



River Mill Subdivision

Preliminary Water Distribution Analysis

Project Location:

East of Speedsville Road
South of Maple Grove Road
City of Cambridge

Prepared for:

River Mill Development Corporation
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MTE File No.: 45244-104





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1.0 Introduction

1.1 Overview

MTE Consultants Inc. (MTE) was retained by River Mill Development Corporation, to complete a Preliminary Water Distribution Analysis in support of a Planning Act application for the proposed River Mill Residential Subdivision in the City of Cambridge. The proposed development consists of two (2) separate applications and Draft Plans of Subdivision, one for Phase 4 and one for Phase 5. For the purposes of this analysis and report, the two draft plans will be reviewed as one cohesive development. As such, the overall River Mill Residential Subdivision will be referred to herein as the 'subject lands'.

The subject lands comprise a total area of approximately 49.5ha. The Phase 4 lands are approximately 45.4ha, and the Phase 5 lands are approximately 4.1ha in size. The subject lands are generally bounded by Maple Grove Road to the North, Speedsville Road to the West, Equestrian Way to the South and Briardean Road to the East. Further east of Briardean Road is an existing residential development. The location of the proposed development is presented in **Figure 1.1**.

The Draft Plans of Subdivision have been prepared by T. Johns Consulting Group dated September 23 and 25, 2020 for Phase 4 and Phase 5 respectively, and forms the basis for the proposed watermain servicing design presented in this report. The Draft Plans of Subdivision include low and medium density residential blocks, high density mixed use blocks, stormwater management facility block, community park, open space block, and municipal right-of-ways.

The purpose of this Preliminary Water Distribution Analysis is to confirm that adequate pressure and water supply is available to support the proposed development through connections to the existing Region of Waterloo (Region) water distribution network. The preliminary analysis is also used to determine the pipe sizes for the proposed internal water distribution network and whether the pressures within the development under various demand scenarios, including fire flow, are within the guidelines set out by the Ministry of the Environment, Conservation and Parks (MECP), The Region, and the City of Cambridge (City).

1.2 Background Information

The subject lands are located just inside the east boundary of Cambridge Pressure Zone 2W; adjacent to Cambridge Pressure Zone 2E. Based on modeling results received from the Region, the current hydraulic grade line (HGL) of Zone 2W is approximately 364.3m, with a serviceability range of approximately 308.3m to 328.3m. The HGL of Zone 2E is approximately 356.1m, with an approximate serviceability range of 300.1m to 320.1m.

The current Zone 2W/2E interface is defined by a pressure reducing valve (PRV) on Maple Grove Road east of Briardean Road.

The current HGL information has specified that any centerline of road elevation below 308.3m in Zone 2W and 300.1m in Zone 2E may require services to be connected to individual pressure reducing valves (PRVs), as specified in section B.2.4.7 of the *Region of Waterloo and Area Municipalities Design Guidelines and Supplemental Specifications for Municipal Services (DGSSMS) (RMOW, 2020)*.

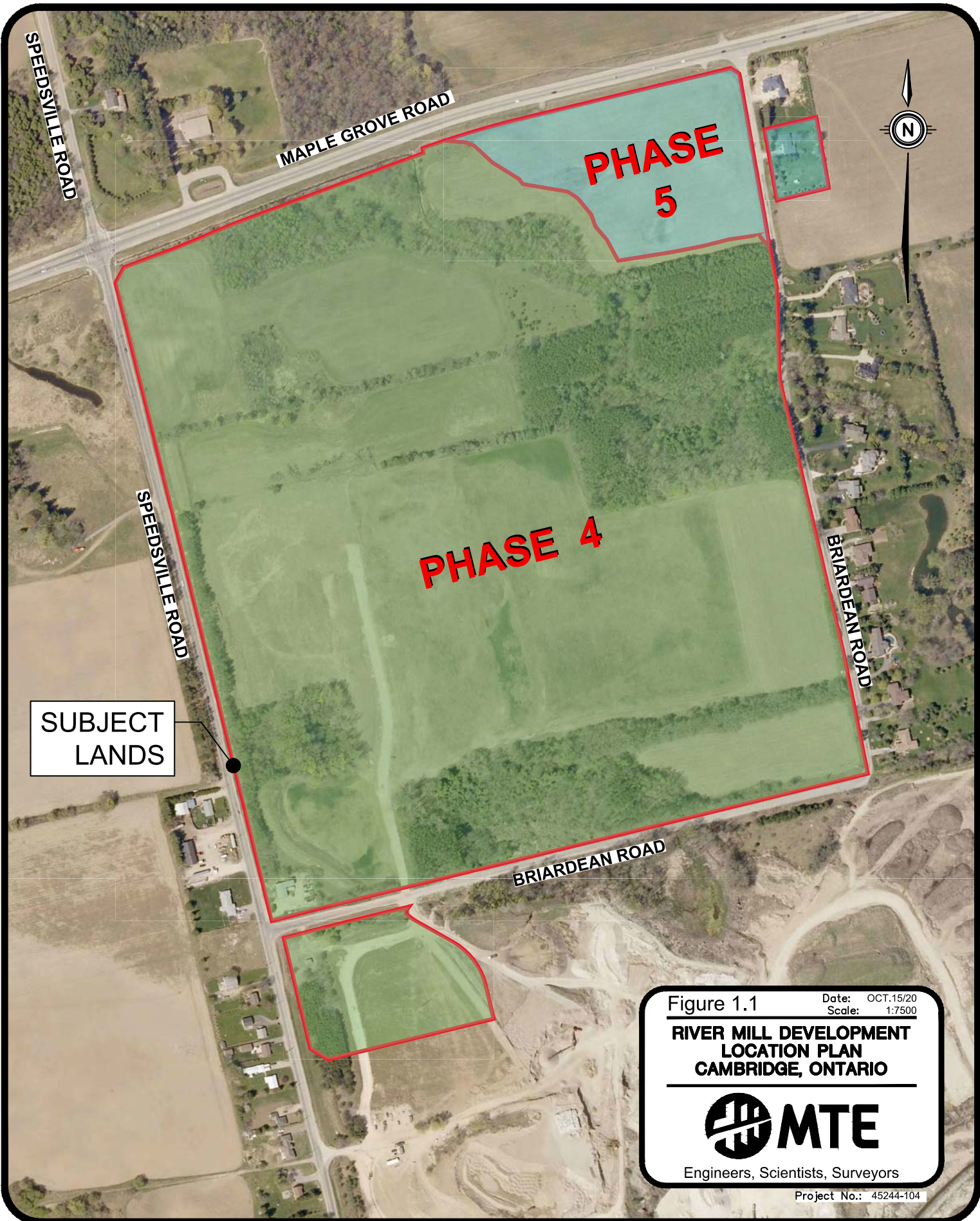


Figure 1.1

Date: OCT.15/20
Scale: 1:7500

**RIVER MILL DEVELOPMENT
LOCATION PLAN
CAMBRIDGE, ONTARIO**



Engineers, Scientists, Surveyors

Project No.: 45244-104

2.0 Analysis Methodology

2.1 Model Development

The Bentley water distribution system analysis program (WaterCAD CONNECT Edition) was utilized for the analysis of the local water distribution system for this study. The model utilizes demands for the fully-developed proposed subdivision. The Region maintains a macro scale water distribution model developed for trunk supply and distribution of water. The macro scale pressure and flow information from the Region's model is used in MTE's micro scale model to ensure the system operates within the allowable pressure ranges. The WaterCAD model includes the proposed road fabric and watermain connectivity to size the internal watermains, accounting for looping and head losses in the local system. One servicing scenario was modeled for the proposed River Mill Subdivision which includes both Phase 4 and Phase 5.

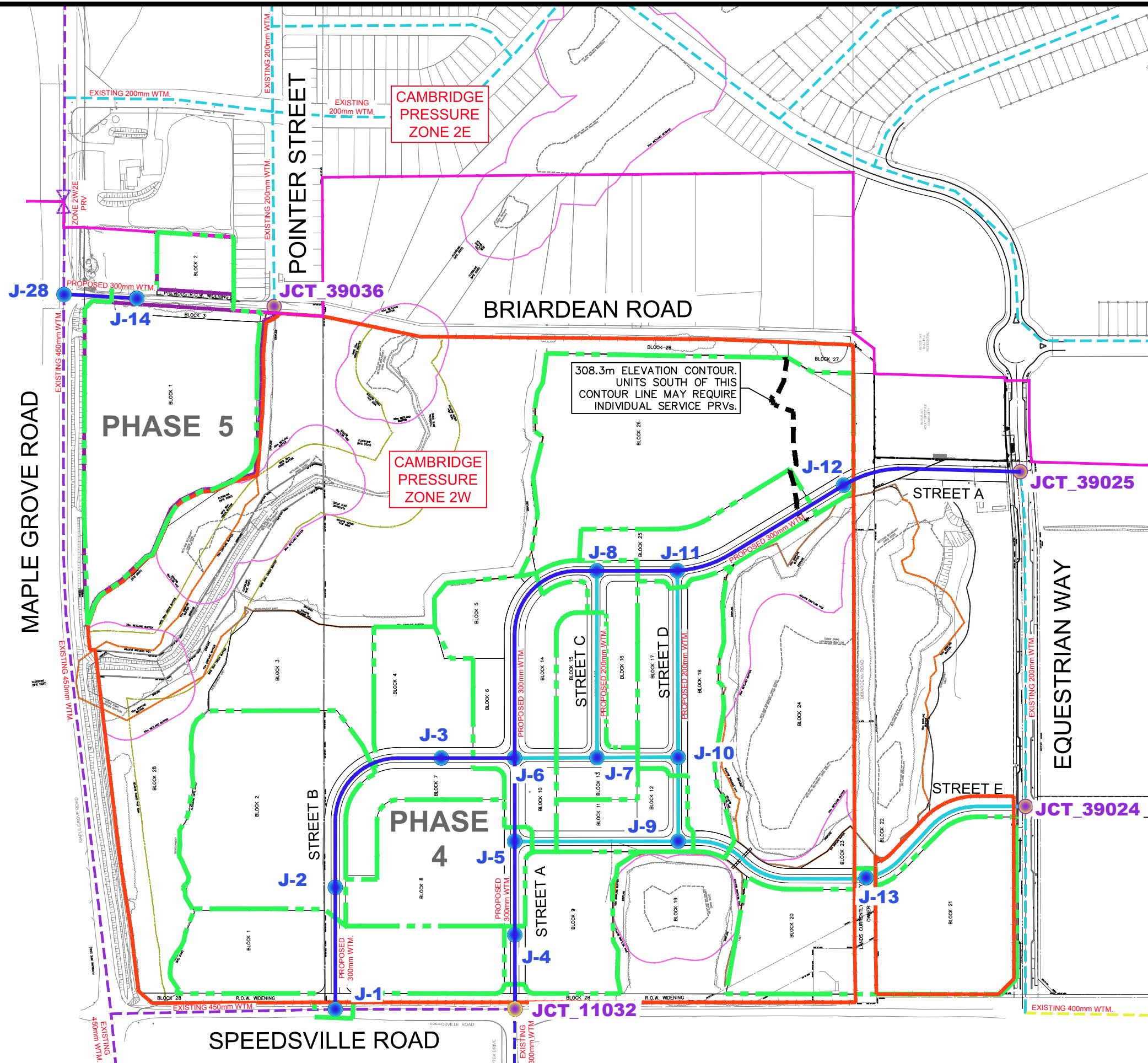
2.1.1 Network Connections

Water supply for the proposed River Mill Subdivision will be provided by five connection points to the existing municipal water distribution system as follows:

- Direct connection to the existing 450mm diameter watermain along Speedsville Road, at the intersection with proposed Street B;
- Direct connection to the existing 450mm diameter watermain along Speedsville Road, at the intersection with proposed Street A;
- Direct connection to the existing 200mm diameter watermain along Equestrian Way, at the intersection with proposed Street E;
- Direct connection to the existing 200mm diameter watermain along Equestrian Way, at the intersection with proposed Street A; and
- Direct connection to the existing 450mm diameter watermain along Maple Grove Road, at the intersection with Briardean Road.

The nearest existing Region Water Distribution Model nodes are JCT_11032, JCT_39024, and JCT_39025 for Zone 2W, and JCT_39036 for Zone 2E. JCT_11032 is located at the intersection of Speedsville Road and proposed Street A. JCT_39024 is located at the intersection of Equestrian Way and proposed Street E. JCT_39025 is located at the intersection of Equestrian Way and proposed Street A. JCT_39036 is located at the intersection of Pointer Street and Briardean Road. Refer to **Figure 2.1** for more details regarding the location of the nodes, network connections and water demand contributing areas.

Connection to the existing 200mm diameter watermain on Pointer Street through JCT_39036 was explored during the analysis. However, it was determined that the existing infrastructure did not provide sufficient flow to adequately service the development. This also avoids a long dead-end watermain over the maximum *DGSSMS* (Section B.2.5.8) permitted length of 150m.



LEGEND

- PHASE 4 BOUNDARY
- PHASE 5 BOUNDARY
- PRESSURE ZONE BOUNDARY LIMIT
- - - JUNCTION CONTRIBUTING AREA
- - - EXISTING 450mm ϕ WATERMAIN
- - - EXISTING 400mm ϕ WATERMAIN
- - - EXISTING 300mm ϕ WATERMAIN
- - - EXISTING 200mm ϕ WATERMAIN
- PROPOSED 300mm ϕ WATERMAIN
- PROPOSED 200mm ϕ WATERMAIN
- J-8 INTERNAL DEMAND JUNCTION
- JCT_# REGIONAL DEMAND JUNCTION

FIGURE 2.1 Date: OCT.15/20
Scale: 1:4000

RIVER MILL DEVELOPMENT
CONCEPTUAL WATER DISTRIBUTION PLAN

MTE
Engineers, Scientists, Surveyors

Project No.: 45244-104

2.2 Design Criteria

The network for the analysis was developed by assigning physical parameters to each node and pipe. The model was run under five demand scenarios: Average Day, Maximum Day, Minimum Hour, Peak Hour, and Maximum Day + Fire Flow. Each scenario was checked against guidelines for pressure and fire flow availability. The model parameters, design criteria, and guidelines are outlined in the following sections.

2.2.1 System Pressure

The system pressure information used for this analysis is based on the Region's water distribution model results provided by the Region (Mr. Kevin Dolishny), on May 1, 2020 for nodes JCT_11032, JCT_39024, JCT_39025, and JCT_39036. The system pressures were determined for the Average Day, Maximum Day, Peak Hour, Minimum Hour, and Maximum Day + Fire Flow scenarios. **Table 2.1**, **Table 2.2**, **Table 2.3** and **Table 2.4** provide a summary of the system pressures used in the analysis at each Regional node. **Appendix A** contains the system pressure data correspondence with the Region.

Table 2.1 – System Pressures for JCT_11032 (Zone 2W)

Demand Scenario	Discharge (L/s)	HGL (m)	Head (m)
Initial	0.00	364.20	55.20
Minimum Hour	4.24	364.13	55.13
Average Day	9.02	364.56	55.56
Maximum Day	12.59	364.06	55.06
Peak Hour	22.26	363.99	54.99
Max Day + 100 L/s Fire Flow	112.72	362.40	53.40
Max Day + 200 L/s Fire Flow	212.72	358.70	49.70
Max Day + 300 L/s Fire Flow	312.72	353.10	44.10
Max Day + 400 L/s Fire Flow	412.72	345.90	36.90
Max Day + 500 L/s Fire Flow	512.72	337.00	28.00
Max Day + 600 L/s Fire Flow	612.72	326.50	17.50
Max Day + 621.6 L/s Fire Flow	634.32	324.00	15.00

Table 2.2 – System Pressures for JCT_39024 (Zone 2W)

Demand Scenario	Discharge (L/s)	HGL (m)	Head (m)
Initial	0.00	364.05	52.20
Minimum Hour	1.75	364.37	52.52
Average Day	3.72	364.49	52.64
Maximum Day	5.26	363.90	52.05
Peak Hour	9.20	363.69	51.84
Max Day + 40 L/s Fire Flow	45.26	361.75	49.90
Max Day + 80 L/s Fire Flow	85.26	356.55	44.70
Max Day + 120 L/s Fire Flow	125.26	348.95	37.10
Max Day + 160 L/s Fire Flow	165.26	338.85	27.00
Max Day + 200 L/s Fire Flow	205.26	326.55	14.70
Max Day + 201.9 L/s Fire Flow	207.16	325.85	14.00

Table 2.3 – System Pressures for JCT_39025 (Zone 2W)

Demand Scenario	Discharge (L/s)	HGL (m)	Head (m)
Initial	0.00	364.10	61.50
Minimum Hour	1.41	364.49	61.89
Average Day	3.00	364.39	61.79
Maximum Day	4.23	363.87	61.27
Peak Hour	7.40	363.59	60.99
Max Day + 40 L/s Fire Flow	44.23	359.40	56.80
Max Day + 80 L/s Fire Flow	84.23	348.40	45.80
Max Day + 120 L/s Fire Flow	124.23	331.70	29.10
Max Day + 148.4 L/s Fire Flow	152.63	316.60	14.00

Table 2.4 – System Pressures for JCT_39036 (Zone 2E)

Demand Scenario	Discharge (L/s)	HGL (m)	Head (m)
Initial	0.00	354.50	43.60
Minimum Hour	0.72	357.35	46.45
Average Day	1.54	355.52	44.62
Maximum Day	2.19	354.55	43.65
Peak Hour	3.83	352.14	41.24
Max Day + 40 L/s Fire Flow	42.19	351.80	40.90
Max Day + 80 L/s Fire Flow	82.19	345.40	34.50
Max Day + 120 L/s Fire Flow	122.19	335.60	24.70
Max Day + 153.8 L/s Fire Flow	155.99	324.90	14.00

2.2.2 System Demands

The system demands for the subdivision were determined using the proposed population, based on the Draft Plans, and specific water usage rates for the City of Cambridge from the *Tri-City Water Distribution Master Plan (AECOM, May 2009)* and *Region of Waterloo 2020 Water and Wastewater Monitoring Report (RMOW, 2020)*. Residential demands were derived for representative areas contributing to each node in the model, multiplied by the respective persons per unit designation from the *Region of Waterloo 2020 Water and Wastewater Monitoring Report* (refer to Note 2 in **Appendix B**), multiplied by 227.7L/p/d per the *Tri-City Water Distribution Master Plan* and then converted to L/s. Based on the Region's maximum unit densities, the estimated population of the subdivision is approximately 4,315. The unit densities, average usage rates, and demand calculations for each node are provided in **Appendix B**.

2.2.3 Peaking Factors

The peaking factors are based on the population of the development (3,001-10,000) as outlined in Chapter 3 of the *Design Guidelines for Drinking-Water Systems (MOE, 2008)*. However, the Maximum Day peaking factor is taken from the Region's *Tri-City Water Distribution Master Plan* as provided in the Recommendations. **Table 2.5** summarizes the peaking factors used in the analysis based on the population calculated in **Appendix B**.

Table 2.5 - Peaking Factors

Demand Scenario	Factor
Average Day	1.0
Maximum Day	1.44
Peak Hour	3.0
Minimum Hour	0.5

2.2.4 Pressure Requirements

As outlined in Section B.2.4 of the Region's *DGSSMS*, the pressure guidelines used for all demand scenarios are shown in **Table 2.6**. The maximum static pressure in the watermain system should not exceed 700kPa under any scenario.

Table 2.6 - DGSSMS Pressure Guidelines

Demand Scenario	Pressure Guidelines (kPa)	
	Minimum	Maximum
Average Day	350	550
Maximum Day	350	550
Peak Hour	275	700
Minimum Hour	275	700
Max Day + Fire	140	700

2.2.5 Fire Flow Requirements

Various guidelines and references exist for calculating the required water supply for firefighting purposes. In Ontario, two standards/guidelines are most often referenced. They are:

1. *Ontario Building Code (OBC)* – Provincial codes and guidelines published by the Ministry of Municipal Affairs and Housing for the Province of Ontario.
2. *The Fire Underwriters Survey (FUS)* – an insurance industry guideline.

Many municipalities in Ontario use both the *OBC* and the *FUS* fire flow requirements for assessing firefighting water supply requirements. Ideally, fire flow demands for new developments are calculated based on the *FUS* criteria, however it is not reasonable to expect that the existing municipal watermain infrastructure always has the operational capacity to

supply water at the rates prescribed in the *FUS* guidelines. As a result, at no time shall the available fire flow be less than that required by the *OBC*.

The fire flow demand for the development was determined from the *Water Supply for Public Fire Protection, A Guide to Recommended Practice (1999), Fire Underwriter's Survey (FUS)*.

Based on the *FUS* manual, the required fire flow is as follows:

- High-density, multiple residential/mixed use – 12,000 L/min (200 L/s)
- Medium-density, contiguous multiple residential townhomes - 8,000 L/min (133 L/s)
- Medium-density, single family homes < 3m separation - 6,000 L/min (100 L/s)

Specific details are not currently available for the proposed multiple residential and mixed use blocks and as such, fire flow values should be confirmed when the information becomes available.

2.2.6 Friction Factors

Section B.2.3.1 of the *DGSSMS* recommends the following Hazen-Williams “C” values be used to estimate frictional losses through the system, regardless of size. The friction factors, as specified in the *DGSSMS* guidelines, include an allowance for age.

Table 2.7 - Hazen-Williams C-Factors

Material (mm)	C-Factor
PVC	150
DI	130
CPP	140
HDPE	140
Unknown	130

2.2.7 Velocity Requirements

Section B.2.3.4 of the *DGSSMS* recommends that velocities throughout the distribution system not exceed a maximum of 5.0 m/s under all flow conditions.

2.2.8 Minor Losses

Minor losses are caused by appurtenances and fittings along the length of pipe in the system. For this preliminary analysis, a conservative K value of 1.0 was used for all pipes.

3.0 Results

The model was run to analyze the pipe sizes according to the aforementioned design criteria, under the various demand scenarios. **Appendix C** provides the proposed network and a series of tables summarizing the output results of the WaterCAD analysis. **Table 3.1** provides a summary of the model results identifying the system pressures for each demand scenario.

As shown in **Table 3.1**, where the centerline of road elevation is above 308.3m near the nodes, the proposed water distribution system will adequately provide the required daily water demands within the *DGSSMS* recommended minimum and maximum pressure range guidelines of 350kPa to 550kPa for the Average and Maximum Day demand scenarios, and 275kPa to 700kPa for the Minimum and Peak Hour demand scenarios.

However, **Table 3.1** indicates that where the centerline of road elevation is below 308.3m near node J-12, the pressures for the Average and Maximum Day demand scenarios are above the recommended *DGSSMS* maximum pressure guideline of 550kPa. The maximum modeled pressure at node J-12 is approximately 568kPa, which represents the lowest elevation (305.88m) within the subdivision potentially requiring service connections. However, the absolute minimum elevation of the subject lands is south of node J-12 near Regional node JCT_39025 at an elevation of 302.60m. Therefore, the implementation of individual pressure reducing valves may be required near this location, as highlighted in **Table 3.1**, to satisfy the maximum pressure requirement.

The fire flow analysis indicates instances where the velocity in some pipes exceeds the current *DGSSMS* recommended maximum of 5.0m/s. However, the pipe sizes were not increased for the sole purpose of reducing the maximum velocity experienced under the rare fire flow condition, as this may create an environment for stagnant water conditions to arise when demands are lower (i.e. Average Day), especially where the pipes with velocities exceeding 5.0m/s feed a cul-de-sac.

Table 3.1 – Modeling Results

Node	Elev. (m)	Pressure (kPa)				Maximum Day + Fire Flow				
		Average Day	Maximum Day	Minimum Hour	Peak Hour	Fire Flow Required (L/s)	Available Fire Flow (L/s)	Residual Pressure (kPa)	Velocity of Max Pipe (m/s)	Pipe with Max. Velocity
J-1	307.52	552.0	552.0	553.0	551.0	200.00	622.00	259.0	3.21	P-47
J-2	310.24	526.0	525.0	526.0	524.0	133.00	622.00	171.0	5.47	P-48
J-3	309.83	530.0	529.0	530.0	528.0	133.00	622.00	162.0	4.95	P-50
J-4	310.97	519.0	518.0	519.0	517.0	200.00	622.00	204.0	5.69	P-32
J-5	310.59	522.0	522.0	522.0	521.0	133.00	622.00	190.0	4.50	P-32
J-6	310.21	526.0	526.0	526.0	525.0	100.00	622.00	187.0	3.83	P-34
J-7	310.61	522.0	522.0	522.0	521.0	100.00	529.05	140.0	6.87	P-35
J-8	310.18	526.0	526.0	526.0	525.0	100.00	589.20	140.0	4.27	P-39
J-9	311.01	518.0	518.0	518.0	517.0	100.00	494.55	140.0	6.32	P-37
J-10	311.04	518.0	518.0	518.0	517.0	100.00	513.28	140.0	6.07	P-36
J-11	310.64	522.0	521.0	522.0	520.0	100.00	561.05	140.0	4.81	P-42
J-12	305.88	568.0	568.0	569.0	567.0	133.00	518.07	140.0	5.48	P-43
J-13	312.79	501.0	500.0	501.0	499.0	200.00	362.57	140.0	5.82	P-46
J-14	312.56	503.0	503.0	503.0	502.0	133.00	470.57	140.0	6.66	P-57

**Highlighted row represents the junction around which individual PRVs may be required. Specifically, potential units near the south end of Block 26 with a centreline of road elevation lower than 308.3m. As concept plans are not yet finalized, this will be confirmed as part of the Site Plan Approval process.*

4.0 Conclusions and Recommendations

Based on the preliminary water distribution analysis, the following conclusions and recommendations are provided:

1. Direct connections to the existing 450mm diameter watermain on Speedsville Road, the existing 200mm diameter watermain on Equestrian Way, and the existing 450mm diameter watermain on Maple Grove Road, will adequately service the proposed subdivision.
2. The proposed water distribution network will adequately provide the required daily water demands within the respective pressure guidelines for most junctions where the centreline of road is above an elevation of 308.3m.
3. Some potential units near the south end of Block 26, where the centreline of road elevation is below 308.3m, may require the installation of individual pressure reducing valves (PRVs) in order to reduce the incoming water pressure to below the *DGSSMS* recommended maximum value of 550kPa under the Average and Maximum Day demand scenarios. However, since concept plans are not yet finalized, this will be confirmed as part of the Site Plan Approval process.
4. Water model results indicate that the proposed water distribution system will adequately provide the recommended *FUS* fire flows at the minimum MECP pressure of 140kPa.
5. Pipe velocities were generally less than the *DGSSMS* recommended maximum of 5.0m/s for most pipes within the subdivision under fire flow conditions. However, the pipe sizes experiencing pipe velocities greater than 5.0m/s, were not increased for the sole purpose of reducing the maximum velocity experienced under the rare fire flow condition, as this may create an environment for stagnant water conditions to arise under normal daily demands.

It is recommended that a final water distribution analysis report be prepared during the final design of the River Mill Subdivision.

All of which is respectfully submitted;

MTE Consultants Inc.



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Appendix A

Pressure Information (Region of Waterloo)



Date: May 1, 2020
File #: E18-10/CA

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Dear: Alex

Re: Hunt Club Subd, Cambridge

Please find the updated results of the modeling simulations for boundary conditions originally requested on October 30th, 2019. The current information has some revised IDs as we reran the model under the new InfowaterPro software. This revised model was able to provide fire flow results we were unable to supply previously.

Attached are a series of spreadsheets containing results for Average Day, Maximum Day demands and available fire flows at the nodes in the table listed below. The diurnal 24 hour demand distribution accounts for the minimum hour and peak hour peaking factors. The minimum hourly demand on the average day represents the minimum hour, and the maximum hourly demand on the maximum day represents the peak hour. The results included a figure showing the locations of the nodes from the Region’s model.

Watermains have been added to this model to complete connectivity in CAM 2E. Please note no watermain was included between Street A at Speedsville Rd and Equestrian Way at Speedsville Rd.

Demands from 2018 records were added to the section in Cam 2E that was recently built in the Compass Trail area (as shown in the Location Map)

Node Locations:

Node	Formerly Node	Elevation	Pressure Zone	Location
JCT_39025	JCT_39024	302.60	CAM 2W	Street A @ Equestrian Way
JCT_39024	JCT_39023	311.85	CAM 2W	Street B @ Equestrian Way
JCT_11032	JCT_11032	309.00	CAM 2W	Street A @ Speedsville Rd
JCT_39036	JCT_39027	310.90	CAM 2E	Briardean Rd @ Pointer St

Demands applied to nodes:

Node	Formerly Node	Residential Demand		Fire Flow	
		Ave Day (L/s)	Max Day (L/s)	Design Flow (L/s)	Design Pressure (m)
JCT_39025	JCT_39024	2.94	4.23	148.4	14.0
JCT_39024	JCT_39023	3.65	5.26	201.9	14.0
JCT_11032	JCT_11032	8.84	12.72	621.7	15.0
JCT_39036	JCT_39027	1.51	2.17	153.8	14.0

A fire flow analysis shows the maximum flow available at a node with a design pressure of 14.0 m during the maximum day scenario while maintaining the minimum design pressure of 14 m (140 kPa) at all nodes within the pressure zone.

Please note the proposed servicing of development Blocks N and O will result in the creation of a long dead-end watermain. Dead-end watermains are to be avoided whenever possible. DGSSMS Section B.2.5.8 states that where dead-end watermains cannot be avoided, the maximum length of a permanent dead-end watermain is 150m. The length of the long dead end here is approximately 290 m.

Also note that development Blocks N and O can be serviced from a new local watermain connected to the 450 mm regional watermain on Maple Grove in Pressure Zone Cam 2W

If you have any questions, please contact me.



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ADMD_JCT_39025

CAM 2w Infowater Location: Street A @ Equestrian Way Formerly: JCT_39024

JCT_39025 Average Day 24 Hour Simulation

Time	Demand (L/s)	Head (m)	Pressure (m)
00:00 hrs	1.71	364.61	62.01
01:00 hrs	1.41	364.49	61.89
02:00 hrs	1.76	364.14	61.54
03:00 hrs	1.85	363.81	61.21
04:00 hrs	1.71	364.52	61.92
05:00 hrs	1.62	364.56	61.96
06:00 hrs	2.26	364.58	61.98
07:00 hrs	3.26	364.49	61.89
08:00 hrs	3.73	364.06	61.46
09:00 hrs	3.50	364.03	61.43
10:00 hrs	3.62	364.11	61.51
11:00 hrs	3.62	364.18	61.58
12:00 hrs	3.41	364.26	61.66
13:00 hrs	3.29	364.30	61.70
14:00 hrs	3.06	364.35	61.75
15:00 hrs	3.00	364.39	61.79
16:00 hrs	3.20	364.45	61.85
17:00 hrs	3.38	364.49	61.89
18:00 hrs	3.76	364.23	61.63
19:00 hrs	4.03	363.83	61.23
20:00 hrs	4.09	364.10	61.50
21:00 hrs	3.70	364.23	61.63
22:00 hrs	3.20	364.34	61.74
23:00 hrs	2.41	364.48	61.88

Average Day HGL:

364.29

Minimum Hour:

364.61

JCT_39025 Maximum Day 24 Hour Simulation

Time	Demand (L/s)	Head (m)	Pressure (m)
00:00 hrs	2.11	364.31	61.71
01:00 hrs	1.44	364.41	61.81
02:00 hrs	1.82	364.44	61.84
03:00 hrs	2.45	364.42	61.82
04:00 hrs	2.28	364.52	61.92
05:00 hrs	2.45	364.54	61.94
06:00 hrs	3.72	364.16	61.56
07:00 hrs	5.71	363.44	60.84
08:00 hrs	5.80	363.72	61.12
09:00 hrs	4.61	363.77	61.17
10:00 hrs	4.23	363.87	61.27
11:00 hrs	4.31	363.90	61.30
12:00 hrs	4.19	363.92	61.32
13:00 hrs	4.19	363.90	61.30
14:00 hrs	3.85	363.90	61.30
15:00 hrs	3.64	363.93	61.33
16:00 hrs	4.27	363.98	61.38
17:00 hrs	4.82	363.95	61.35
18:00 hrs	5.41	364.00	61.40
19:00 hrs	6.34	363.90	61.30
20:00 hrs	7.11	363.73	61.13
21:00 hrs	7.40	363.59	60.99
22:00 hrs	5.80	363.78	61.18
23:00 hrs	3.55	364.08	61.48

Maximum Day HGL:

364.01

Peak Hour:

363.44

ADMD_JCT_39024

CAM 2w Infowater Location: Street B @ Equestrian Way Formerly: JCT_39023

JCT_39024 Average Day 24 Hour Simulation

Time	Demand (L/s)	Head (m)	Pressure (m)
00:00 hrs	2.12	364.66	52.81
01:00 hrs	1.75	364.37	52.52
02:00 hrs	2.19	364.04	52.19
03:00 hrs	2.30	364.40	52.55
04:00 hrs	2.12	364.58	52.73
05:00 hrs	2.01	364.62	52.77
06:00 hrs	2.81	364.66	52.81
07:00 hrs	4.05	364.43	52.58
08:00 hrs	4.64	364.03	52.18
09:00 hrs	4.34	364.18	52.33
10:00 hrs	4.49	364.26	52.41
11:00 hrs	4.49	364.33	52.48
12:00 hrs	4.23	364.39	52.54
13:00 hrs	4.09	364.42	52.57
14:00 hrs	3.80	364.46	52.61
15:00 hrs	3.72	364.49	52.64
16:00 hrs	3.98	364.56	52.71
17:00 hrs	4.20	364.55	52.70
18:00 hrs	4.67	364.17	52.32
19:00 hrs	5.00	363.80	51.95
20:00 hrs	5.07	364.28	52.43
21:00 hrs	4.60	364.39	52.54
22:00 hrs	3.98	364.47	52.62
23:00 hrs	2.99	364.57	52.72

Average Day HGL:

364.38

Minimum Hour:

364.66

JCT_39024 Maximum Day 24 Hour Simulation

Time	Demand (L/s)	Head (m)	Pressure (m)
00:00 hrs	2.63	364.32	52.47
01:00 hrs	1.79	364.42	52.57
02:00 hrs	2.26	364.45	52.60
03:00 hrs	3.05	364.44	52.59
04:00 hrs	2.84	364.53	52.68
05:00 hrs	3.05	364.55	52.70
06:00 hrs	4.63	364.19	52.34
07:00 hrs	7.10	363.50	51.65
08:00 hrs	7.21	363.78	51.93
09:00 hrs	5.73	363.81	51.96
10:00 hrs	5.26	363.90	52.05
11:00 hrs	5.37	363.94	52.09
12:00 hrs	5.21	363.96	52.11
13:00 hrs	5.21	363.93	52.08
14:00 hrs	4.79	363.93	52.08
15:00 hrs	4.52	363.96	52.11
16:00 hrs	5.31	364.02	52.17
17:00 hrs	6.00	364.00	52.15
18:00 hrs	6.73	364.06	52.21
19:00 hrs	7.89	363.98	52.13
20:00 hrs	8.84	363.82	51.97
21:00 hrs	9.20	363.69	51.84
22:00 hrs	7.21	363.84	51.99
23:00 hrs	4.42	364.10	52.25

Maximum Day HGL:

364.05

Peak Hour:

363.50

ADMD_JCT_11032

CAM 2w Infowater Location: Street A @ Speedsville Rd

JCT_11032 Average Day 24 Hour Simulation

Time	Demand (L/s)	Head (m)	Pressure (m)
00:00 hrs	5.13	364.46	55.46
01:00 hrs	4.24	364.13	55.13
02:00 hrs	5.30	364.39	55.39
03:00 hrs	5.57	364.50	55.50
04:00 hrs	5.13	364.66	55.66
05:00 hrs	4.86	364.69	55.69
06:00 hrs	6.81	364.55	55.55
07:00 hrs	9.81	364.22	55.22
08:00 hrs	11.23	363.85	54.85
09:00 hrs	10.52	364.31	55.31
10:00 hrs	10.87	364.39	55.39
11:00 hrs	10.87	364.45	55.45
12:00 hrs	10.25	364.50	55.50
13:00 hrs	9.90	364.52	55.52
14:00 hrs	9.19	364.54	55.54
15:00 hrs	9.02	364.56	55.56
16:00 hrs	9.64	364.62	55.62
17:00 hrs	10.17	364.35	55.35
18:00 hrs	11.32	363.99	54.99
19:00 hrs	12.11	364.36	55.36
20:00 hrs	12.29	364.42	55.42
21:00 hrs	11.14	364.51	55.51
22:00 hrs	9.64	364.57	55.57
23:00 hrs	7.25	364.64	55.64

Average Day HGL:

364.42
364.69

Minimum Hour:

JCT_11032 Maximum Day 24 Hour Simulation

Time	Demand (L/s)	Head (m)	Pressure (m)
00:00 hrs	6.36	364.35	55.35
01:00 hrs	4.32	364.43	55.43
02:00 hrs	5.47	364.47	55.47
03:00 hrs	7.38	364.48	55.48
04:00 hrs	6.87	364.56	55.56
05:00 hrs	7.38	364.59	55.59
06:00 hrs	11.19	364.27	55.27
07:00 hrs	17.17	363.69	54.69
08:00 hrs	17.43	363.97	54.97
09:00 hrs	13.86	363.94	54.94
10:00 hrs	12.72	364.01	55.01
11:00 hrs	12.97	364.05	55.05
12:00 hrs	12.59	364.06	55.06
13:00 hrs	12.59	364.03	55.03
14:00 hrs	11.58	364.01	55.01
15:00 hrs	10.94	364.03	55.03
16:00 hrs	12.85	364.13	55.13
17:00 hrs	14.50	364.13	55.13
18:00 hrs	16.28	364.22	55.22
19:00 hrs	19.08	364.20	55.20
20:00 hrs	21.37	364.10	55.10
21:00 hrs	22.26	363.99	54.99
22:00 hrs	17.43	364.03	55.03
23:00 hrs	10.68	364.18	55.18

Maximum Day HGL:

364.16
363.69

Peak Hour:

H_Curve_JCT_11032

CAM 2w Infowater Location: Street A @ Speedsville Rd

Fire Flow Analysis

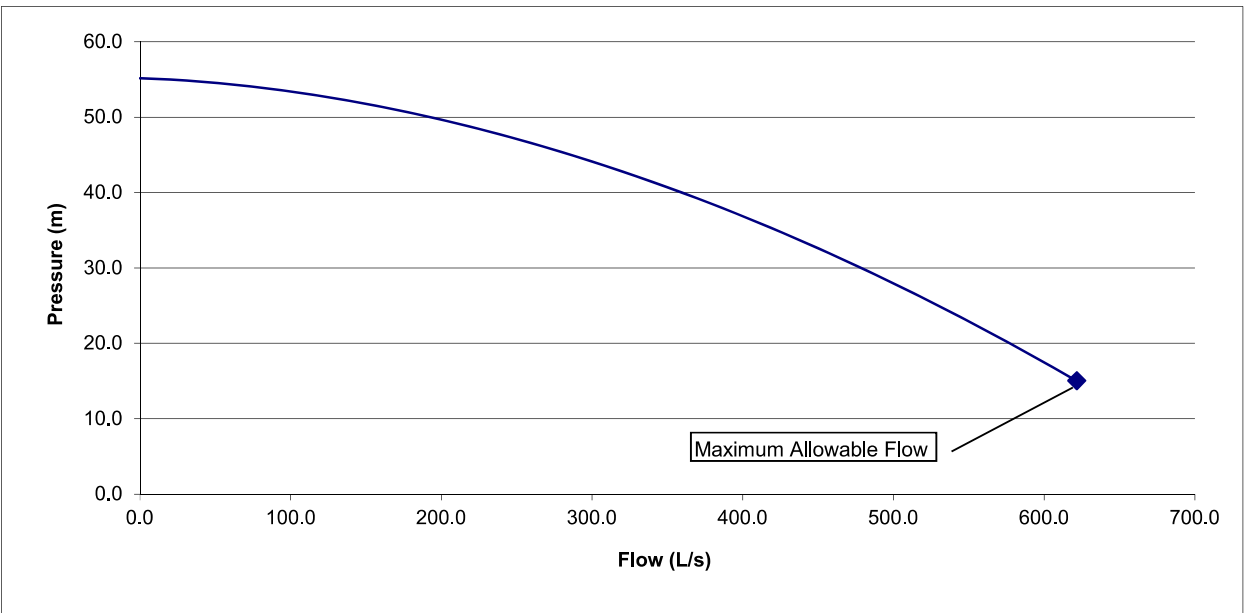
Fire Flow Node:	JCT_11032
Design Flow (L/s):	621.6
Design Pressure (m):	15.0

Design Flow: The final adjusted flow at the node to maintain the minimum design pressure (14m (140 kPa)) at ALL locations within the pressure zone.

Design Pressure: The lowest allowable pressure at the node to maintain the minimum design pressure (14m (140 kPa)) at ALL locations within the pressure zone.

Critical Node ID: The constraining node within the pressure zone that drops to the minimum design pressure of (14m (140 kPa)) during the design flow.

Available Flow (L/s)	Residual Pressure (m)
0.0	55.2
20.0	55.0
40.0	54.7
60.0	54.4
80.0	53.9
100.0	53.4
120.0	52.8
140.0	52.1
160.0	51.4
180.0	50.6
200.0	49.7
220.0	48.7
240.0	47.7
260.0	46.6
280.0	45.4
300.0	44.1
320.0	42.8
340.0	41.4
360.0	40.0
380.0	38.5
400.0	36.9
420.0	35.2
440.0	33.5
460.0	31.7
480.0	29.9
500.0	28.0
520.0	26.0
540.0	24.0
560.0	21.9
580.0	19.7
600.0	17.5
620.0	15.2
621.6	15.0



ADMD_JCT_39036

CAM 2e Infowater

Location: Briardean Rd @ Pointer St

Formerly: JCT_39027

JCT_39036 Average Day 24 Hour Simulation

Time	Demand (L/s)	Head (m)	Pressure (m)
00:00 hrs	0.88	356.94	46.04
01:00 hrs	0.72	357.35	46.45
02:00 hrs	0.91	357.75	46.85
03:00 hrs	0.95	357.85	46.95
04:00 hrs	0.88	357.40	46.50
05:00 hrs	0.83	357.00	46.10
06:00 hrs	1.16	356.48	45.58
07:00 hrs	1.68	355.56	44.66
08:00 hrs	1.92	355.93	45.03
09:00 hrs	1.80	355.94	45.04
10:00 hrs	1.86	355.88	44.98
11:00 hrs	1.86	355.77	44.87
12:00 hrs	1.75	355.65	44.75
13:00 hrs	1.69	355.57	44.67
14:00 hrs	1.57	355.53	44.63
15:00 hrs	1.54	355.52	44.62
16:00 hrs	1.65	355.51	44.61
17:00 hrs	1.74	355.52	44.62
18:00 hrs	1.93	355.53	44.63
19:00 hrs	2.07	355.51	44.61
20:00 hrs	2.10	355.50	44.60
21:00 hrs	1.90	355.54	44.64
22:00 hrs	1.65	355.63	44.73
23:00 hrs	1.24	355.78	44.88

Average Day HGL:

356.11

Minimum Hour:

357.85

JCT_39036 Maximum Day 24 Hour Simulation

Time	Demand (L/s)	Head (m)	Pressure (m)
00:00 hrs	1.09	351.15	40.25
01:00 hrs	0.74	351.89	40.99
02:00 hrs	0.94	352.52	41.62
03:00 hrs	1.27	353.02	42.12
04:00 hrs	1.18	353.61	42.71
05:00 hrs	1.27	354.42	43.52
06:00 hrs	1.93	354.87	43.97
07:00 hrs	2.95	354.93	44.03
08:00 hrs	3.00	354.76	43.86
09:00 hrs	2.38	354.58	43.68
10:00 hrs	2.19	354.55	43.65
11:00 hrs	2.23	354.53	43.63
12:00 hrs	2.17	354.50	43.60
13:00 hrs	2.17	354.42	43.52
14:00 hrs	1.99	354.43	43.53
15:00 hrs	1.88	354.54	43.64
16:00 hrs	2.21	354.58	43.68
17:00 hrs	2.49	354.31	43.41
18:00 hrs	2.80	354.02	43.12
19:00 hrs	3.28	353.64	42.74
20:00 hrs	3.68	352.94	42.04
21:00 hrs	3.83	352.14	41.24
22:00 hrs	3.00	352.00	41.10
23:00 hrs	1.84	352.19	41.29

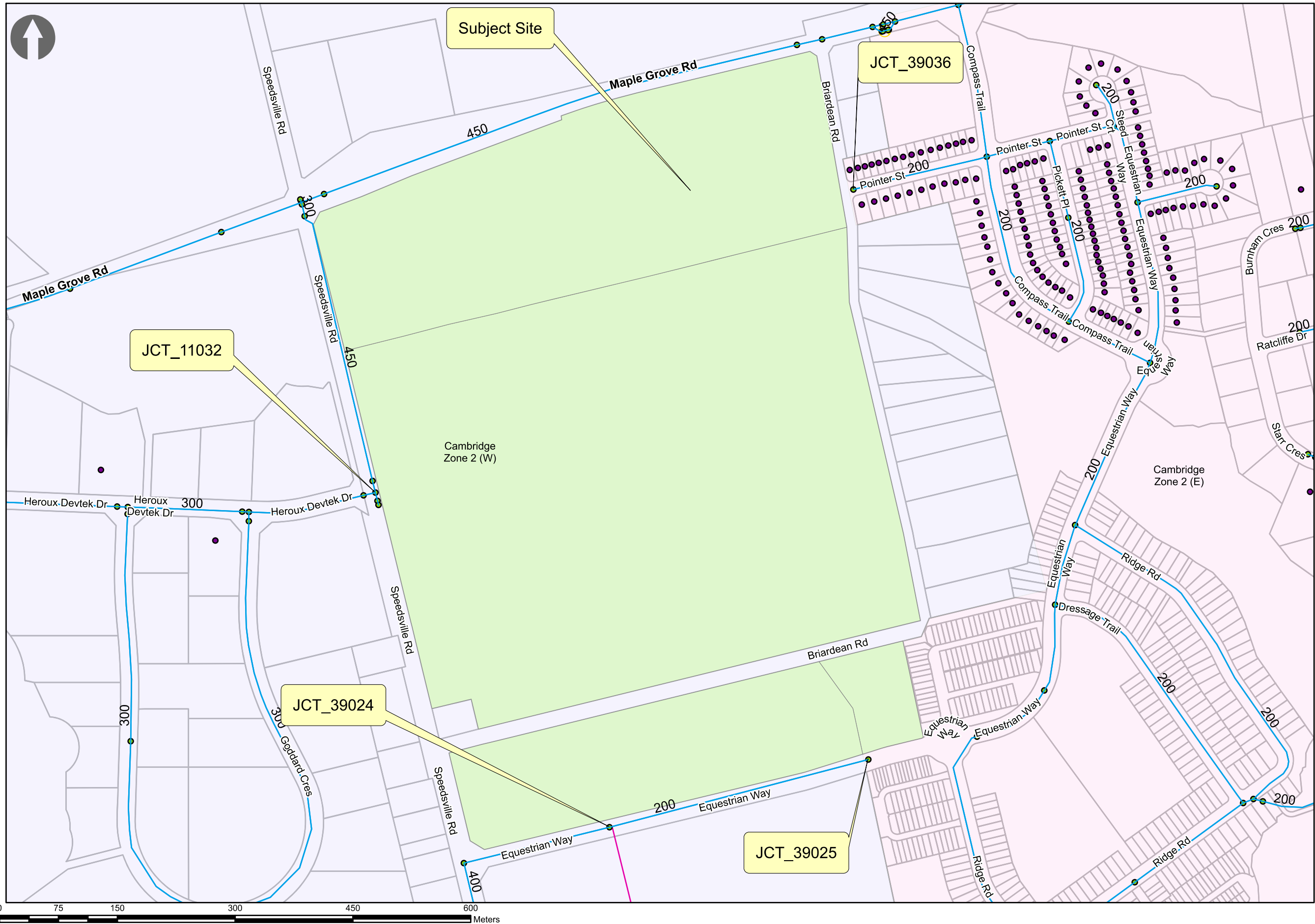
Maximum Day HGL:

353.69

Peak Hour:

351.15

Time: 3:52 PM Date: 2020-04-28 Author: NLena Document Path: I:\InfoWater\Modelling Requests\2020\MTE\Hunt Club revised\All_Pipes_20200304_HuntClubSubd_CAM_V3.aprx



Region of Waterloo

TRANSPORTATION AND ENVIRONMENTAL SERVICES
Water Services
150 Frederick Street
Kitchener ON Canada N2G 4J3
Telephone: (519) 575-4426
Fax: (519) 575-4452
www.regionofwaterloo.ca

Legend

- CAM Billing 2018
- Junction
 - Active
 - Domain
- Tank
 - ⊠ Active
 - ⊠ Domain
- Reservoir
 - ⊠ Active
 - ⊠ Domain
- Pump
 - ⊠ Active
 - ⊠ Domain
- Valve
 - ⊠ Active
 - ⊠ Domain
- Pipe
 - Active
 - Domain
- Roads
 - Highway
 - Arterial/Collector
 - Local
 - Private
 - Proposed Roads
- Pressure Zone
 - Cam 2e
 - Cam 2w
- Assessment Parcels (MPAC)
- Subject Site

Revised Hunt Club, Cambridge

Appendix B

Usage Rates/Water Demands & Design Values

River Mill Subdivision - Phase 4 and Phase 5

City of Cambridge
 Project No: 45244-104
 Date: October 13, 2020
 By: MXF



File: Q:\45244\104\Water Distribution\45244-104 Water Demands.xlsx

Node ID	Residential									Commercial		Final Demands ⁴ (l/s)					Road Elevation (m)
	Single Detached and Semi-detached			Medium Density - Townhomes			High Density - Apartment			Area (ha)	Demand (l/s)	Average Day Q _{avg}	Maximum Day Q _{max,day}	Minimum Hour Q _{min,hr}	Peak Hour Q _{peak}	Max Day + Fire Flow ⁵ Q _{max,day+fire}	
	# Units ¹	# Persons ²	Demand ³ (l/s)	# Units ¹	# Persons ²	Demand ³ (l/s)	# Units ¹	# Persons ²	Demand ³ (l/s)								
J-1							460	814	2,146			2,146	3,090	1,073	6,437	203.09	307.52
J-2				144	351	0,926						0,926	1,333	0,463	2,778	134.67	310.24
J-3	28	91	0,240	43	105	0,277						0,516	0,744	0,258	1,549	134.08	309.83
J-4								230	407	1,073		1,073	1,545	0,536	3,219	201.54	310.97
J-5				94	229	0,604						0,604	0,870	0,302	1,813	134.20	310.59
J-6	28	91	0,240									0,240	0,345	0,120	0,719	100.35	310.21
J-7	20	65	0,171									0,171	0,247	0,086	0,514	100.25	310.61
J-8	15	49	0,128									0,128	0,185	0,064	0,385	100.19	310.18
J-9	13	42	0,111									0,111	0,160	0,056	0,334	100.16	311.01
J-10	38	124	0,325									0,325	0,469	0,163	0,976	100.47	311.04
J-11	22	72	0,188									0,188	0,271	0,094	0,565	100.27	310.64
J-12				116	283	0,746						0,746	1,074	0,373	2,238	134.41	305.88
J-13							640	1133	2,985	0,215	0,070	3,055	4,399	1,528	9,165	204.40	312.79
J-14				188	459	1,209						1,209	1,741	0,604	3,627	135.07	312.56
J-28												0,000	0,000	0,000	0,000	0,00	311.90
JCT_11032												0,000	0,000	0,000	0,000	0,00	309.00
JCT_39024												0,000	0,000	0,000	0,000	0,00	311.85
JCT_39025												0,000	0,000	0,000	0,000	0,00	302.60
Total	164	533	1,405	585	1427	3,762	1330	2354	6,204	0,22	0,07	11,440	16,474	5,720	34,321		

Total Units = 2079
Total Population = 4315

Table Notes:

1. Unit Count based on T.Johns Consulting Group document: Draft Plans of Subdivision - Phase 4 (September 23, 2020) and Phase 5 (September 25, 2020)

2. Population Density

Structure Type	PPU
Single, detached	3.25
Semi-detached	3.25
Townhouse	2.44
Apartment	1.77
Multiple Unit Types	2.11
Unspecified Unit Type	3.05

Reference: Region of Waterloo 2020 Water and Wastewater Monitoring Report (Region of Waterloo, June 2020)

3. Water Demand

Residential	227.7 l/d/person 0.00264 l/s/person
Commercial	28 m ³ /ha/day 0.324 l/s/ha

Reference: Residential - Tri-City Distribution System Study (AECOM, May 2009)

Commercial - Design Guidelines for Drinking-Water Systems (MOE, 2008)

4. Peaking Factors

Average Day	1.00
Maximum Day*	1.44
Minimum Hour	0.50
Peak Hour	3.00

Reference: Design Guidelines for Drinking-Water Systems (MOE, 2008) . Table 3-1: Peaking Factors (population 3001 to 10000)

*Max Day Peak Factor taken from Tri-City Distribution System Study (AECOM, May 2009)

5. Fire Flow

Single Family <3m separation	6,000 l/min 100 l/s
Medium-density / Townhomes (contiguous)	8,000 l/min 133 l/s
High-density (Multi-residential/Mixed Use)	12,000 l/min 200 l/s
Commercial	9,000 l/min 150 l/s

Reference: Water Supply for Public Fire Protection, A Guide to Recommended Practice (1999), Fire Underwriter's Survey (FUS) .

**River Mill Subdivision
CITY OF CAMBRIDGE - PRESSURE ZONE 2W
Pump Curve Design Sheet**

Project No.: 45244-104
 Date: 27-May-20
 Design By: MXF
 File: Q:\45244\104\Water Distribution\45244-104 Region Pressures & Pump Curves.xlsx
 Note: System pressure information is from correspondence to Alex Cressman from Kevin Dolishny at the Region of Waterloo on May 1, 2020.

Note 11032 Speedville Road at Proposed Street A
 Elevation = **309.00** m

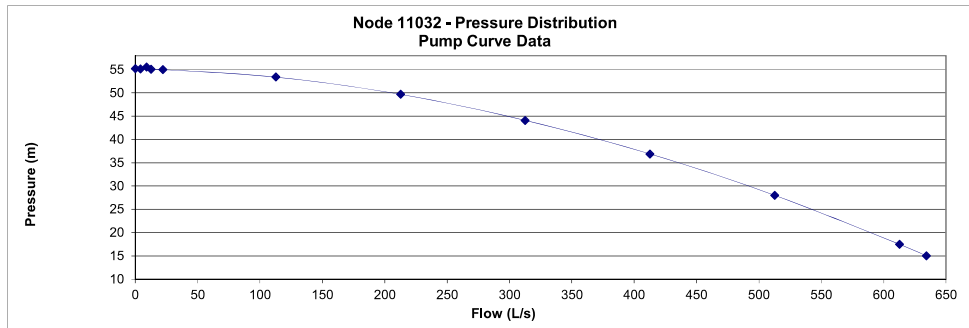
Average Day			
Time	Flow (L/s)	Head (m)	Residual Pressure (m)
00:00 hrs	5.13	364.46	55.46
01:00 hrs	4.24	364.13	55.13
02:00 hrs	5.30	364.39	55.39
03:00 hrs	5.57	364.50	55.50
04:00 hrs	5.13	364.66	55.66
05:00 hrs	4.86	364.69	55.69
06:00 hrs	6.81	364.55	55.55
07:00 hrs	9.81	364.22	55.22
08:00 hrs	11.23	363.85	54.85
09:00 hrs	10.52	364.31	55.31
10:00 hrs	10.87	364.39	55.39
11:00 hrs	10.87	364.45	55.45
12:00 hrs	10.25	364.50	55.50
13:00 hrs	9.90	364.52	55.52
14:00 hrs	9.19	364.54	55.54
15:00 hrs	9.02	364.56	55.56
16:00 hrs	9.64	364.62	55.62
17:00 hrs	10.17	364.35	55.35
18:00 hrs	11.32	363.99	54.99
19:00 hrs	12.11	364.36	55.36
20:00 hrs	12.29	364.42	55.42
21:00 hrs	11.14	364.51	55.51
22:00 hrs	9.64	364.57	55.57
23:00 hrs	7.25	364.64	55.64
Average =	8.84	364.42	55.42
Minimum =	4.24	364.69	55.69

Maximum Day			
Time	Flow (L/s)	Head (m)	Residual Pressure (m)
00:00 hrs	6.36	364.35	55.35
01:00 hrs	4.32	364.43	55.43
02:00 hrs	5.47	364.47	55.47
03:00 hrs	7.38	364.48	55.48
04:00 hrs	6.87	364.56	55.56
05:00 hrs	7.38	364.59	55.59
06:00 hrs	11.19	364.27	55.27
07:00 hrs	17.17	363.69	54.69
08:00 hrs	17.43	363.97	54.97
09:00 hrs	13.86	363.94	54.94
10:00 hrs	12.72	364.01	55.01
11:00 hrs	12.97	364.05	55.05
12:00 hrs	12.59	364.06	55.06
13:00 hrs	12.59	364.03	55.03
14:00 hrs	11.58	364.01	55.01
15:00 hrs	10.94	364.03	55.03
16:00 hrs	12.85	364.13	55.13
17:00 hrs	14.50	364.13	55.13
18:00 hrs	16.28	364.22	55.22
19:00 hrs	19.08	364.20	55.20
20:00 hrs	21.37	364.10	55.10
21:00 hrs	22.26	363.99	54.99
22:00 hrs	17.43	364.03	55.03
23:00 hrs	10.68	364.18	55.18
Max Day =	12.72	364.16	55.16
Peak Hour =	22.26	363.69	54.69

Fire Flow Analysis		
Available Flow (L/s)	Head (m)	Residual Pressure (m)
0.0	364.20	55.20
20.0	364.00	55.00
40.0	363.70	54.70
60.0	363.40	54.40
80.0	362.90	53.90
100.0	362.40	53.40
120.0	361.80	52.80
140.0	361.10	52.10
160.0	360.40	51.40
180.0	359.60	50.60
200.0	358.70	49.70
220.0	357.70	48.70
240.0	356.70	47.70
260.0	355.60	46.60
280.0	354.40	45.40
300.0	353.10	44.10
320.0	351.80	42.80
340.0	350.40	41.40
360.0	349.00	40.00
380.0	347.50	38.50
400.0	345.90	36.90
420.0	344.20	35.20
440.0	342.50	33.50
460.0	340.70	31.70
480.0	338.90	29.90
500.0	337.00	28.00
520.0	335.00	26.00
540.0	333.00	24.00
560.0	330.90	21.90
580.0	328.70	19.70
600.0	326.50	17.50
620.0	324.20	15.20
621.6	324.00	15.00

Fire Flow Analysis Adjusted for Maximum Day Flows		
Available Flow (L/s)	Head (m)	Residual Pressure (m)
12.7	364.20	55.20
32.7	364.00	55.00
52.7	363.70	54.70
72.7	363.40	54.40
92.7	362.90	53.90
112.7	362.40	53.40
132.7	361.80	52.80
152.7	361.10	52.10
172.7	360.40	51.40
192.7	359.60	50.60
212.7	358.70	49.70
232.7	357.70	48.70
252.7	356.70	47.70
272.7	355.60	46.60
292.7	354.40	45.40
312.7	353.10	44.10
332.7	351.80	42.80
352.7	350.40	41.40
372.7	349.00	40.00
392.7	347.50	38.50
412.7	345.90	36.90
432.7	344.20	35.20
452.7	342.50	33.50
472.7	340.70	31.70
492.7	338.90	29.90
512.7	337.00	28.00
532.7	335.00	26.00
552.7	333.00	24.00
572.7	330.90	21.90
592.7	328.70	19.70
612.7	326.50	17.50
632.7	324.20	15.20
634.3	324.00	15.00

Node 11032 - Pump Curve Pressure Distribution			
Demand Scenario	Discharge (L/s)	HGL (m)	Head (m)
0 (Est.)	0.00	364.20	55.20
Minimum Hour	4.24	364.13	55.13
Average Day	9.02	364.56	55.56
Maximum Day	12.59	364.06	55.06
Peak Hour	22.26	363.99	54.99
Max Day + 100 L/s Fire Flow	112.72	362.40	53.40
Max Day + 200 L/s Fire Flow	212.72	358.70	49.70
Max Day + 300 L/s Fire Flow	312.72	353.10	44.10
Max Day + 400 L/s Fire Flow	412.72	345.90	36.90
Max Day + 500 L/s Fire Flow	512.72	337.00	28.00
Max Day + 600 L/s Fire Flow	612.72	326.50	17.50
Max Day + 621.6 L/s Fire Flow	634.32	324.00	15.00



River Mill Subdivision
CITY OF CAMBRIDGE - PRESSURE ZONE 2W
Pump Curve Design Sheet

Project No.: 45244-104
 Date: 27-May-20
 Design By: MXF
 File: Q:\45244\104\Water Distribution\45244-104 Region Pressures & Pump Curves.xlsx
 Note: System pressure information is from correspondence to Alex Cressman from Kevin Dolishny at the Region of Waterloo on May 1, 2020.



Node 39024 Equestrian Way at Proposed Street B
 Elevation = **311.85** m

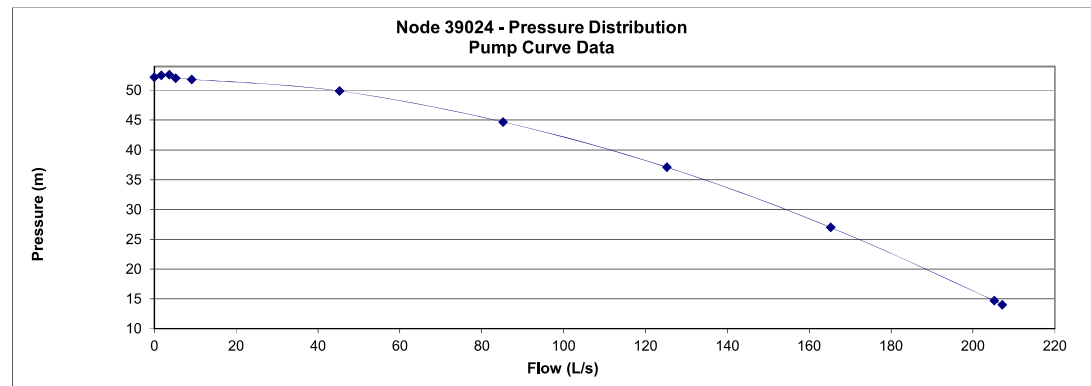
Average Day			
Time	Flow (L/s)	Head (m)	Residual Pressure (m)
00:00 hrs	2.12	364.66	52.81
01:00 hrs	1.75	364.37	52.52
02:00 hrs	2.19	364.04	52.19
03:00 hrs	2.30	364.40	52.55
04:00 hrs	2.12	364.58	52.73
05:00 hrs	2.01	364.62	52.77
06:00 hrs	2.81	364.66	52.81
07:00 hrs	4.05	364.43	52.58
08:00 hrs	4.64	364.03	52.18
09:00 hrs	4.34	364.18	52.33
10:00 hrs	4.49	364.26	52.41
11:00 hrs	4.49	364.33	52.48
12:00 hrs	4.23	364.39	52.54
13:00 hrs	4.09	364.42	52.57
14:00 hrs	3.80	364.46	52.61
15:00 hrs	3.72	364.49	52.64
16:00 hrs	3.98	364.56	52.71
17:00 hrs	4.20	364.55	52.70
18:00 hrs	4.67	364.17	52.32
19:00 hrs	5.00	363.80	51.95
20:00 hrs	5.07	364.28	52.43
21:00 hrs	4.60	364.39	52.54
22:00 hrs	3.98	364.47	52.62
23:00 hrs	2.99	364.57	52.72
Average =	3.65	364.38	52.53
Minimum =	1.75	364.66	52.81

Maximum Day			
Time	Flow (L/s)	Head (m)	Residual Pressure (m)
00:00 hrs	2.63	364.32	52.47
01:00 hrs	1.79	364.42	52.57
02:00 hrs	2.26	364.45	52.60
03:00 hrs	3.05	364.44	52.59
04:00 hrs	2.84	364.53	52.68
05:00 hrs	3.05	364.55	52.70
06:00 hrs	4.63	364.19	52.34
07:00 hrs	7.10	363.50	51.65
08:00 hrs	7.21	363.78	51.93
09:00 hrs	5.73	363.81	51.96
10:00 hrs	5.26	363.90	52.05
11:00 hrs	5.37	363.94	52.09
12:00 hrs	5.21	363.96	52.11
13:00 hrs	5.21	363.93	52.08
14:00 hrs	4.79	363.93	52.08
15:00 hrs	4.52	363.96	52.11
16:00 hrs	5.31	364.02	52.17
17:00 hrs	6.00	364.00	52.15
18:00 hrs	6.73	364.06	52.21
19:00 hrs	7.89	363.98	52.13
20:00 hrs	8.84	363.82	51.97
21:00 hrs	9.20	363.69	51.84
22:00 hrs	7.21	363.84	51.99
23:00 hrs	4.42	364.10	52.25
Max Day =	5.26	364.05	52.20
Peak Hour =	9.20	363.50	51.65

Fire Flow Analysis		
Available Flow (L/s)	Head (m)	Residual Pressure (m)
0.0	364.05	52.20
20.0	363.25	51.40
40.0	361.75	49.90
60.0	359.45	47.60
80.0	356.55	44.70
100.0	353.05	41.20
120.0	348.95	37.10
140.0	344.15	32.30
160.0	338.85	27.00
180.0	332.95	21.10
200.0	326.55	14.70
201.9	325.85	14.00

Fire Flow Analysis Adjusted for Maximum Day Flows		
Available Flow (L/s)	Head (m)	Residual Pressure (m)
5.3	364.05	52.20
25.3	363.25	51.40
45.3	361.75	49.90
65.3	359.45	47.60
85.3	356.55	44.70
105.3	353.05	41.20
125.3	348.95	37.10
145.3	344.15	32.30
165.3	338.85	27.00
185.3	332.95	21.10
205.3	326.55	14.70
207.2	325.85	14.00

Node 39024 - Pump Curve Pressure Distribution			
Demand Scenario	Discharge (L/s)	HGL (m)	Head (m)
0 (Est.)	0.00	364.05	52.20
Minimum Hour	1.75	364.37	52.52
Average Day	3.72	364.49	52.64
Maximum Day	5.26	363.90	52.05
Peak Hour	9.20	363.69	51.84
Max Day + 40 L/s Fire Flow	45.26	361.75	49.90
Max Day + 80 L/s Fire Flow	85.26	356.55	44.70
Max Day + 120 L/s Fire Flow	125.26	348.95	37.10
Max Day + 160 L/s Fire Flow	165.26	338.85	27.00
Max Day + 200 L/s Fire Flow	205.26	326.55	14.70
Max Day + 201.9 L/s Fire Flow	207.16	325.85	14.00



River Mill Subdivision
CITY OF CAMBRIDGE - PRESSURE ZONE 2W
Pump Curve Design Sheet

Project No.: 45244-104
 Date: 27-May-20
 Design By: MXF
 File: Q:\45244\104\Water Distribution\45244-104 Region Pressures & Pump Curves.xlsx
 Note: System pressure information is from correspondence to Alex Cressman from Kevin Dolishny at the Region of Waterloo on May 1, 2020.



Node 39025 Equestrian Way at Proposed Street A
 Elevation = **302.60** m

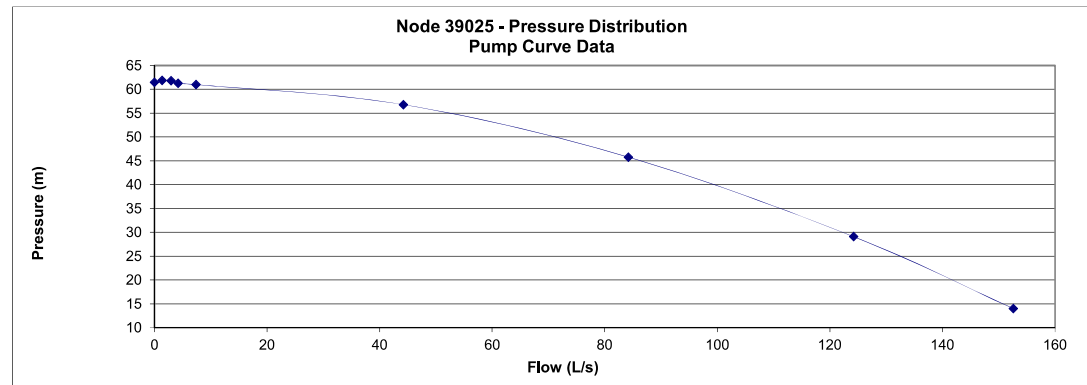
Average Day			
Time	Flow (L/s)	Head (m)	Residual Pressure (m)
00:00 hrs	1.71	364.61	62.01
01:00 hrs	1.41	364.49	61.89
02:00 hrs	1.76	364.14	61.54
03:00 hrs	1.85	363.81	61.21
04:00 hrs	1.71	364.52	61.92
05:00 hrs	1.62	364.56	61.96
06:00 hrs	2.26	364.58	61.98
07:00 hrs	3.26	364.49	61.89
08:00 hrs	3.73	364.06	61.46
09:00 hrs	3.50	364.03	61.43
10:00 hrs	3.62	364.11	61.51
11:00 hrs	3.62	364.18	61.58
12:00 hrs	3.41	364.26	61.66
13:00 hrs	3.29	364.30	61.70
14:00 hrs	3.06	364.35	61.75
15:00 hrs	3.00	364.39	61.79
16:00 hrs	3.20	364.45	61.85
17:00 hrs	3.38	364.49	61.89
18:00 hrs	3.76	364.23	61.63
19:00 hrs	4.03	363.83	61.23
20:00 hrs	4.09	364.10	61.50
21:00 hrs	3.70	364.23	61.63
22:00 hrs	3.20	364.34	61.74
23:00 hrs	2.41	364.48	61.88
Average =	<u>2.94</u>	364.29	61.69
Minimum =	<u>1.41</u>	364.61	62.01

Maximum Day			
Time	Flow (L/s)	Head (m)	Residual Pressure (m)
00:00 hrs	2.11	364.31	61.71
01:00 hrs	1.44	364.41	61.81
02:00 hrs	1.82	364.44	61.84
03:00 hrs	2.45	364.42	61.82
04:00 hrs	2.28	364.52	61.92
05:00 hrs	2.45	364.54	61.94
06:00 hrs	3.72	364.16	61.56
07:00 hrs	5.71	363.44	60.84
08:00 hrs	5.80	363.72	61.12
09:00 hrs	4.61	363.77	61.17
10:00 hrs	4.23	363.87	61.27
11:00 hrs	4.31	363.90	61.30
12:00 hrs	4.19	363.92	61.32
13:00 hrs	4.19	363.90	61.30
14:00 hrs	3.85	363.90	61.30
15:00 hrs	3.64	363.93	61.33
16:00 hrs	4.27	363.98	61.38
17:00 hrs	4.82	363.95	61.35
18:00 hrs	5.41	364.00	61.40
19:00 hrs	6.34	363.90	61.30
20:00 hrs	7.11	363.73	61.13
21:00 hrs	7.40	363.59	60.99
22:00 hrs	5.80	363.78	61.18
23:00 hrs	3.55	364.08	61.48
Max Day =	<u>4.23</u>	364.01	61.41
Peak Hour =	<u>7.40</u>	363.44	60.84

Fire Flow Analysis		
Available Flow (L/s)	Head (m)	Residual Pressure (m)
0.0	364.10	61.50
20.0	362.60	60.00
40.0	359.40	56.80
60.0	354.70	52.10
80.0	348.40	45.80
100.0	340.80	38.20
120.0	331.70	29.10
140.0	321.30	18.70
148.4	316.60	14.00

Fire Flow Analysis Adjusted for Maximum Day Flows		
Available Flow (L/s)	Head (m)	Residual Pressure (m)
4.2	364.10	61.50
24.2	362.60	60.00
44.2	359.40	56.80
64.2	354.70	52.10
84.2	348.40	45.80
104.2	340.80	38.20
124.2	331.70	29.10
144.2	321.30	18.70
152.6	316.60	14.00

Node 39025 - Pump Curve Pressure Distribution			
Demand Scenario	Discharge (L/s)	HGL (m)	Head (m)
0 (Est.)	0.00	364.10	61.50
Minimum Hour	1.41	364.49	61.89
Average Day	3.00	364.39	61.79
Maximum Day	4.23	363.87	61.27
Peak Hour	7.40	363.59	60.99
Max Day + 40 L/s Fire Flow	44.23	359.40	56.80
Max Day + 80 L/s Fire Flow	84.23	348.40	45.80
Max Day + 120 L/s Fire Flow	124.23	331.70	29.10
Max Day + 148.4 L/s Fire Flow	152.63	316.60	14.00



**River Mill Subdivision
CITY OF CAMBRIDGE - PRESSURE ZONE 2E
Pump Curve Design Sheet**

Project No.: 45244-104
 Date: 27-May-20
 Design By: MXF
 File: Q:\45244\104\Water Distribution\45244-104 Region Pressures & Pump Curves.xlsx
 Note: System pressure information is from correspondence to Alex Cressman from Kevin Dolishny at the Region of Waterloo on May 1, 2020.



Node 39036 Pointer Street at Briardean Road
 Elevation = **310.90** m

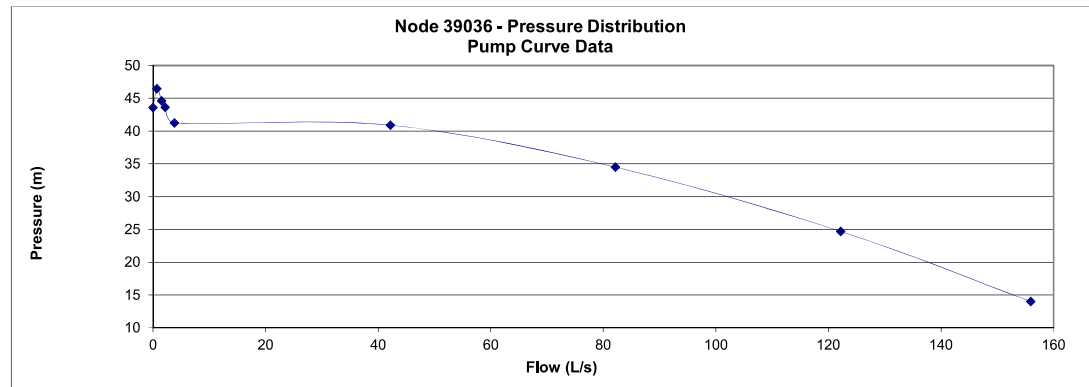
Average Day			
Time	Flow (L/s)	Head (m)	Residual Pressure (m)
00:00 hrs	0.88	356.94	46.04
01:00 hrs	0.72	357.35	46.45
02:00 hrs	0.91	357.75	46.85
03:00 hrs	0.95	357.85	46.95
04:00 hrs	0.88	357.40	46.50
05:00 hrs	0.83	357.00	46.10
06:00 hrs	1.16	356.48	45.58
07:00 hrs	1.68	355.56	44.66
08:00 hrs	1.92	355.93	45.03
09:00 hrs	1.80	355.94	45.04
10:00 hrs	1.86	355.88	44.98
11:00 hrs	1.86	355.77	44.87
12:00 hrs	1.75	355.65	44.75
13:00 hrs	1.69	355.57	44.67
14:00 hrs	1.57	355.53	44.63
15:00 hrs	1.54	355.52	44.62
16:00 hrs	1.65	355.51	44.61
17:00 hrs	1.74	355.52	44.62
18:00 hrs	1.93	355.53	44.63
19:00 hrs	2.07	355.51	44.61
20:00 hrs	2.10	355.50	44.60
21:00 hrs	1.90	355.54	44.64
22:00 hrs	1.65	355.63	44.73
23:00 hrs	1.24	355.78	44.88
Average =	1.51	356.11	45.21
Minimum =	0.72	357.85	46.95

Maximum Day			
Time	Flow (L/s)	Head (m)	Residual Pressure (m)
00:00 hrs	1.09	351.15	40.25
01:00 hrs	0.74	351.89	40.99
02:00 hrs	0.94	352.52	41.62
03:00 hrs	1.27	353.02	42.12
04:00 hrs	1.18	353.61	42.71
05:00 hrs	1.27	354.42	43.52
06:00 hrs	1.93	354.87	43.97
07:00 hrs	2.95	354.93	44.03
08:00 hrs	3.00	354.76	43.86
09:00 hrs	2.38	354.58	43.68
10:00 hrs	2.19	354.55	43.65
11:00 hrs	2.23	354.53	43.63
12:00 hrs	2.17	354.50	43.60
13:00 hrs	2.17	354.42	43.52
14:00 hrs	1.99	354.43	43.53
15:00 hrs	1.88	354.54	43.64
16:00 hrs	2.21	354.58	43.68
17:00 hrs	2.49	354.31	43.41
18:00 hrs	2.80	354.02	43.12
19:00 hrs	3.28	353.64	42.74
20:00 hrs	3.68	352.94	42.04
21:00 hrs	3.83	352.14	41.24
22:00 hrs	3.00	352.00	41.10
23:00 hrs	1.84	352.19	41.29
Max Day =	2.19	353.69	42.79
Peak Hour =	3.83	351.15	40.25

Fire Flow Analysis		
Available Flow (L/s)	Head (m)	Residual Pressure (m)
0.0	354.50	43.60
20.0	353.60	42.70
40.0	351.80	40.90
60.0	349.00	38.10
80.0	345.40	34.50
100.0	340.90	30.00
120.0	335.60	24.70
140.0	329.50	18.60
153.8	324.90	14.00

Fire Flow Analysis Adjusted for Maximum Day Flows		
Available Flow (L/s)	Head (m)	Residual Pressure (m)
2.2	354.50	43.60
22.2	353.60	42.70
42.2	351.80	40.90
62.2	349.00	38.10
82.2	345.40	34.50
102.2	340.90	30.00
122.2	335.60	24.70
142.2	329.50	18.60
156.0	324.90	14.00

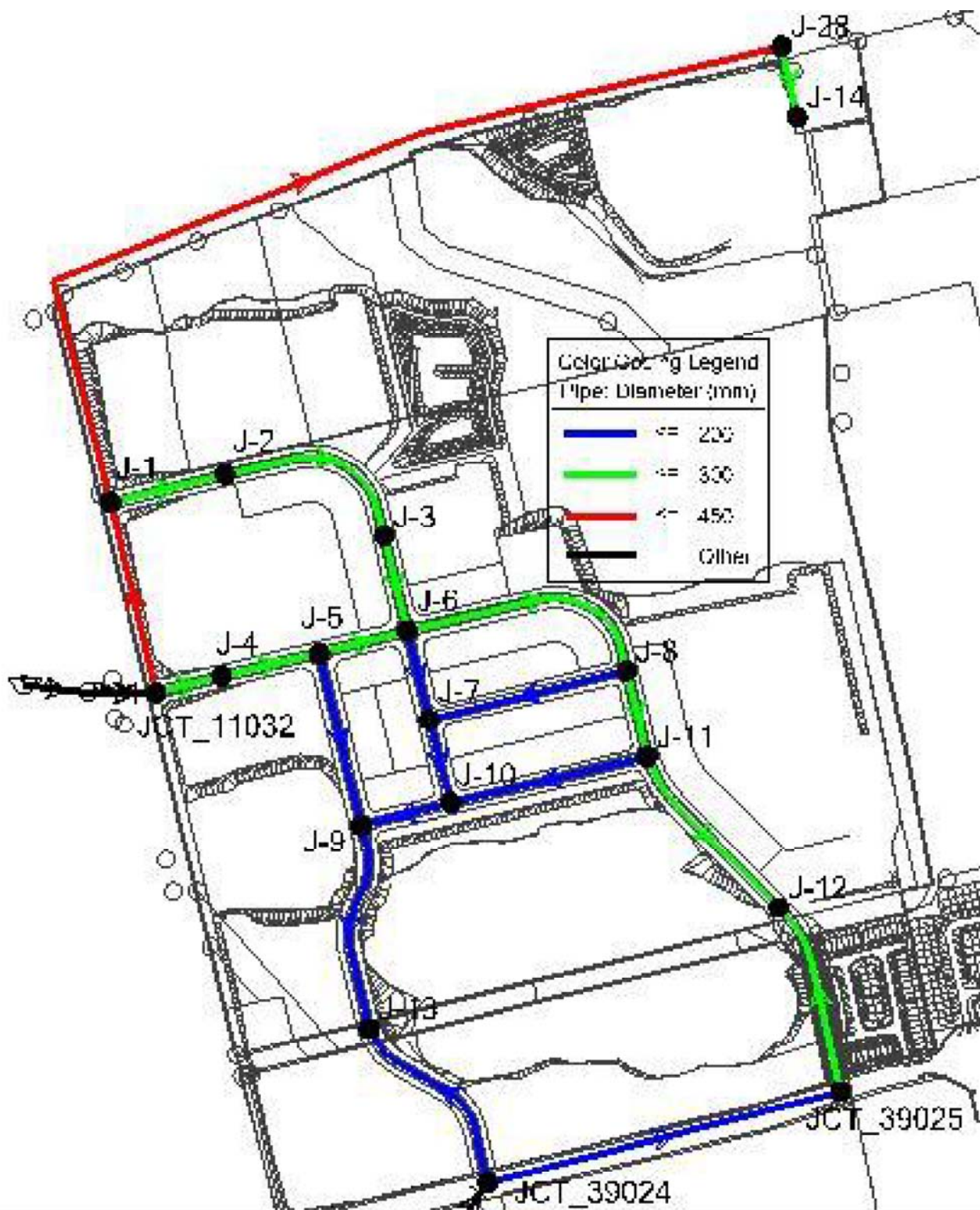
Node 39036- Pump Curve Pressure Distribution			
Demand Scenario	Discharge (L/s)	HGL (m)	Head (m)
0 (Est.)	0.00	354.50	43.60
Minimum Hour	0.72	357.35	46.45
Average Day	1.54	355.52	44.62
Maximum Day	2.19	354.55	43.65
Peak Hour	3.83	352.14	41.24
Max Day + 40 L/s Fire Flow	42.19	351.80	40.90
Max Day + 80 L/s Fire Flow	82.19	345.40	34.50
Max Day + 120 L/s Fire Flow	122.19	335.60	24.70
Max Day + 153.8 L/s Fire Flow	155.99	324.90	14.00



Appendix C

WaterCAD Output Files

Water Distribution Network



River Mill Subdivision
Active Scenario: Avg Day

Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (kPa)
J-1	307.52	2.15	363.95	552
J-2	310.24	0.93	363.95	526
J-3	309.83	0.52	363.95	530
J-4	310.97	1.07	363.95	519
J-5	310.59	0.60	363.95	522
J-6	310.21	0.24	363.95	526
J-7	310.61	0.17	363.95	522
J-8	310.18	0.13	363.95	526
J-9	311.01	0.11	363.95	518
J-10	311.04	0.32	363.95	518
J-11	310.64	0.19	363.95	522
J-12	305.88	0.75	363.95	568
J-13	312.79	3.06	363.94	501
J-14	312.56	1.21	363.95	503

River Mill Subdivision
Active Scenario: Max Day

Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (kPa)
J-1	307.52	3.09	363.92	552
J-2	310.24	1.33	363.92	525
J-3	309.83	0.74	363.92	529
J-4	310.97	1.54	363.92	518
J-5	310.59	0.87	363.92	522
J-6	310.21	0.34	363.92	526
J-7	310.61	0.25	363.92	522
J-8	310.18	0.19	363.92	526
J-9	311.01	0.16	363.92	518
J-10	311.04	0.47	363.92	518
J-11	310.64	0.27	363.92	521
J-12	305.88	1.07	363.92	568
J-13	312.79	4.40	363.91	500
J-14	312.56	1.74	363.92	503

River Mill Subdivision
Active Scenario: Min Hour

Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (kPa)
J-1	307.52	1.07	363.98	553
J-2	310.24	0.46	363.97	526
J-3	309.83	0.26	363.97	530
J-4	310.97	0.54	363.98	519
J-5	310.59	0.30	363.97	522
J-6	310.21	0.12	363.97	526
J-7	310.61	0.09	363.97	522
J-8	310.18	0.06	363.97	526
J-9	311.01	0.06	363.97	518
J-10	311.04	0.16	363.97	518
J-11	310.64	0.09	363.97	522
J-12	305.88	0.37	363.97	569
J-13	312.79	1.53	363.97	501
J-14	312.56	0.60	363.98	503

River Mill Subdivision
Active Scenario: Peak Hour

Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (kPa)
J-1	307.52	6.44	363.83	551
J-2	310.24	2.78	363.82	524
J-3	309.83	1.55	363.82	528
J-4	310.97	3.22	363.83	517
J-5	310.59	1.81	363.82	521
J-6	310.21	0.72	363.82	525
J-7	310.61	0.51	363.82	521
J-8	310.18	0.38	363.82	525
J-9	311.01	0.33	363.82	517
J-10	311.04	0.98	363.82	517
J-11	310.64	0.57	363.82	520
J-12	305.88	2.24	363.82	567
J-13	312.79	9.16	363.80	499
J-14	312.56	3.63	363.83	502

River Mill Subdivision
Active Scenario: Max Day + Fire

Label	Elevation (m)	Fire Flow Iterations	Satisfies Fire Flow Constraints?	Fire Flow (Needed) (L/s)	Flow (Total Needed) (L/s)	Flow (Total Available) (L/s)	Pressure (Calculated Residual) (kPa)	Pressure (Calculated System Lower Limit) (kPa)	Velocity of Maximum Pipe (m/s)	Pipe w/ Maximum Velocity
J-1	307.52	2	True	200.00	203.09	625.09	259	210	3.21	P-47
J-2	310.24	3	True	133.00	134.33	623.33	171	224	5.47	P-48
J-3	309.83	3	True	133.00	133.74	622.74	162	213	4.95	P-50
J-4	310.97	2	True	200.00	201.54	623.54	204	232	5.69	P-32
J-5	310.59	3	True	133.00	133.87	622.87	190	214	4.50	P-32
J-6	310.21	3	True	100.00	100.34	622.34	187	193	3.83	P-34
J-7	310.61	4	True	100.00	100.25	529.05	140	228	6.87	P-35
J-8	310.18	4	True	100.00	100.18	589.20	140	151	4.27	P-39
J-9	311.01	4	True	100.00	100.16	494.55	140	210	6.32	P-37
J-10	311.04	4	True	100.00	100.47	513.28	140	240	6.07	P-36
J-11	310.64	4	True	100.00	100.27	561.05	140	192	4.81	P-42
J-12	305.88	4	True	133.00	134.07	518.07	140	188	5.48	P-43
J-13	312.79	3	True	200.00	204.40	362.57	140	353	5.82	P-46
J-14	312.56	4	True	133.00	134.74	470.57	140	223	6.66	P-57