SWALE2004.1	60SWALE2004a	7.681	8	156.4	0.2	Agricultural	0.04	0.07	0.15
60SWALE2004.1.9	60SWALE2004a	0.551	70	41.9	0.2	Residential_-_LD_Heavy_Clay	0.06	0.09	0.17
60UNCON0001	60UNCON0001_OUT	82.336	8	511.9	0.5	Agricultural	0.42	0.63	1.37
CA_314,_315,_316	CA_314,_315,_316_OUT	229.674	8	858.6	1.5	Agricultural	1.19	1.78	3.83
CNR_CULV_c.1	CNR_CULV_c	1.076	13	58.5	0.2	EXTERNAL_DRAINAGE_W/_SOME_URBAN	0.03	0.04	0.08
CULV025.1	60CULV2002e	3.857	8	110.8	0.2	Open_Spaces	0.02	0.02	0.08
Ultimate_Outlet_SE	CA_314,_315,_316_OUT	421.318	8	1158.1	1.5	Agricultural	1.99	3.03	6.51
D_SWM_FACILITY.1	D_SWM_FACILITY	0.989	40	56.1	0.2	Future_Development	0.06	0.09	0.17
D1	D1_OUT	1.284	40	63.9	0.2	Future_Development	0.07	0.11	0.21
D2	D2_OUT	2.029	40	80.4	0.3	Future_Development	0.12	0.17	0.33
D3	D3_OUT	1.191	40	61.6	24.8	Future_Development	0.08	0.12	0.25
JM1	JM1_OUT	1.097	40	59.1	0.1	Future_Development	0.06	0.09	0.17
JM10	JM10_OUT	0.537	40	41.3	0.1	Future_Development	0.03	0.05	0.09
JM13	JM13_OUT	1.106	40	59.3	0.1	Future_Development	0.06	0.09	0.18
JM14	JM14_OUT	1.055	40	57.9	0.6	Future_Development	0.07	0.1	0.19
JM2	JM2_OUT	0.512	40	40.4	0.1	Future_Development	0.03	0.05	0.09
JM3	JM3_OUT	0.76	40	49.2	0.6	Future_Development	0.05	0.07	0.14
JM4	JM4_OUT	0.811	40	50.8	0.1	Future_Development	0.05	0.07	0.13
JM5	JM5_OUT	1.092	40	58.9	0.1	Future_Development	0.06	0.09	0.18
JM6	JM6_OUT	0.652	40	45.5	0.1	Future_Development	0.04	0.06	0.11
JM7	JM7_OUT	0.568	40	42.5	0.1	Future_Development	0.03	0.05	0.1
M1	M1_OUT	0.564	70	42.4	3.3	Residential_-_LD_Heavy_Clay	0.08	0.11	0.22
M3	M3_OUT	0.784	67	49.9	1.7	Residential_-_LD_Cul-Sac	0.09	0.13	0.26
M4	M4_OUT	0.666	70	46	0.3	Residential_-_LD_Heavy_Clay	0.07	0.11	0.22
STCP-5	STCP-5_OUT	0.418	70	36.5	5.4	Residential_-_LD_Heavy_Clay	0.06	0.08	0.17
60CULV2006.1	60CULV2006	371.578	8	1086.4	1.5	Agricultural	1.79	2.71	5.79
CNR_culv_a	CNR_culv_a_OUT	18.1134	13	282.4	0.2	EXTERNAL_DRAINAGE_W/_SOME_URBAN	0.4	0.59	1.17
60STOF2009	60STOF2009_OUT	27.2955	8	294.7	0.1	Agricultural	0.13	0.2	0.43
north_culvert	north_culvert_a	12.2446	13	197.4	3.5	EXTERNAL_DRAINAGE_W/_SOME_URBAN	0.32	0.46	0.93
60STCB0107	60STCB0103	0.4906	40	89.8	2.3	Mixed_LD_RES_with_Commercial	0.03	0.05	0.13
60STOV2006	60STOV2006.1	2.5991	40	117.3	0.2	Mixed_LD_RES_with_Commercial	0.15	0.22	0.42
60STOF2000.4.1	60SWALE2003b	5.3221	8	540	0.3	Agricultural	0.03	0.06	0.3
DN_8	J3	2.3981	13	87.3	0.1	Recent_Development	0.06	0.08	0.16
JM_Pond_1	JSWMF-4	0.3066	70	31.2	0.1	Recent_Development	0.03	0.05	0.1
JM_Pond_2	JSMF-5	1.0719	70	58.4	0.1	Recent_Development	0.09	0.14	0.29
JM'1'	60STMH0272_OUT	0.2684	40	29.2	0.4	Recent_Development	0.02	0.03	0.05
JM11	60STMH0339_OUT	0.5988	40	43.6	0.4	Recent_Development	0.04	0.06	0.11
JM12	60STMH0338_OUT	0.4175	40	36.7	0.4	Recent_Development	0.03	0.04	0.08
JM16	60STMH0336_OUT	0.5073	40	40.2	0.2	Recent_Development	0.03	0.05	0.09
JM17	60STMH0335_OUT	0.6152	40	44.2	0.4	Recent_Development	0.04	0.06	0.11
JM18	60STMH0334_OUT	0.4668	40	38.5	0.1	Recent_Development	0.03	0.04	0.08
JM19	60STMH0332_OUT	0.6319	40	44.8	2.3	Recent_Development	0.04	0.06	0.12
JM'2'	JM'2'_OUT	0.4076	40	36	0.1	Recent_Development	0.03	0.04	0.07
JM'3'	60STMH0279_OUT	0.2909	40	30.4	0.5	Recent_Development	0.02	0.03	0.05
JM'3b'	60STMH0279_OUT	0.4418	40	37.5	0.5	Recent_Development	0.03	0.04	0.08
JM'4'	60STMH0282_OUT	0.2493	8	28.2	0.8	Recent_Development	0.00	0.00	0.01
JM'5'	60STMH0289_OUT	0.3025	40	31	0.6	Recent_Development	0.02	0.03	0.06
JM'6'	60STMH0303_OUT	0.4456	40	37.7	0.3	Recent_Development	0.03	0.04	0.08
JM'7'	60STMH0300_OUT	0.1988	40	25.1	0.4	Recent_Development	0.01	0.02	0.04
JM'7'comm	60STMH0300_OUT	0.6658	70	46	0.4	Recent_Development	0.08	0.11	0.22
JM8	60STMH0341_OUT	0.4298	40	37	0.2	Recent_Development	0.03	0.04	0.08
JM'8'	60STMH0296_OUT	0.7501	40	48.8	0.1	Recent_Development	0.04	0.06	0.12
E_Talbot	60CULV2012a	4.527	8	120	0.65	Agricultural	0.03	0.04	0.14
60CULV2012.4	60CULV2012d	3.232	64	101.4	0.2	School	0.24	0.39	0.81
EAST_OUTFALL	60CULV2012d	36.064	8	338.8	0.2	Agricultural	0.18	0.27	0.59

Appendix D

Transportation Report

paradigm
TRANSPORTATION SOLUTIONS LIMITED

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20 March 2019
Project: 180197

Jane Wilson
Environmental Engineer
J.L. Richards & Associates Limited
107-450 Speedvale Avenue West
Guelph ON N1H 7Y6

Dear Ms. Wilson:

RE: JARVIS MASTER SERVICING PLAN – TRANSPORTATION COMPONENT, TECHNICAL MEMORANDUM 2, GROWTH FORECAST AND FUTURE NEEDS

Haldimand County is undertaking an update of the 2010 Master Servicing Plan (MSP) for the community of Jarvis in support of planned growth and intensification identified in the County's Official Plan. The updated MSP will address the four servicing components (transportation, storm, water and wastewater) of the 2010 Jarvis MSP corresponding to changes in land use and growth forecasts within the study area over the next twenty years, as well as changes to existing conditions and related assumptions based on growth that has occurred within the study area.

The study area for the update includes the network of municipal services, local environment, and community make up, consistent with the 2010 Jarvis MSP study area. The community of Jarvis is built along and adjacent to Highway 6 (Main Street) and Highway 3 (Talbot Street) in the southwest part of Haldimand County. The study area road system is centered on the intersection of Highway 6 and Highway 3 and is generally bounded by Haldimand Road 69 to the north, Haldimand Road 55 to the east, Haldimand Road 70 to the west, and Concession 6 Walpole to the south. Both Highway 6 and Highway 3 are "connecting links" in the Provincial highway network.

The MSP update, including transportation, is being undertaken within the following framework:

- Class Environmental Assessment Master Planning
- Background Review and Updates to Existing Conditions
- Growth Forecast and Assessment of Future Needs
- Development of Preferred Servicing Strategies
- Implementation Plan Development and Final Report

Technical Memorandum 1, dated 13 November 2018, provided background review and updates to existing conditions. The purpose of this memorandum (Technical Memorandum 2) is to contextualize the projected growth in the community and review the future transportation conditions alongside this forecast growth. A twenty-year planning horizon (2018-2038) is used for future growth forecasts and assessment of transportation impacts.

Future (2038) Traffic Conditions

Future (2028) Background Traffic Forecasts

The future traffic conditions in the study area are likely to comprise general traffic growth (i.e. traffic generated by development outside the study area) over ten years, and future development traffic based on land development in the study area. The 2038 background traffic was estimated by applying a general growth rate of one percent compounded per annum to the base year (2018) volumes This growth rate is based on historic traffic growth at Talbot Street and Main Street between 2012 and 2018

Figure 1 and **Figure 2** (attached) respectively illustrate the 2038 background traffic volumes for the weekday AM and PM peak hours.

Future (2038) Development Traffic Forecasts

The future development in the study area is anticipated to include 120 low-density, 34 medium-density, and 24 high-density residential units. **Figure 3** (attached) illustrates the location of the proposed development parcels. It is noted that some of this development is already underway; therefore, the trip generation estimates are considered conservative, as some of the forecast trips may already be included in the existing traffic counts. The trips generated by the development lands were estimated using trip generation rates for different land uses provided in the ITE Trip Generation Manual.[1] The following land use codes (LUC) have been referenced:

- LUC 210: Single Family Detached Residential;
- LUC 220: Multifamily Housing (Low-Rise); and
- LUC 221: Multifamily Housing (Mid-Rise).

The trip generation for these three uses were based on the regression equations. In total, the development of the land parcels shown in **Figure 3** are forecast to generate 154 new trips in the AM peak hour, and 149 trips in the PM peak hour. **Table 1** summarizes the trip generation estimates.

[1] Institute of Transportation Engineers. 2017. *Trip Generation Manual (10th Edition).* Washington D.C.

TABLE 1: TRIP GENERATION ESTIMATES

Land Parcel	Land Use Code	Units Allocated	AM Peak Hour				PM Peak Hour			
			Rate	In	Out	Total	Rate	In	Out	Total
Milmont Estates	LUC 220 - Multifamily Housing (Low-Rise)	34	Eqn. [2]	6	22	28	Eqn. [2]	14	9	23
Country Fields Phase 1	LUC 210 - Single Family Detached Housing	8	Eqn. [1]	3	7	10	Eqn. [1]	5	3	8
Country Fields Phase 2	LUC 210 - Single Family Detached Housing	25	Eqn. [1]	6	17	23	Eqn. [1]	14	8	22
Jarvis Meadows Phase 2	LUC 210 - Single Family Detached Housing	20	Eqn. [1]	5	14	19	Eqn. [1]	11	7	18
Jarvis Meadows Phase 3	LUC 210 - Single Family Detached Housing	67	Eqn. [1]	13	39	52	Eqn. [1]	36	21	57
Saunders Drive	LUC 221 - Multifamily Housing (Mid-Rise)	24	Eqn. [3]	6	16	22	Eqn. [3]	13	8	21
		Total Trip Generation		39	115	154		93	56	149

1. LUC 210 - AM: T = 0.71(X) + 4.80 | PM: Ln(T) = 0.96Ln(X) + 0.20
2. LUC 220 - AM: Ln(T) = 0.95Ln(X) - 0.51 | PM: Ln(T) = 0.89Ln(X) - 0.02
3. LUC 221 - AM: Ln(T) = 0.98Ln(X) - 0.98 | PM: Ln(T) = 0.96Ln(X) - 0.63

The development trips were assigned to the study area road network based on the existing travel patterns identified in the existing traffic counts, and the most logical routes to and from the respective land parcels. **Table 2** summarizes the trip distribution applied in this study. **Figure 4** and **Figure 5** (attached) illustrate the site-generated traffic assignments for the AM and PM peak hours.

TABLE 2: TRIP DISTRIBUTION ESTIMATES

Origin/Destination	AM		PM	
	IN	OUT	IN	OUT
North via Ontario Highway 6	35%	43%	46%	32%
South via Ontario Highway 6	25%	13%	15%	26%
East via Talbot Street	17%	13%	13%	17%
West via Talbot Street	23%	31%	26%	25%
Total	100%	100%	100%	100%

Future (2038) Total Traffic Conditions

The future (2038) total traffic volumes include the addition of the development traffic volumes (**Figure 4** and **Figure 5**) and the background traffic forecasts (**Figure 1** and **Figure 2**). **Figure 6** and **Figure 7** illustrate the 2038 total traffic volumes.

Future Traffic Operations

The future total traffic volumes have been analyzed at the 2038 horizon year to determine the level of service conditions. The analysis assumed the existing traffic controls, and signal timings at the signalized intersections were not adjusted to determine if the future total traffic can be accommodated by the existing geometric and operational infrastructure.

Table 3 details the level of service conditions and indicates the study area intersections are forecast to generally operate at acceptable levels of service and within capacity, similar to the existing (2018) traffic conditions. The following changes are noted:

- The intersection of Talbot Street and Main Street is currently operating at LOS B or better and is forecast to operate at LOS C or better under 2038 conditions; and
- The eastbound approach on Nanticoke Creek Parkway is currently operating at LOS C (v/c ratio of 0.32) and is forecast to degrade to LOS E (v/c ratio of 0.56) under 2038 conditions.

Appendix A contains the detailed Synchro reports.

Potential Remedial Measures

The intersection analyses conducted in this memorandum does not identify any critical movements at the 2038 horizon; however, remedial measures that could be implemented to improve traffic operations include the following:

- Installation of eastbound and westbound left-turn lanes on Nanticoke Creek Parkway at Highway 6. The installation of these lanes can be accommodated within the existing right-of-way through pavement marking modifications;
- Monitoring the intersection of Nanticoke Creek Parkway and Highway 6 for the installation of traffic signals, even though 2038 volumes do not appear to warrant traffic signals at the intersection;
- Monitoring the intersection of Main Street and Talbot Street to ensure a reasonable level of service is maintained; and
- Installing left-turn lanes on all approaches at the intersection of Main Street and Talbot Street. This would serve to separate left-turning traffic from through and right-turning traffic and reduce the potential for turning movement collisions.

TABLE 3: 2038 FUTURE TOTAL TRAFFIC OPERATIONS

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																
				Eastbound				Westbound				Northbound				Southbound				
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Overall
AM Peak Hour	1 - Highway 6 & Natnticoke Creek Parkway	TWSC	LOS	<	C	>	C	<	C	>	C	A	A	A	A	A	A	A	A	
			Delay	<	19	>	19	<	19	>	19	8	0	0	1	0	0	0	0	
			V/C	<	0.31	>		<	0.09	>		0.03	0.25	0.01		0.00	0.16	0.05		
			Q	<	11	>		<	3	>		1	0	0		0	0	0		
			Ex	<	-	>		<	-	>		120	-	120		90	-	90		
			Avail.	<	-	>		<	-	>		119	-	120		90	-	120		
	2 - Talbot Street & Main Street	TCS	LOS	<	B	>	B	<	B	>	B	<	B	>	B	<	B	>	B	B
			Delay	<	14	>	14	<	15	>	15	<	13	>	13	<	14	>	14	14
			V/C	<	0.41	>		<	0.46	>		<	0.35	>		<	0.39	>		0.42
			Q	<	32	>		<	40	>		<	31	>		<	30	>		
			Ex	<	-	>		<	-	>		<	-	>		<	-	>		
			Avail.	<	-	>		<	-	>		<	-	>		<	-	>		
	3 - Talbot Street & Craddock Boulevard	TWSC	LOS	<	A		A		A	>	A					<	B	>	B	
			Delay	<	1		1		0	>	0					<	11	>	11	
			V/C	<	0.02				0.14	>						<	0.12	>		
			Q	<	1				0	>						<	3	>		
			Ex	<	-				-	>						<	-	>		
			Avail.	<	-				-	>						<	-	>		
	4 - Talbot Street & Saunders Drive	TWSC	LOS	<	A		A		A	>	A					<	A	>	C	
			Delay	<	0		0		0	>	0					<	2	>	15	
			V/C	<	0.00				0.00	>						<	0.00	>		
			Q	<	0				0	>						<	0	>		
			Ex	<	-				-	>						<	-	>		
			Avail.	<	-				-	>						<	-	>		
	5 - Talbot Street & Haldimand Road 55	TCS	LOS	B	B	B	B	B	B	>	B	B	B	B	B	B	C	>	C	B
			Delay	13	14	13	17	13	14	>	14	19	20	18	20	18	21	>	21	17
			V/C	0.03	0.16	0.02		0.04	0.18	>		0.07	0.15	0.00		0.01	0.26	>		0.22
			Q	5	23	1		6	26	>		9	20	0		4	34	>		
			Ex	85	-	100		110	-	>		85	-	100		105	-	>		
			Avail.	80	-	99		104	-	>		76	-	100		102	-	>		
PM Peak Hour	1 - Highway 6 & Natnticoke Creek Parkway	TWSC	LOS	<	E	>	E	<	D	>	D	A	A	A	A	A	A	A	A	
			Delay	<	35	>	35	<	25	>	25	9	0	0	1	9	0	0	0	
			V/C	<	0.56	>		<	0.12	>		0.05	0.21	0.01		0.01	0.31	0.05		
			Q	<	25	>		<	3	>		1	0	0		0	0	0		
			Ex	<	-	>		<	-	>		120	-	120		90	-	90		
			Avail.	<	-	>		<	-	>		119	-	120		90	-	120		
	2 - Talbot Street & Main Street	TCS	LOS	<	B	>	B	<	B	>	B	<	B	>	B	<	C	>	C	C
			Delay	<	20	>	20	<	14	>	14	<	12	>	12	<	32	>	32	23
			V/C	<	0.65	>		<	0.42	>		<	0.29	>		<	0.88	>		0.76
			Q	<	57	>		<	34	>		<	25	>		<	#110.5	>		
			Ex	<	-	>		<	-	>		<	-	>		<	-	>		
			Avail.	<	-	>		<	-	>		<	-	>		<	-	>		
	3 - Talbot Street & Craddock Boulevard	TWSC	LOS	<	A		A		A	>	A					<	B	>	B	
			Delay	<	2		2		0	>	0					<	11	>	11	
			V/C	<	0.06				0.16	>						<	0.08	>		
			Q	<	1				0	>						<	2	>		
			Ex	<	-				-	>						<	-	>		
			Avail.	<	-				-	>						<	-	>		
	4 - Talbot Street & Saunders Drive	TWSC	LOS	<	A		A		A	>	A					<	B	>	B	
			Delay	<	2		2		0	>	0					<	10	>	10	
			V/C	<	0.03				0.14	>						<	0.05	>		
			Q	<	1				0	>						<	1	>		
			Ex	<	-				-	>						<	-	>		
			Avail.	<	-				-	>						<	-	>		
	5 - Talbot Street & Haldimand Road 55	TCS	LOS	B	B	B	B	B	B	>	B	B	C	B	B	B	B	>	B	B
			Delay	13	15	13	14	13	14	>	14	19	20	18	20	19	19	>	19	17
			V/C	0.02	0.24	0.01		0.00	0.21	>		0.09	0.20	0.01		0.06	0.10	>		0.22
			Q	4	34	1		1	31	>		12	28	0		9	14	>		
			Ex	85	-	100		110	-	>		85	-	100		105	-	>		
			Avail.	81	-	100		109	-	>		73	-	100		97	-	>		

MOE - Measure of Effectiveness
LOS - Level of Service
Delay - Average Delay per Vehicle in Seconds
Q - 95th Percentile Queue Length (m)
Ex. - Existing Available Storage (m)
Avail. - Available Storage (m)
TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
AWSC - All-Way Stop Control
<- Shared Left/Through Lane
>- Shared Right/Through Lane

2010 Jarvis MSP Recommendations

It is noted the 2010 MSP identified the following infrastructure improvements over a 20-year timeframe:

- Monitoring and implementing mitigative measures (e.g., parking restrictions, revised lane designations) to improve LOS and safety at the Main Street and Talbot Street intersection;
- Need for a new collector road connecting to Highway 3 to accommodate developments in southwest Jarvis;
- Addition of sidewalks on one or both sides of Highway 3 from Highway 6 to the easterly Town limits; and
- Potential re-striping of Main Street (Highway 6) and Talbot Street (Highway 3) to accommodate bicycle lanes.

The remedial measures identified in this Memorandum can be implemented along with the 2010 recommendations involving mitigative measures at the Main Street and Talbot Street intersection, as well as the addition of sidewalks and bicycle lanes on Main Street and Talbot Street.

Also, the need for a new collector road connecting to Highway 3 (Talbot Street) as identified in the 2010 MSP will depend on the development of the vacant lands in the southeast quadrant of Highway 3 and Highway 6.

This memorandum provides an assessment of the transportation impacts of the proposed land use projections at the 2038 horizon year and identifies potential remedial measures to address those impacts. It also provides the context and continuity from 2010 Jarvis MSP recommendations. We look forward to receiving feedback from the Project Team on the findings and conclusions of this Memorandum in preparing the Final Report and Recommendations.

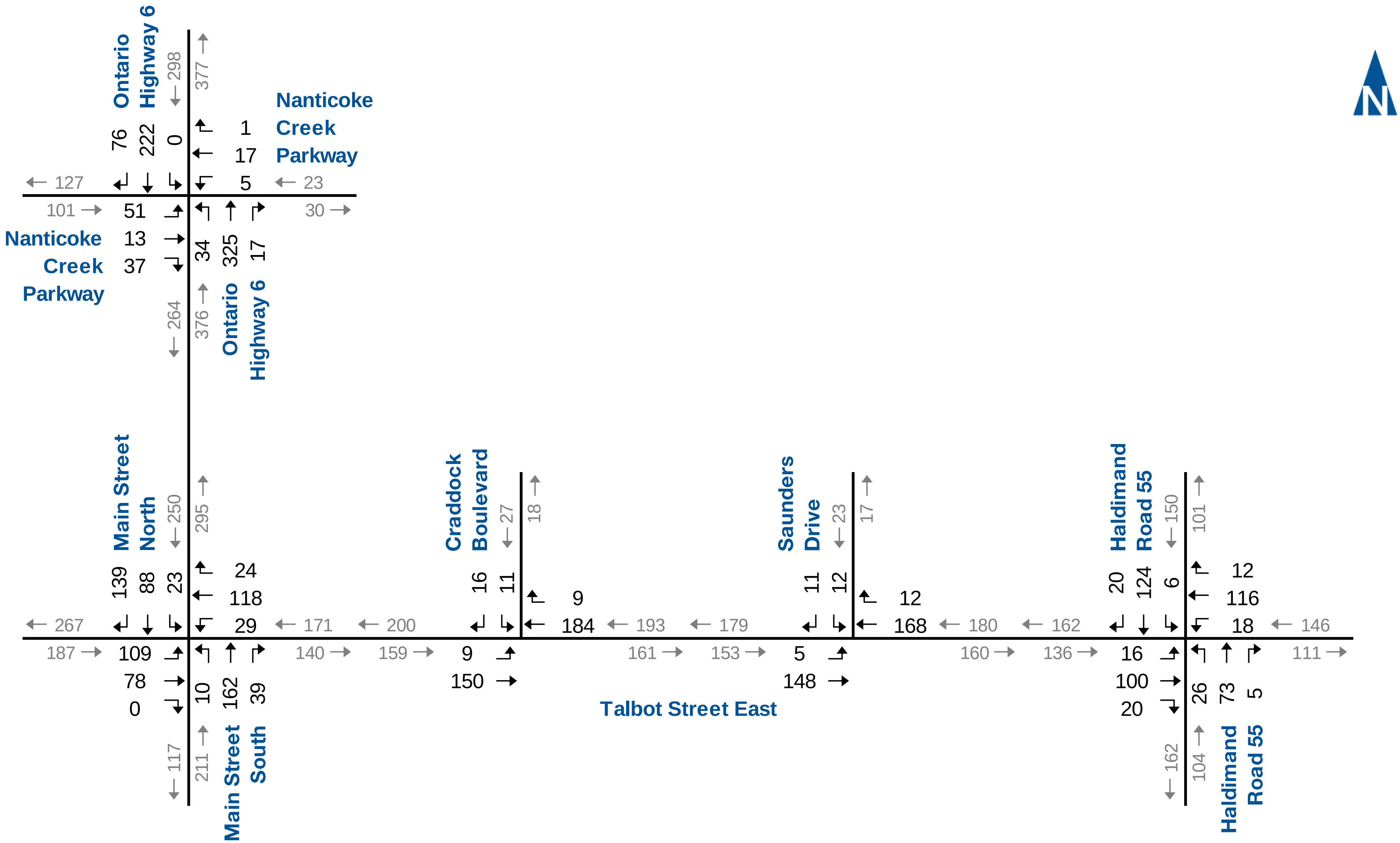
Yours very truly,

PARADIGM TRANSPORTATION SOLUTIONS LIMITED

Rajan Philips
M.A.Sc., P.Eng, FITE
Senior Transportation Consultant

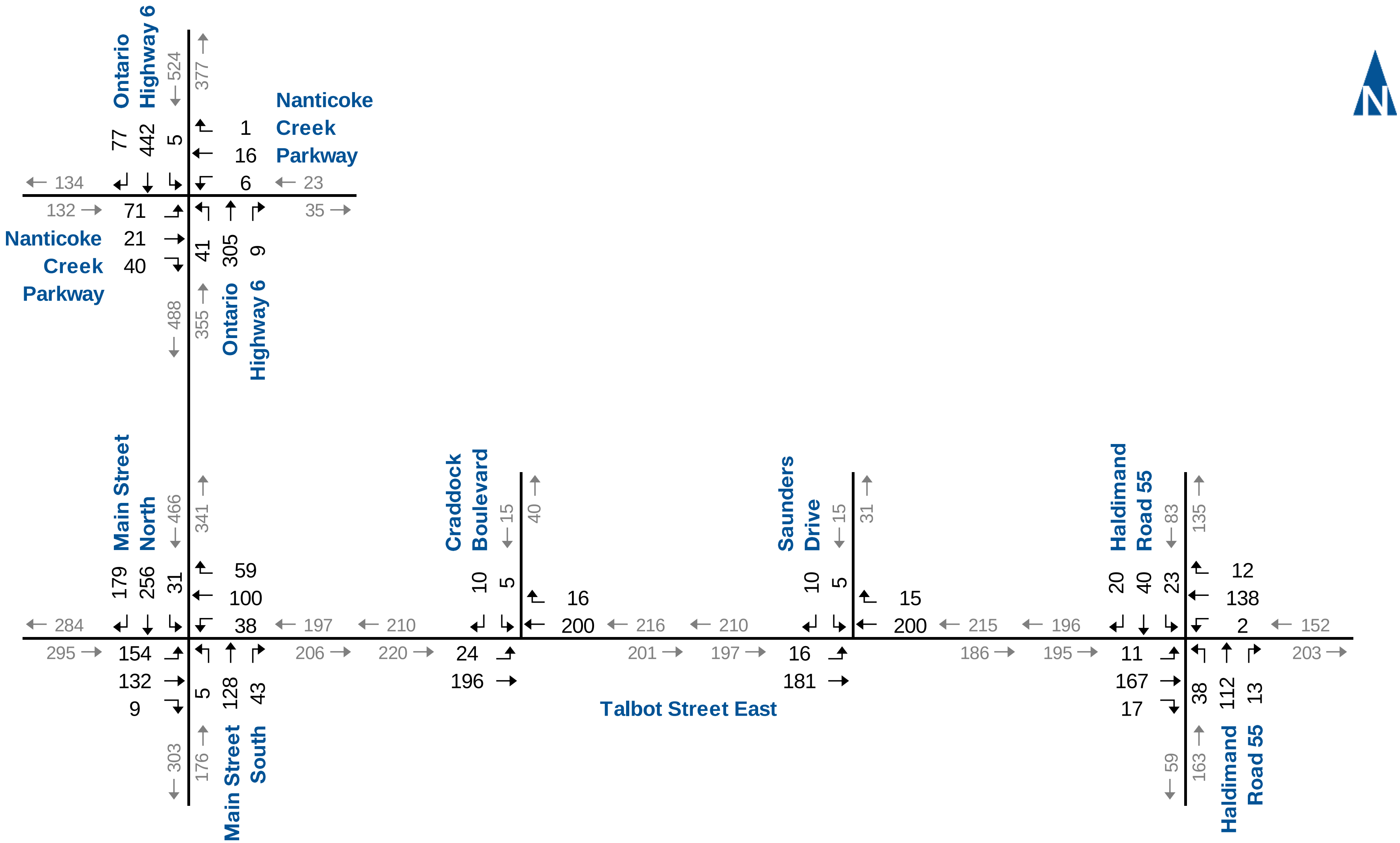
Gene Chartier
M.A.Sc., P.Eng, FITE
Vice-President

Attachments



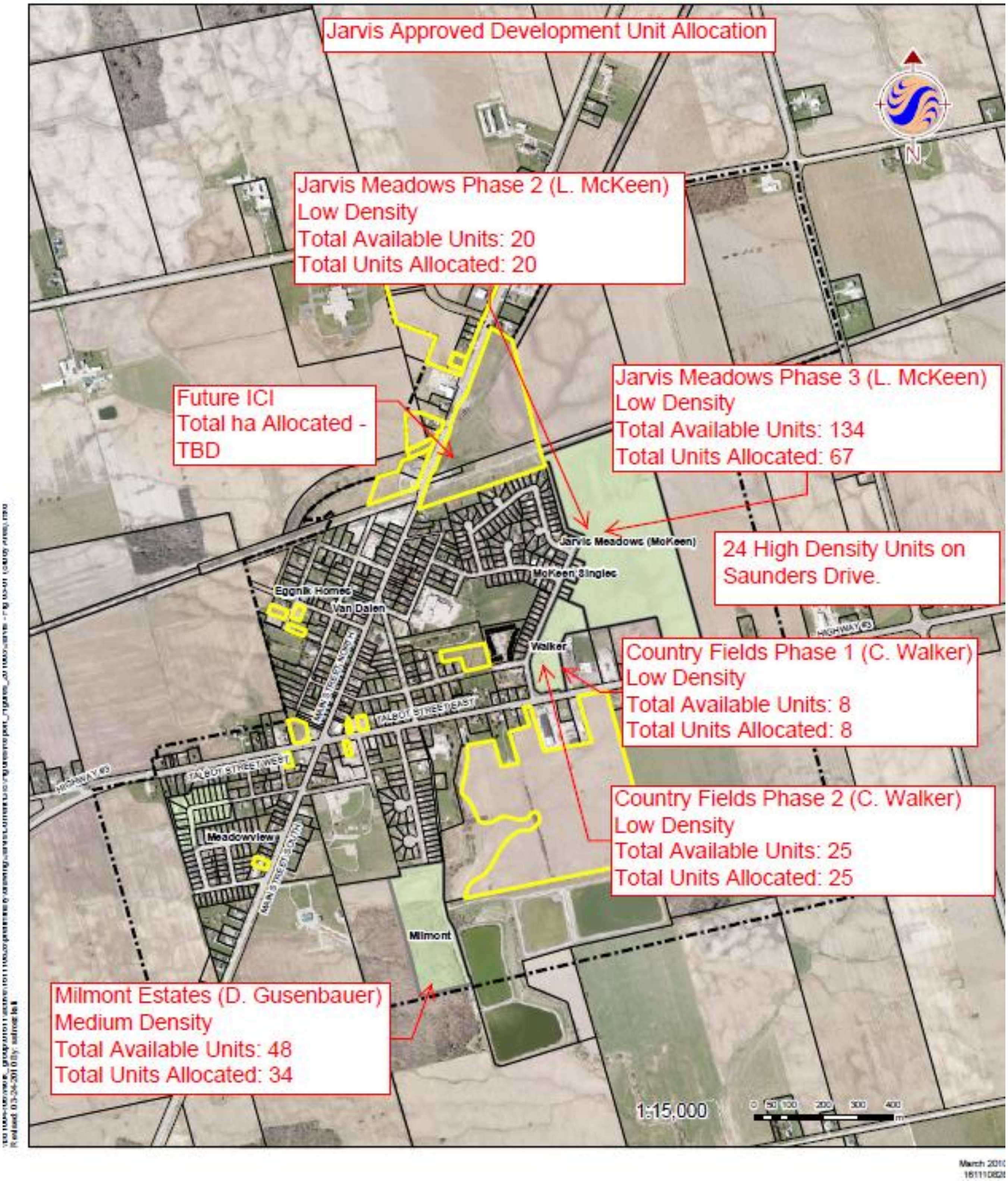
2038 Future Background Traffic Forecast
AM Peak Hour

Figure 1



2038 Future Background Traffic Forecast
PM Peak Hour

Figure 2



March 2010
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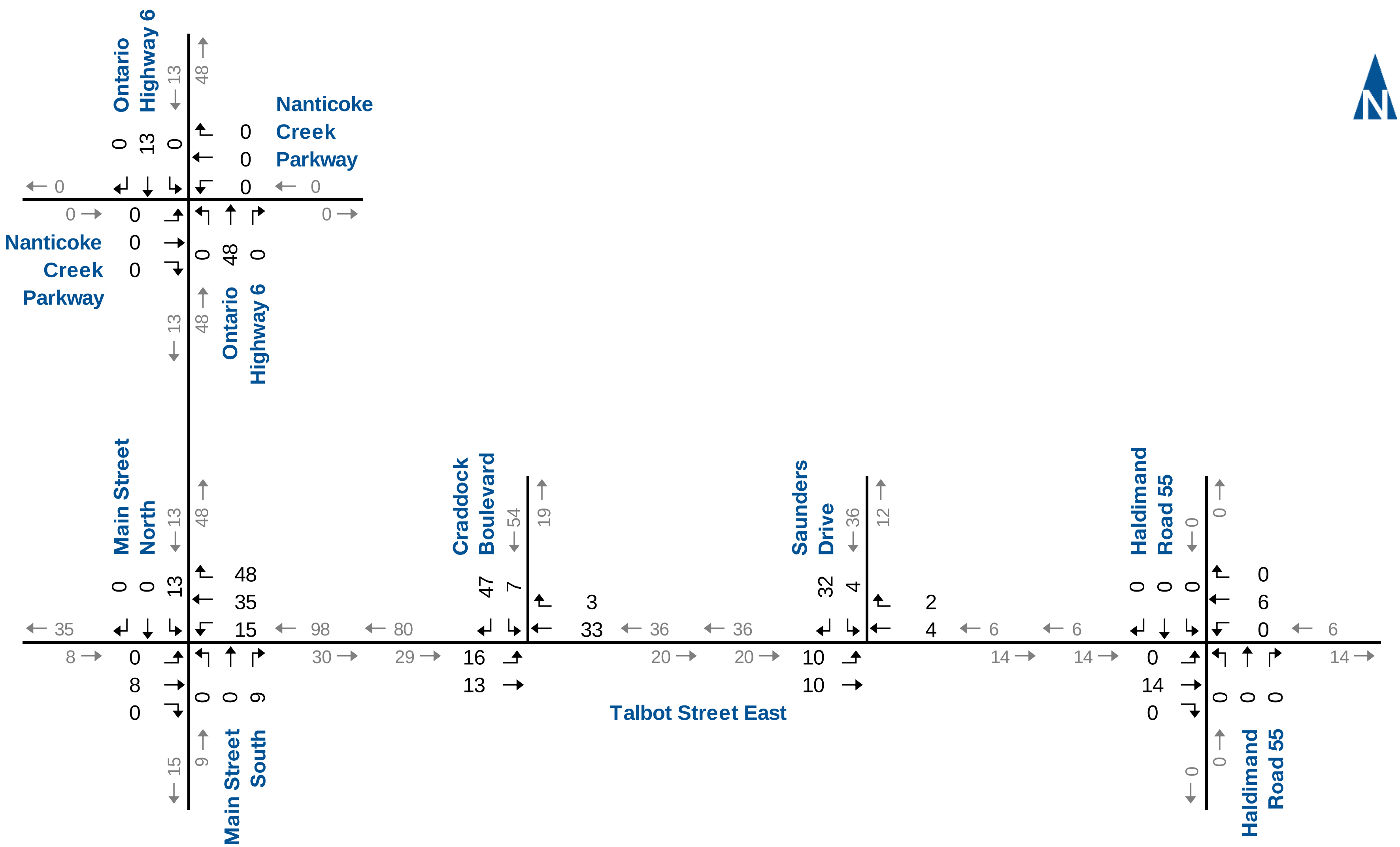
Approved Development Unit Allocations

Figure 3



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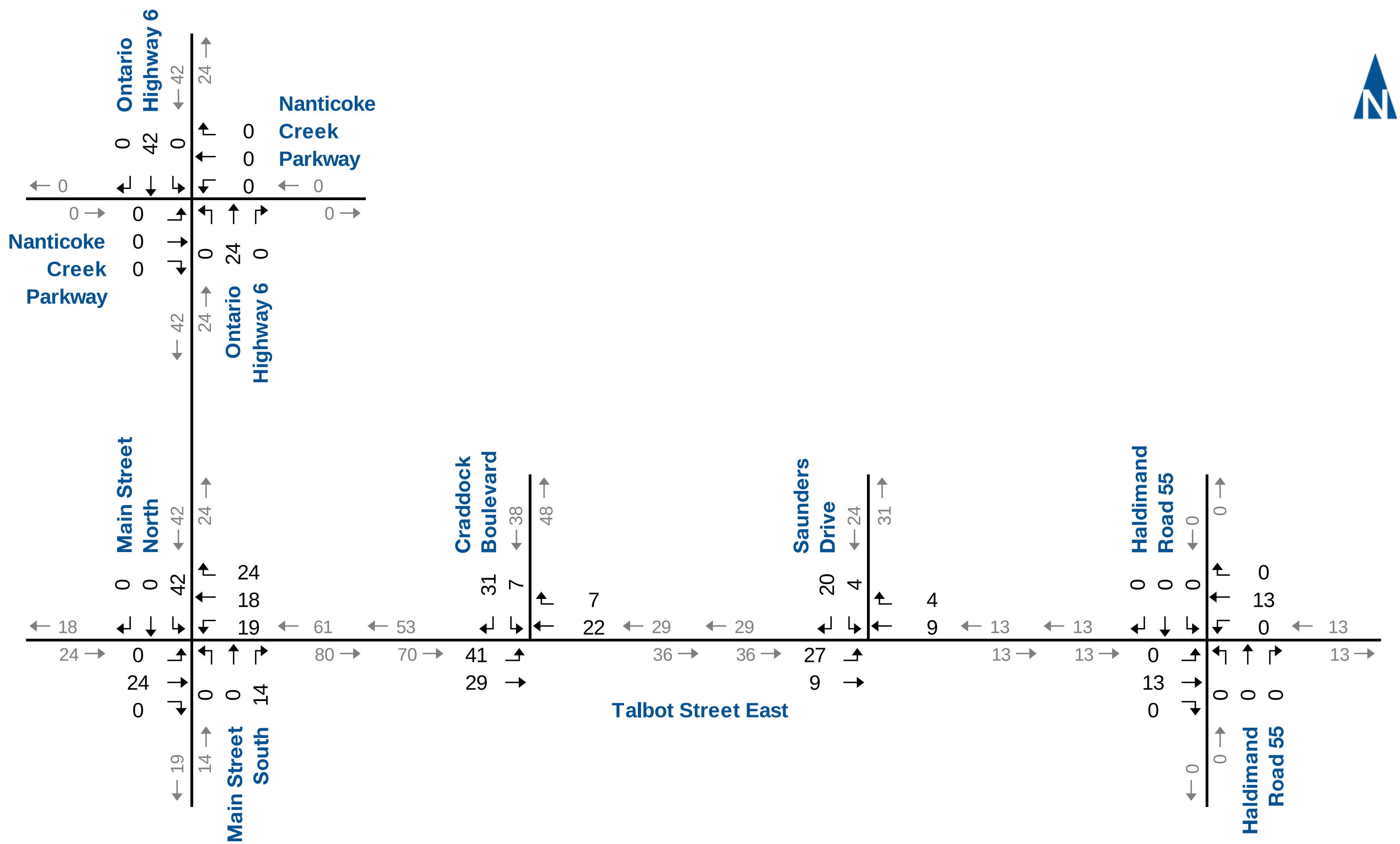
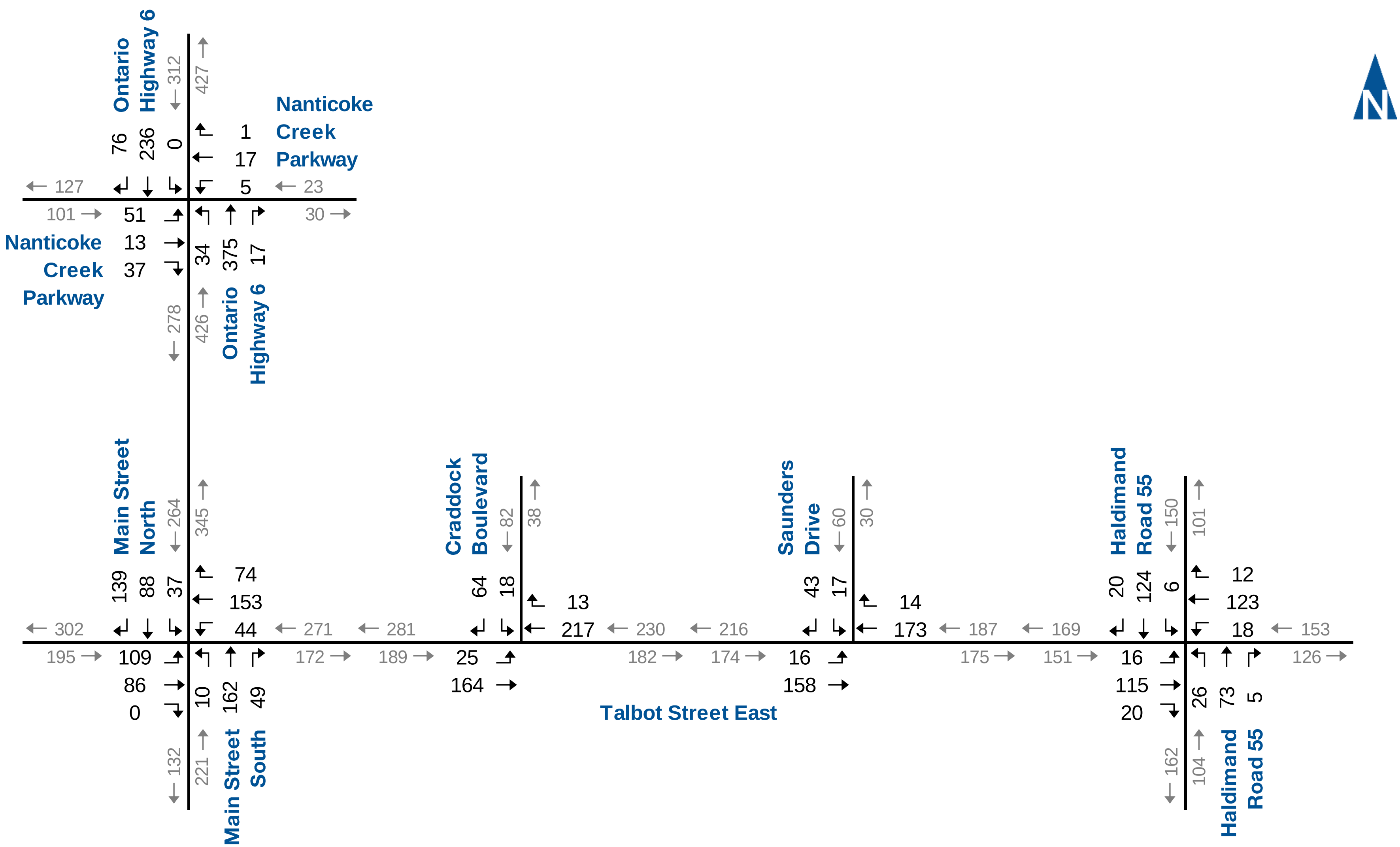
Site Generated Traffic Forecast AM Peak Hour

Figure 4



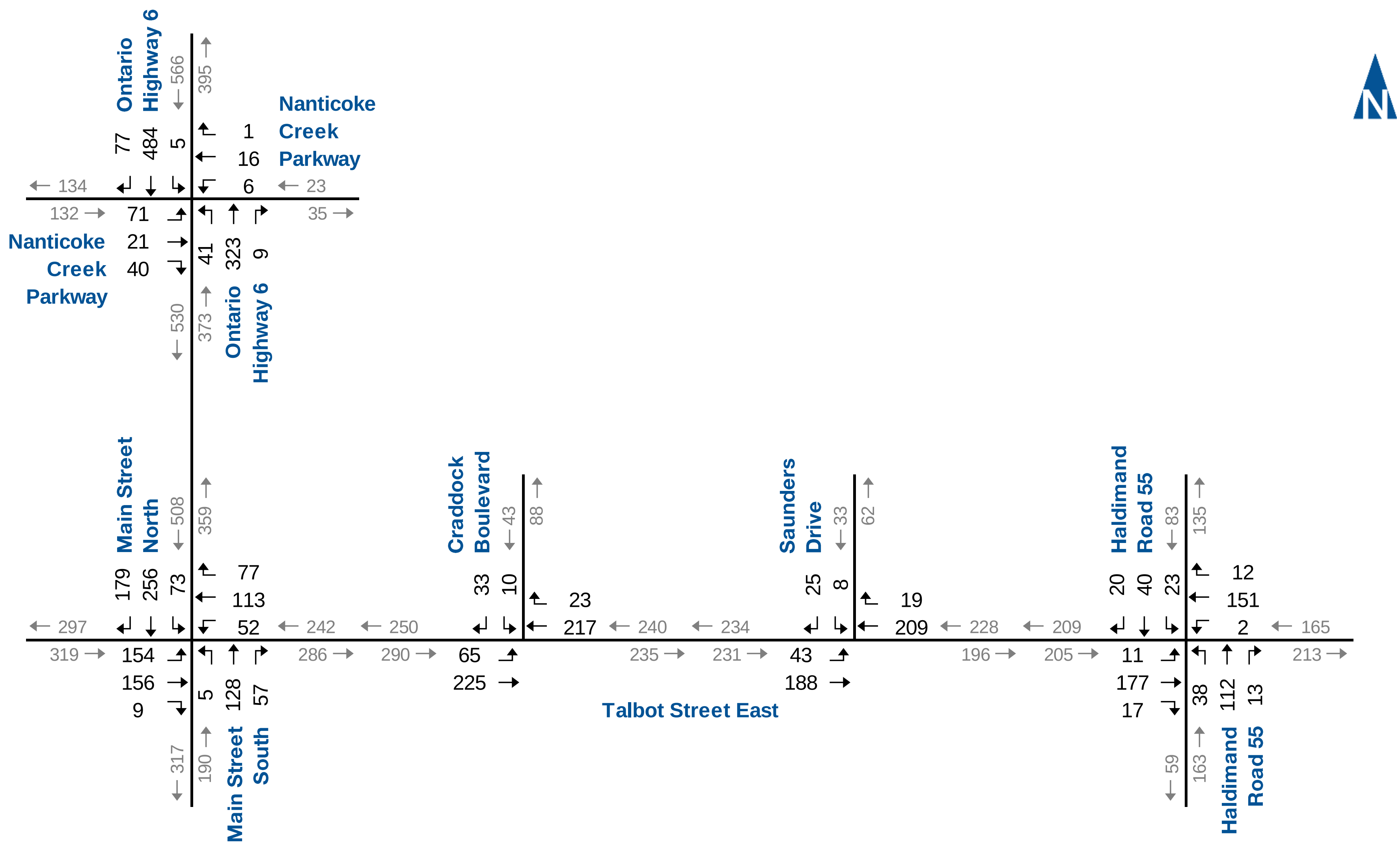
Site Generated Traffic Forecast PM Peak Hour

Figure 5



2038 Future Total Traffic Forecast AM Peak Hour

Figure 6



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2038 Future Total Traffic Forecast PM Peak Hour

Figure 7

Appendix A

Future Total Traffic Operations Summary Reports

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	51	13	37	5	17	1	34	375	17	0	236	76
Future Volume (vph)	51	13	37	5	17	1	34	375	17	0	236	76
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	0.0		0.0	0.0		0.0	120.0		120.0	90.0		90.0
Storage Lanes	0		0	0		0	1		1	1		1
Taper Length (m)	7.5			7.5			7.5			7.5		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.951			0.995				0.850			0.850
Flt Protected		0.975			0.989		0.950					
Satd. Flow (prot)	0	1629	0	0	1696	0	1626	1845	1509	1900	1810	1524
Flt Permitted		0.975			0.989		0.950					
Satd. Flow (perm)	0	1629	0	0	1696	0	1626	1845	1509	1900	1810	1524
Link Speed (k/h)		80			80			60			60	
Link Distance (m)		334.7			473.5			426.8			479.3	
Travel Time (s)		15.1			21.3			25.6			28.8	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Heavy Vehicles (%)	7%	27%	3%	0%	14%	0%	11%	3%	7%	0%	5%	6%
Adj. Flow (vph)	58	15	42	6	19	1	39	426	19	0	268	86
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	115	0	0	26	0	39	426	19	0	268	86
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			3.6			3.6	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Stop			Stop			Free			Free	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 44.9% ICU Level of Service A

Analysis Period (min) 15

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	51	13	37	5	17	1	34	375	17	0	236	76
Future Volume (Veh/h)	51	13	37	5	17	1	34	375	17	0	236	76
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	58	15	42	6	19	1	39	426	19	0	268	86
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	782	791	268	822	858	426	354			445		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	782	791	268	822	858	426	354			445		
tC, single (s)	7.2	6.8	6.2	7.1	6.6	6.2	4.2			4.1		
tC, 2 stage (s)												
tF (s)	3.6	4.2	3.3	3.5	4.1	3.3	2.3			2.2		
p0 queue free %	79	95	95	98	93	100	97			100		
cM capacity (veh/h)	281	285	768	261	272	633	1156			1126		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	115	26	39	426	19	0	268	86
Volume Left	58	6	39	0	0	0	0	0
Volume Right	42	1	0	0	19	0	0	86
cSH	367	276	1156	1700	1700	1700	1700	1700
Volume to Capacity	0.31	0.09	0.03	0.25	0.01	0.00	0.16	0.05
Queue Length 95th (m)	10.5	2.5	0.8	0.0	0.0	0.0	0.0	0.0
Control Delay (s)	19.2	19.4	8.2	0.0	0.0	0.0	0.0	0.0
Lane LOS	C	C	A					
Approach Delay (s)	19.2	19.4	0.7			0.0		
Approach LOS	C	C						

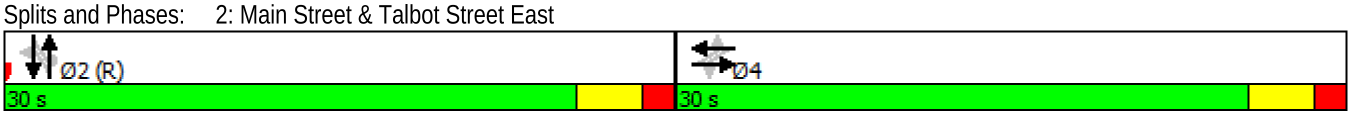
Intersection Summary			
Average Delay	3.1		
Intersection Capacity Utilization	44.9%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	109	86	0	44	153	74	10	162	49	37	88	139
Future Volume (vph)	109	86	0	44	153	74	10	162	49	37	88	139
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor								1.00			0.99	
Frt					0.963			0.970			0.929	
Flt Protected		0.973			0.992			0.998			0.993	
Satd. Flow (prot)	0	1708	0	0	1542	0	0	1590	0	0	1489	0
Flt Permitted		0.715			0.925			0.984			0.933	
Satd. Flow (perm)	0	1255	0	0	1437	0	0	1568	0	0	1399	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)					39			30			115	
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		190.6			627.7			265.6			263.4	
Travel Time (s)		13.7			45.2			19.1			19.0	
Confl. Peds. (#/hr)							2		1	1		2
Peak Hour Factor	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Heavy Vehicles (%)	6%	11%	0%	4%	7%	5%	0%	4%	3%	5%	4%	5%
Parking (#/hr)					0			0			0	
Adj. Flow (vph)	122	97	0	49	172	83	11	182	55	42	99	156
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	219	0	0	304	0	0	248	0	0	297	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.14	1.00	1.00	1.14	1.00	1.00	1.14	1.00
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			4			2			2	
Permitted Phases	4			4			2			2		
Minimum Split (s)	30.5	30.5		30.5	30.5		30.5	30.5		30.5	30.5	
Total Split (s)	30.0	30.0		30.0	30.0		30.0	30.0		30.0	30.0	
Total Split (%)	50.0%	50.0%		50.0%	50.0%		50.0%	50.0%		50.0%	50.0%	
Maximum Green (s)	25.5	25.5		25.5	25.5		25.5	25.5		25.5	25.5	
Yellow Time (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
All-Red Time (s)	1.5	1.5		1.5	1.5		1.5	1.5		1.5	1.5	
Lost Time Adjust (s)		0.0			0.0			0.0			0.0	
Total Lost Time (s)		4.5			4.5			4.5			4.5	
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)	15.0	15.0		15.0	15.0		15.0	15.0		15.0	15.0	
Flash Dont Walk (s)	10.0	10.0		10.0	10.0		10.0	10.0		10.0	10.0	
Pedestrian Calls (#/hr)	0	0		0	0		0	0		0	0	
Act Effct Green (s)		25.5			25.5			25.5			25.5	
Actuated g/C Ratio		0.42			0.42			0.42			0.42	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio		0.41			0.48			0.36			0.45	
Control Delay		15.0			13.9			12.1			9.9	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		15.0			13.9			12.1			9.9	
LOS		B			B			B			A	
Approach Delay		15.0			13.9			12.1			9.9	
Approach LOS		B			B			B			A	

Intersection Summary	
Area Type: Other	
Cycle Length: 60	
Actuated Cycle Length: 60	
Offset: 0 (0%), Referenced to phase 2:NBSB and 6:, Start of Green	
Natural Cycle: 65	
Control Type: Pretimed	
Maximum v/c Ratio: 0.48	
Intersection Signal Delay: 12.6	Intersection LOS: B
Intersection Capacity Utilization 64.3%	ICU Level of Service C
Analysis Period (min) 15	

Splits and Phases: 2: Main Street & Talbot Street East



Lane Group	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	219	304	248	297
v/c Ratio	0.41	0.48	0.36	0.45
Control Delay	15.0	13.9	12.1	9.9
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	15.0	13.9	12.1	9.9
Queue Length 50th (m)	16.8	20.6	16.0	13.2
Queue Length 95th (m)	32.4	39.6	31.0	30.3
Internal Link Dist (m)	166.6	603.7	241.6	239.4
Turn Bay Length (m)				
Base Capacity (vph)	533	633	683	660
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.41	0.48	0.36	0.45

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	109	86	0	44	153	74	10	162	49	37	88	139
Future Volume (vph)	109	86	0	44	153	74	10	162	49	37	88	139
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.5			4.5			4.5			4.5	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frpb, ped/bikes		1.00			1.00			1.00			0.99	
Flpb, ped/bikes		1.00			1.00			1.00			1.00	
Frt		1.00			0.96			0.97			0.93	
Flt Protected		0.97			0.99			1.00			0.99	
Satd. Flow (prot)		1708			1542			1590			1489	
Flt Permitted		0.71			0.93			0.98			0.93	
Satd. Flow (perm)		1255			1438			1568			1399	
Peak-hour factor, PHF	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Adj. Flow (vph)	122	97	0	49	172	83	11	182	55	42	99	156
RTOR Reduction (vph)	0	0	0	0	22	0	0	17	0	0	66	0
Lane Group Flow (vph)	0	219	0	0	282	0	0	231	0	0	231	0
Confl. Peds. (#/hr)							2		1	1		2
Heavy Vehicles (%)	6%	11%	0%	4%	7%	5%	0%	4%	3%	5%	4%	5%
Parking (#/hr)					0			0			0	
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			4			2			2	
Permitted Phases	4			4			2			2		
Actuated Green, G (s)		25.5			25.5			25.5			25.5	
Effective Green, g (s)		25.5			25.5			25.5			25.5	
Actuated g/C Ratio		0.42			0.42			0.42			0.42	
Clearance Time (s)		4.5			4.5			4.5			4.5	
Lane Grp Cap (vph)		533			611			666			594	
v/s Ratio Prot												
v/s Ratio Perm		0.17			c0.20			0.15			c0.17	
v/c Ratio		0.41			0.46			0.35			0.39	
Uniform Delay, d1		12.0			12.3			11.6			11.9	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		2.3			2.5			1.4			1.9	
Delay (s)		14.4			14.8			13.1			13.8	
Level of Service		B			B			B			B	
Approach Delay (s)		14.4			14.8			13.1			13.8	
Approach LOS		B			B			B			B	

Intersection Summary			
HCM 2000 Control Delay	14.0	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.42		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	64.3%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	25	164	217	13	18	64
Future Volume (vph)	25	164	217	13	18	64
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor						
Frt			0.992		0.895	
Flt Protected		0.993			0.989	
Satd. Flow (prot)	0	1722	1710	0	1514	0
Flt Permitted		0.993			0.989	
Satd. Flow (perm)	0	1722	1710	0	1514	0
Link Speed (k/h)		50	50		50	
Link Distance (m)		627.7	323.8		121.4	
Travel Time (s)		45.2	23.3		8.7	
Confl. Peds. (#/hr)	5			5		
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Heavy Vehicles (%)	0%	11%	10%	14%	22%	8%
Adj. Flow (vph)	26	171	226	14	19	67
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	197	240	0	86	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		0.0	0.0		3.6	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		4.8	4.8		4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25			15	25	15
Sign Control		Free	Free		Stop	

Intersection Summary	
Area Type: Other	
Control Type: Unsignalized	
Intersection Capacity Utilization 37.4%	ICU Level of Service A
Analysis Period (min) 15	

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	25	164	217	13	18	64
Future Volume (Veh/h)	25	164	217	13	18	64
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	26	171	226	14	19	67
Pedestrians					5	
Lane Width (m)					3.6	
Walking Speed (m/s)					1.2	
Percent Blockage					0	
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	245				461	238
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	245				461	238
tC, single (s)	4.1				6.6	6.3
tC, 2 stage (s)						
tF (s)	2.2				3.7	3.4
p0 queue free %	98				96	91
cM capacity (veh/h)	1327				511	783

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	197	240	86
Volume Left	26	0	19
Volume Right	0	14	67
cSH	1327	1700	701
Volume to Capacity	0.02	0.14	0.12
Queue Length 95th (m)	0.5	0.0	3.3
Control Delay (s)	1.2	0.0	10.9
Lane LOS	A		B
Approach Delay (s)	1.2	0.0	10.9
Approach LOS			B

Intersection Summary			
Average Delay	2.2		
Intersection Capacity Utilization	37.4%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	16	158	173	14	17	43
Future Volume (vph)	16	158	173	14	17	43
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor						
Frt			0.990		0.902	
Flt Protected		0.996			0.986	
Satd. Flow (prot)	0	1706	1696	0	1640	0
Flt Permitted		0.996			0.986	
Satd. Flow (perm)	0	1706	1696	0	1640	0
Link Speed (k/h)		50	50		50	
Link Distance (m)		323.8	805.7		146.6	
Travel Time (s)		23.3	58.0		10.6	
Confl. Peds. (#/hr)	3			3		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	12%	11%	10%	11%	0%
Adj. Flow (vph)	17	172	188	15	18	47
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	189	203	0	65	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.6	3.6		3.6	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		4.8	4.8		4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25			15	25	15
Sign Control		Free	Free		Stop	

Intersection Summary	
Area Type: Other	
Control Type: Unsignalized	
Intersection Capacity Utilization 31.9%	ICU Level of Service A
Analysis Period (min) 15	

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	16	158	173	14	17	43
Future Volume (Veh/h)	16	158	173	14	17	43
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	17	172	188	15	18	47
Pedestrians					3	
Lane Width (m)					3.6	
Walking Speed (m/s)					1.2	
Percent Blockage					0	
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	206				404	198
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	206				404	198
tC, single (s)	4.1				6.5	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.6	3.3
p0 queue free %	99				97	94
cM capacity (veh/h)	1374				577	846

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	189	203	65
Volume Left	17	0	18
Volume Right	0	15	47
cSH	1374	1700	749
Volume to Capacity	0.01	0.12	0.09
Queue Length 95th (m)	0.3	0.0	2.3
Control Delay (s)	0.8	0.0	10.3
Lane LOS	A		B
Approach Delay (s)	0.8	0.0	10.3
Approach LOS			B

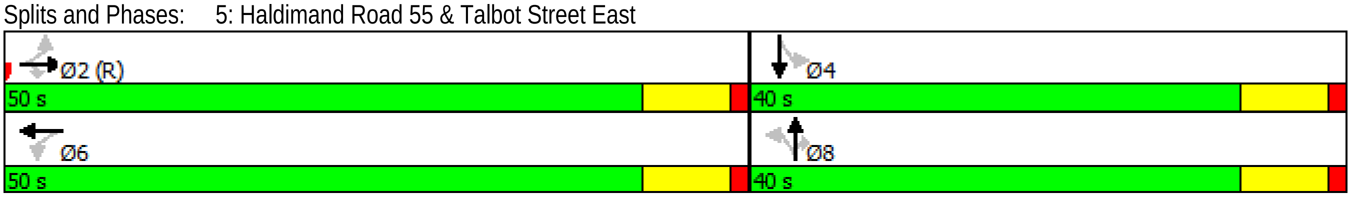
Intersection Summary			
Average Delay	1.8		
Intersection Capacity Utilization	31.9%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	16	115	20	18	123	12	26	73	5	6	124	20
Future Volume (vph)	16	115	20	18	123	12	26	73	5	6	124	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	85.0		100.0	110.0		0.0	85.0		100.0	105.0		0.0
Storage Lanes	1		1	1		0	1		1	1		0
Taper Length (m)	7.5			7.5			7.5			7.5		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850		0.986				0.850		0.979	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1805	1727	1233	1504	1776	0	1641	1545	1615	1805	1660	0
Flt Permitted	0.659			0.673			0.652			0.702		
Satd. Flow (perm)	1252	1727	1233	1066	1776	0	1126	1545	1615	1334	1660	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			51		8				52		10	
Link Speed (k/h)		80			80			80			80	
Link Distance (m)		805.7			412.7			457.4			469.5	
Travel Time (s)		36.3			18.6			20.6			21.1	
Peak Hour Factor	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
Heavy Vehicles (%)	0%	10%	31%	20%	6%	0%	10%	23%	0%	0%	14%	0%
Adj. Flow (vph)	18	132	23	21	141	14	30	84	6	7	143	23
Shared Lane Traffic (%)												
Lane Group Flow (vph)	18	132	23	21	155	0	30	84	6	7	166	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.6			3.6			3.6			3.6	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Turn Type	Perm	NA	Perm	Perm	NA		Perm	NA	Perm	Perm	NA	
Protected Phases		2			6			8			4	
Permitted Phases	2		2	6			8		8	4		
Minimum Split (s)	27.3	27.3	27.3	27.3	27.3		25.2	25.2	25.2	25.2	25.2	
Total Split (s)	50.0	50.0	50.0	50.0	50.0		40.0	40.0	40.0	40.0	40.0	
Total Split (%)	55.6%	55.6%	55.6%	55.6%	55.6%		44.4%	44.4%	44.4%	44.4%	44.4%	
Maximum Green (s)	42.7	42.7	42.7	42.7	42.7		32.8	32.8	32.8	32.8	32.8	
Yellow Time (s)	5.9	5.9	5.9	5.9	5.9		5.9	5.9	5.9	5.9	5.9	
All-Red Time (s)	1.4	1.4	1.4	1.4	1.4		1.3	1.3	1.3	1.3	1.3	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	7.3	7.3	7.3	7.3	7.3		7.2	7.2	7.2	7.2	7.2	
Lead/Lag												
Lead-Lag Optimize?												
Act Effct Green (s)	42.7	42.7	42.7	42.7	42.7		32.8	32.8	32.8	32.8	32.8	
Actuated g/C Ratio	0.47	0.47	0.47	0.47	0.47		0.36	0.36	0.36	0.36	0.36	
v/c Ratio	0.03	0.16	0.04	0.04	0.18		0.07	0.15	0.01	0.01	0.27	
Control Delay	12.9	14.1	1.1	13.1	13.6		19.4	20.2	0.0	18.5	20.4	
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay	12.9	14.1	1.1	13.1	13.6		19.4	20.2	0.0	18.5	20.4	
LOS	B	B	A	B	B		B	C	A	B	C	
Approach Delay		12.3			13.5			19.0			20.3	
Approach LOS		B			B			B			C	

Intersection Summary	
Area Type: Other	
Cycle Length: 90	
Actuated Cycle Length: 90	
Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green	
Natural Cycle: 55	
Control Type: Pretimed	
Maximum v/c Ratio: 0.27	
Intersection Signal Delay: 16.1	Intersection LOS: B
Intersection Capacity Utilization 59.8%	ICU Level of Service B
Analysis Period (min) 15	

Splits and Phases: 5: Haldimand Road 55 & Talbot Street East



Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	18	132	23	21	155	30	84	6	7	166
v/c Ratio	0.03	0.16	0.04	0.04	0.18	0.07	0.15	0.01	0.01	0.27
Control Delay	12.9	14.1	1.1	13.1	13.6	19.4	20.2	0.0	18.5	20.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	12.9	14.1	1.1	13.1	13.6	19.4	20.2	0.0	18.5	20.4
Queue Length 50th (m)	1.7	13.1	0.0	2.0	14.7	3.5	10.1	0.0	0.8	19.6
Queue Length 95th (m)	5.2	23.0	1.2	5.8	25.5	9.3	19.8	0.0	3.5	33.8
Internal Link Dist (m)		781.7			388.7		433.4			445.5
Turn Bay Length (m)	85.0		100.0	110.0		85.0		100.0	105.0	
Base Capacity (vph)	594	819	611	505	846	410	563	621	486	611
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.03	0.16	0.04	0.04	0.18	0.07	0.15	0.01	0.01	0.27

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	16	115	20	18	123	12	26	73	5	6	124	20
Future Volume (vph)	16	115	20	18	123	12	26	73	5	6	124	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	7.3	7.3	7.3	7.3	7.3		7.2	7.2	7.2	7.2	7.2	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85	1.00	0.98	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1805	1727	1233	1504	1777		1641	1545	1615	1805	1660	
Flt Permitted	0.66	1.00	1.00	0.67	1.00		0.65	1.00	1.00	0.70	1.00	
Satd. Flow (perm)	1251	1727	1233	1065	1777		1126	1545	1615	1335	1660	
Peak-hour factor, PHF	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
Adj. Flow (vph)	18	132	23	21	141	14	30	84	6	7	143	23
RTOR Reduction (vph)	0	0	12	0	4	0	0	0	4	0	6	0
Lane Group Flow (vph)	18	132	11	21	151	0	30	84	2	7	160	0
Heavy Vehicles (%)	0%	10%	31%	20%	6%	0%	10%	23%	0%	0%	14%	0%
Turn Type	Perm	NA	Perm	Perm	NA		Perm	NA	Perm	Perm	NA	
Protected Phases		2			6			8			4	
Permitted Phases	2		2	6			8		8	4		
Actuated Green, G (s)	42.7	42.7	42.7	42.7	42.7		32.8	32.8	32.8	32.8	32.8	
Effective Green, g (s)	42.7	42.7	42.7	42.7	42.7		32.8	32.8	32.8	32.8	32.8	
Actuated g/C Ratio	0.47	0.47	0.47	0.47	0.47		0.36	0.36	0.36	0.36	0.36	
Clearance Time (s)	7.3	7.3	7.3	7.3	7.3		7.2	7.2	7.2	7.2	7.2	
Lane Grp Cap (vph)	593	819	584	505	843		410	563	588	486	604	
v/s Ratio Prot		0.08			c0.08			0.05			c0.10	
v/s Ratio Perm	0.01		0.01	0.02			0.03		0.00	0.01		
v/c Ratio	0.03	0.16	0.02	0.04	0.18		0.07	0.15	0.00	0.01	0.26	
Uniform Delay, d1	12.6	13.5	12.5	12.7	13.6		18.7	19.2	18.2	18.3	20.1	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.1	0.4	0.1	0.2	0.5		0.3	0.6	0.0	0.1	1.1	
Delay (s)	12.7	13.9	12.6	12.8	14.0		19.0	19.8	18.2	18.3	21.2	
Level of Service	B	B	B	B	B		B	B	B	B	C	
Approach Delay (s)		13.6			13.9			19.5			21.1	
Approach LOS		B			B			B			C	

Intersection Summary			
HCM 2000 Control Delay	16.8	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.22		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	14.5
Intersection Capacity Utilization	59.8%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	71	21	40	6	16	1	41	323	9	5	484	77
Future Volume (vph)	71	21	40	6	16	1	41	323	9	5	484	77
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	0.0		0.0	0.0		0.0	120.0		120.0	90.0		90.0
Storage Lanes	0		0	0		0	1		1	1		1
Taper Length (m)	7.5			7.5			7.5			7.5		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.959			0.995				0.850			0.850
Flt Protected		0.974			0.986		0.950			0.950		
Satd. Flow (prot)	0	1724	0	0	1792	0	1752	1810	1417	1031	1863	1615
Flt Permitted		0.974			0.986		0.950			0.950		
Satd. Flow (perm)	0	1724	0	0	1792	0	1752	1810	1417	1031	1863	1615
Link Speed (k/h)		80			80			60			60	
Link Distance (m)		334.7			473.5			426.8			479.3	
Travel Time (s)		15.1			21.3			25.6			28.8	
Confl. Peds. (#/hr)			3	3					3	3		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	2%	6%	3%	0%	0%	100%	3%	5%	14%	75%	2%	0%
Adj. Flow (vph)	77	23	43	7	17	1	45	351	10	5	526	84
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	143	0	0	25	0	45	351	10	5	526	84
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			3.6			3.6	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Sign Control		Stop			Stop			Free			Free	

Intersection Summary	
Area Type: Other	
Control Type: Unsignalized	
Intersection Capacity Utilization 53.1%	ICU Level of Service A
Analysis Period (min) 15	

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	71	21	40	6	16	1	41	323	9	5	484	77
Future Volume (Veh/h)	71	21	40	6	16	1	41	323	9	5	484	77
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	77	23	43	7	17	1	45	351	10	5	526	84
Pedestrians					3			3				
Lane Width (m)					3.6			3.6				
Walking Speed (m/s)					1.2			1.2				
Percent Blockage					0			0				
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	986	990	529	1038	1064	354	610			364		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	986	990	529	1038	1064	354	610			364		
tC, single (s)	7.1	6.6	6.2	7.1	6.5	7.2	4.1			4.8		
tC, 2 stage (s)												
tF (s)	3.5	4.1	3.3	3.5	4.0	4.2	2.2			2.9		
p0 queue free %	62	90	92	96	92	100	95			99		
cM capacity (veh/h)	204	229	546	171	212	514	964			881		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	143	25	45	351	10	5	526	84
Volume Left	77	7	45	0	0	5	0	0
Volume Right	43	1	0	0	10	0	0	84
cSH	257	204	964	1700	1700	881	1700	1700
Volume to Capacity	0.56	0.12	0.05	0.21	0.01	0.01	0.31	0.05
Queue Length 95th (m)	24.8	3.3	1.2	0.0	0.0	0.1	0.0	0.0
Control Delay (s)	35.3	25.1	8.9	0.0	0.0	9.1	0.0	0.0
Lane LOS	E	D	A			A		
Approach Delay (s)	35.3	25.1	1.0			0.1		
Approach LOS	E	D						

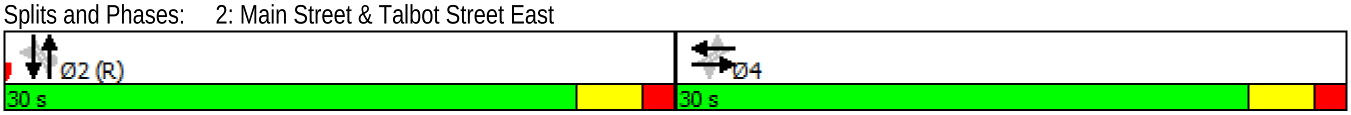
Intersection Summary			
Average Delay	5.2		
Intersection Capacity Utilization	53.1%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	154	156	9	52	113	77	5	128	57	73	256	179
Future Volume (vph)	154	156	9	52	113	77	5	128	57	73	256	179
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor		1.00			0.99			0.99			0.99	
Frt		0.996			0.957			0.960			0.952	
Flt Protected		0.976			0.989			0.999			0.993	
Satd. Flow (prot)	0	1753	0	0	1557	0	0	1567	0	0	1554	0
Flt Permitted		0.720			0.869			0.986			0.922	
Satd. Flow (perm)	0	1291	0	0	1368	0	0	1547	0	0	1442	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		3			49			45			57	
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		190.6			627.7			265.6			263.4	
Travel Time (s)		13.7			45.2			19.1			19.0	
Confl. Peds. (#/hr)	4					4	6		5	5		6
Peak Hour Factor	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Heavy Vehicles (%)	3%	8%	0%	0%	4%	4%	0%	3%	6%	8%	3%	1%
Parking (#/hr)					0			0			0	
Adj. Flow (vph)	173	175	10	58	127	87	6	144	64	82	288	201
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	358	0	0	272	0	0	214	0	0	571	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.14	1.00	1.00	1.14	1.00	1.00	1.14	1.00
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			4			2			2	
Permitted Phases	4			4			2			2		
Minimum Split (s)	30.5	30.5		30.5	30.5		30.5	30.5		30.5	30.5	
Total Split (s)	30.0	30.0		30.0	30.0		30.0	30.0		30.0	30.0	
Total Split (%)	50.0%	50.0%		50.0%	50.0%		50.0%	50.0%		50.0%	50.0%	
Maximum Green (s)	25.5	25.5		25.5	25.5		25.5	25.5		25.5	25.5	
Yellow Time (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
All-Red Time (s)	1.5	1.5		1.5	1.5		1.5	1.5		1.5	1.5	
Lost Time Adjust (s)		0.0			0.0			0.0			0.0	
Total Lost Time (s)		4.5			4.5			4.5			4.5	
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)	15.0	15.0		15.0	15.0		15.0	15.0		15.0	15.0	
Flash Dont Walk (s)	10.0	10.0		10.0	10.0		10.0	10.0		10.0	10.0	
Pedestrian Calls (#/hr)	0	0		0	0		0	0		0	0	
Act Effct Green (s)		25.5			25.5			25.5			25.5	
Actuated g/C Ratio		0.42			0.42			0.42			0.42	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio		0.65			0.45			0.31			0.89	
Control Delay		20.4			12.8			10.5			33.5	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		20.4			12.8			10.5			33.5	
LOS		C			B			B			C	
Approach Delay		20.4			12.8			10.5			33.5	
Approach LOS		C			B			B			C	

Intersection Summary	
Area Type: Other	
Cycle Length: 60	
Actuated Cycle Length: 60	
Offset: 0 (0%), Referenced to phase 2:NBSB and 6:, Start of Green	
Natural Cycle: 65	
Control Type: Pretimed	
Maximum v/c Ratio: 0.89	
Intersection Signal Delay: 22.7	Intersection LOS: C
Intersection Capacity Utilization 95.4%	ICU Level of Service F
Analysis Period (min) 15	

Splits and Phases: 2: Main Street & Talbot Street East



Queues
2: Main Street & Talbot Street East

Lane Group	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	358	272	214	571
v/c Ratio	0.65	0.45	0.31	0.89
Control Delay	20.4	12.8	10.5	33.5
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	20.4	12.8	10.5	33.5
Queue Length 50th (m)	31.1	16.9	12.0	52.7
Queue Length 95th (m)	57.2	34.1	24.9	#110.5
Internal Link Dist (m)	166.6	603.7	241.6	239.4
Turn Bay Length (m)				
Base Capacity (vph)	550	609	683	645
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.65	0.45	0.31	0.89

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	154	156	9	52	113	77	5	128	57	73	256	179
Future Volume (vph)	154	156	9	52	113	77	5	128	57	73	256	179
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.5			4.5			4.5			4.5	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frpb, ped/bikes		1.00			0.99			0.99			0.99	
Flpb, ped/bikes		1.00			1.00			1.00			1.00	
Frt		1.00			0.96			0.96			0.95	
Flt Protected		0.98			0.99			1.00			0.99	
Satd. Flow (prot)		1752			1557			1566			1554	
Flt Permitted		0.72			0.87			0.99			0.92	
Satd. Flow (perm)		1292			1368			1546			1444	
Peak-hour factor, PHF	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Adj. Flow (vph)	173	175	10	58	127	87	6	144	64	82	288	201
RTOR Reduction (vph)	0	2	0	0	28	0	0	26	0	0	33	0
Lane Group Flow (vph)	0	356	0	0	244	0	0	188	0	0	538	0
Confl. Peds. (#/hr)	4					4	6		5	5		6
Heavy Vehicles (%)	3%	8%	0%	0%	4%	4%	0%	3%	6%	8%	3%	1%
Parking (#/hr)					0			0			0	
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			4			2			2	
Permitted Phases	4			4			2			2		
Actuated Green, G (s)		25.5			25.5			25.5			25.5	
Effective Green, g (s)		25.5			25.5			25.5			25.5	
Actuated g/C Ratio		0.42			0.42			0.42			0.42	
Clearance Time (s)		4.5			4.5			4.5			4.5	
Lane Grp Cap (vph)		549			581			657			613	
v/s Ratio Prot												
v/s Ratio Perm		c0.28			0.18			0.12			c0.37	
v/c Ratio		0.65			0.42			0.29			0.88	
Uniform Delay, d1		13.7			12.1			11.3			15.8	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		5.8			2.2			1.1			16.3	
Delay (s)		19.5			14.3			12.4			32.1	
Level of Service		B			B			B			C	
Approach Delay (s)		19.5			14.3			12.4			32.1	
Approach LOS		B			B			B			C	

Intersection Summary			
HCM 2000 Control Delay	22.5	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.76		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	95.4%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	65	225	217	23	10	33
Future Volume (vph)	65	225	217	23	10	33
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.987		0.895	
Flt Protected		0.989			0.989	
Satd. Flow (prot)	0	1796	1826	0	1592	0
Flt Permitted		0.989			0.989	
Satd. Flow (perm)	0	1796	1826	0	1592	0
Link Speed (k/h)		50	50		50	
Link Distance (m)		627.7	323.8		121.4	
Travel Time (s)		45.2	23.3		8.7	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Heavy Vehicles (%)	0%	6%	3%	0%	25%	0%
Adj. Flow (vph)	74	256	247	26	11	38
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	330	273	0	49	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		0.0	0.0		3.6	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		4.8	4.8		4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25			15	25	15
Sign Control		Free	Free		Stop	

Intersection Summary	
Area Type: Other	
Control Type: Unsignalized	
Intersection Capacity Utilization 41.6%	ICU Level of Service A
Analysis Period (min) 15	

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	65	225	217	23	10	33
Future Volume (Veh/h)	65	225	217	23	10	33
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	74	256	247	26	11	38
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	273				664	260
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	273				664	260
tC, single (s)	4.1				6.6	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.7	3.3
p0 queue free %	94				97	95
cM capacity (veh/h)	1302				370	784

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	330	273	49
Volume Left	74	0	11
Volume Right	0	26	38
cSH	1302	1700	626
Volume to Capacity	0.06	0.16	0.08
Queue Length 95th (m)	1.4	0.0	2.0
Control Delay (s)	2.2	0.0	11.2
Lane LOS	A		B
Approach Delay (s)	2.2	0.0	11.2
Approach LOS			B

Intersection Summary			
Average Delay	2.0		
Intersection Capacity Utilization	41.6%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	43	188	209	19	8	25
Future Volume (vph)	43	188	209	19	8	25
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor						
Frt			0.989		0.899	
Flt Protected		0.991			0.988	
Satd. Flow (prot)	0	1795	1829	0	1688	0
Flt Permitted		0.991			0.988	
Satd. Flow (perm)	0	1795	1829	0	1688	0
Link Speed (k/h)		50	50		50	
Link Distance (m)		323.8	805.7		146.6	
Travel Time (s)		23.3	58.0		10.6	
Confl. Peds. (#/hr)	1			1	1	
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94
Heavy Vehicles (%)	0%	6%	3%	0%	0%	0%
Adj. Flow (vph)	46	200	222	20	9	27
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	246	242	0	36	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.6	3.6		3.6	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		4.8	4.8		4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25			15	25	15
Sign Control		Free	Free		Stop	

Intersection Summary	
Area Type: Other	
Control Type: Unsignalized	
Intersection Capacity Utilization 37.8%	ICU Level of Service A
Analysis Period (min) 15	

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	43	188	209	19	8	25
Future Volume (Veh/h)	43	188	209	19	8	25
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94
Hourly flow rate (vph)	46	200	222	20	9	27
Pedestrians			1		1	
Lane Width (m)			3.6		3.6	
Walking Speed (m/s)			1.2		1.2	
Percent Blockage			0		0	
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	243				526	233
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	243				526	233
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	97				98	97
cM capacity (veh/h)	1334				497	810

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	246	242	36
Volume Left	46	0	9
Volume Right	0	20	27
cSH	1334	1700	700
Volume to Capacity	0.03	0.14	0.05
Queue Length 95th (m)	0.9	0.0	1.3
Control Delay (s)	1.7	0.0	10.4
Lane LOS	A		B
Approach Delay (s)	1.7	0.0	10.4
Approach LOS			B

Intersection Summary			
Average Delay	1.5		
Intersection Capacity Utilization	37.8%	ICU Level of Service	A
Analysis Period (min)	15		

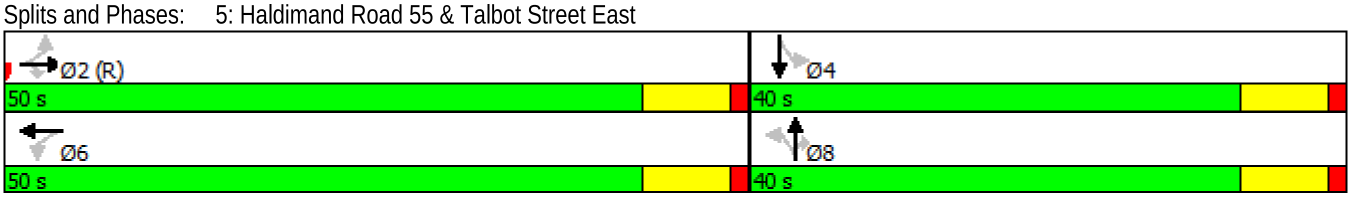
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	11	177	17	2	151	12	38	112	13	23	40	20
Future Volume (vph)	11	177	17	2	151	12	38	112	13	23	40	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	85.0		100.0	110.0		0.0	85.0		100.0	105.0		0.0
Storage Lanes	1		1	1		0	1		1	1		0
Taper Length (m)	7.5			7.5			7.5			7.5		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850		0.989				0.850		0.949	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1805	1792	1509	1805	1802	0	1752	1776	1042	1626	1479	0
Flt Permitted	0.640			0.632			0.713			0.676		
Satd. Flow (perm)	1216	1792	1509	1201	1802	0	1315	1776	1042	1157	1479	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			51		6				52		23	
Link Speed (k/h)		80			80			80			80	
Link Distance (m)		805.7			412.7			457.4			469.5	
Travel Time (s)		36.3			18.6			20.6			21.1	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Heavy Vehicles (%)	0%	6%	7%	0%	3%	20%	3%	7%	55%	11%	30%	6%
Adj. Flow (vph)	13	201	19	2	172	14	43	127	15	26	45	23
Shared Lane Traffic (%)												
Lane Group Flow (vph)	13	201	19	2	186	0	43	127	15	26	68	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.6			3.6			3.6			3.6	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Turn Type	Perm	NA	Perm	Perm	NA		Perm	NA	Perm	Perm	NA	
Protected Phases		2			6			8			4	
Permitted Phases	2		2	6			8		8	4		
Minimum Split (s)	27.3	27.3	27.3	27.3	27.3		25.2	25.2	25.2	25.2	25.2	
Total Split (s)	50.0	50.0	50.0	50.0	50.0		40.0	40.0	40.0	40.0	40.0	
Total Split (%)	55.6%	55.6%	55.6%	55.6%	55.6%		44.4%	44.4%	44.4%	44.4%	44.4%	
Maximum Green (s)	42.7	42.7	42.7	42.7	42.7		32.8	32.8	32.8	32.8	32.8	
Yellow Time (s)	5.9	5.9	5.9	5.9	5.9		5.9	5.9	5.9	5.9	5.9	
All-Red Time (s)	1.4	1.4	1.4	1.4	1.4		1.3	1.3	1.3	1.3	1.3	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	7.3	7.3	7.3	7.3	7.3		7.2	7.2	7.2	7.2	7.2	
Lead/Lag												
Lead-Lag Optimize?												
Act Effct Green (s)	42.7	42.7	42.7	42.7	42.7		32.8	32.8	32.8	32.8	32.8	
Actuated g/C Ratio	0.47	0.47	0.47	0.47	0.47		0.36	0.36	0.36	0.36	0.36	
v/c Ratio	0.02	0.24	0.03	0.00	0.22		0.09	0.20	0.04	0.06	0.12	
Control Delay	12.8	14.9	0.4	12.5	14.2		19.6	20.6	0.2	19.3	14.4	
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay	12.8	14.9	0.4	12.5	14.2		19.6	20.6	0.2	19.3	14.4	
LOS	B	B	A	B	B		B	C	A	B	B	
Approach Delay		13.6			14.2			18.7			15.8	
Approach LOS		B			B			B			B	

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green
Natural Cycle: 55
Control Type: Pretimed
Maximum v/c Ratio: 0.24
Intersection Signal Delay: 15.4 — Intersection LOS: B
Intersection Capacity Utilization 59.8% — ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 5: Haldimand Road 55 & Talbot Street East



Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	13	201	19	2	186	43	127	15	26	68
v/c Ratio	0.02	0.24	0.03	0.00	0.22	0.09	0.20	0.04	0.06	0.12
Control Delay	12.8	14.9	0.4	12.5	14.2	19.6	20.6	0.2	19.3	14.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	12.8	14.9	0.4	12.5	14.2	19.6	20.6	0.2	19.3	14.4
Queue Length 50th (m)	1.2	20.8	0.0	0.2	18.4	5.1	15.6	0.0	3.0	5.3
Queue Length 95th (m)	4.3	34.0	0.5	1.4	30.9	12.1	27.8	0.0	8.5	13.9
Internal Link Dist (m)		781.7			388.7		433.4			445.5
Turn Bay Length (m)	85.0		100.0	110.0		85.0		100.0	105.0	
Base Capacity (vph)	576	850	742	569	858	479	647	412	421	553
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.02	0.24	0.03	0.00	0.22	0.09	0.20	0.04	0.06	0.12

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	11	177	17	2	151	12	38	112	13	23	40	20
Future Volume (vph)	11	177	17	2	151	12	38	112	13	23	40	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	7.3	7.3	7.3	7.3	7.3		7.2	7.2	7.2	7.2	7.2	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85	1.00	0.95	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1805	1792	1509	1805	1801		1752	1776	1042	1626	1480	
Flt Permitted	0.64	1.00	1.00	0.63	1.00		0.71	1.00	1.00	0.68	1.00	
Satd. Flow (perm)	1217	1792	1509	1200	1801		1315	1776	1042	1156	1480	
Peak-hour factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	12	201	19	2	172	14	43	127	15	26	45	23
RTOR Reduction (vph)	0	0	10	0	3	0	0	0	10	0	15	0
Lane Group Flow (vph)	13	201	9	2	183	0	43	127	5	26	53	0
Heavy Vehicles (%)	0%	6%	7%	0%	3%	20%	3%	7%	55%	11%	30%	6%
Turn Type	Perm	NA	Perm	Perm	NA		Perm	NA	Perm	Perm	NA	
Protected Phases		2			6			8			4	
Permitted Phases	2		2	6			8		8	4		
Actuated Green, G (s)	42.7	42.7	42.7	42.7	42.7		32.8	32.8	32.8	32.8	32.8	
Effective Green, g (s)	42.7	42.7	42.7	42.7	42.7		32.8	32.8	32.8	32.8	32.8	
Actuated g/C Ratio	0.47	0.47	0.47	0.47	0.47		0.36	0.36	0.36	0.36	0.36	
Clearance Time (s)	7.3	7.3	7.3	7.3	7.3		7.2	7.2	7.2	7.2	7.2	
Lane Grp Cap (vph)	577	850	715	569	854		479	647	379	421	539	
v/s Ratio Prot		c0.11			0.10			c0.07			0.04	
v/s Ratio Perm	0.01		0.01	0.00			0.03		0.01	0.02		
v/c Ratio	0.02	0.24	0.01	0.00	0.21		0.09	0.20	0.01	0.06	0.10	
Uniform Delay, d1	12.6	14.0	12.5	12.5	13.8		18.8	19.6	18.3	18.6	18.9	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.1	0.7	0.0	0.0	0.6		0.4	0.7	0.1	0.3	0.4	
Delay (s)	12.6	14.7	12.5	12.5	14.4		19.2	20.3	18.3	18.9	19.2	
Level of Service	B	B	B	B	B		B	C	B	B	B	
Approach Delay (s)		14.4			14.4			19.8			19.1	
Approach LOS		B			B			B			B	

Intersection Summary			
HCM 2000 Control Delay	16.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.22		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	14.5
Intersection Capacity Utilization	59.8%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group