



---

To: **Stephen Erickson, BA, CPT** Company: **Urban Solutions**  
From: **Sam Ziemann, P.Eng.** Project Ref. #: **221682**  
c.519-404-4529  
Copy: Date: **December 20, 2022**  
Subject: **253 & 259 Limeridge Road West Watermain Hydraulic Analysis**

---

*The contents of this memorandum are intended only for the recipient. Any other use and/or reproduction without prior consent of C3 Water Inc. is strictly prohibited.*

---

**Urban Solutions**

**253 & 259 Limeridge Road West  
Watermain Hydraulic Analysis**

**C3 WATER INC.**

**December 20, 2022**



VERSION	DATE	DESCRIPTION OF REVISIONS	REVISED BY	REVIEWED BY
1	December 20, 2022	Draft Report	Kelly Ward, Brad Sun	Sam Ziemann
2	December 20, 2022	Final Report	Brad Sun	Sam Ziemann, Stephen Erickson

**SIGN OFF**

This document, entitled “**253 & 259 Limeridge Road West Watermain Hydraulic Analysis**”, was prepared by C3 Water Inc. for **Urban Solutions**.

C3W certifies that the information contained in this report is accurate, complete and in accordance with the terms of our engagement. This assessment is based, in part, on information provided by others. Unless specifically noted, C3W has assumed that this information is correct, and has relied on it in the development of conclusions.

The material herein reflects C3 Water’s best judgement based upon the information available at the time of preparation. Any use which a third party makes of this report or any reliance on or decisions made based on it, are the responsibilities of such third parties. C3 Water Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based upon this report.

DATE: December 20, 2022

Prepared by: **Brad Sun, E.I.T.**  
**Junior Water Specialist, C. 519-831-5233**

Reviewed by: **SAM ZIEMANN, P.Eng.,**  
**PRESIDENT, C. 519-404-4529**



## Table of Contents

1.0	Introduction .....	5
1.1	Background.....	5
1.2	Limitations.....	6
2.0	Criteria .....	7
2.1	Pressure Requirements .....	7
2.2	Domestic Demand .....	7
2.3	Fire Flow Demand .....	8
3.0	Hydraulic Water Model.....	8
3.1	Boundary Conditions.....	8
3.2	Model Verification .....	9
3.3	Development.....	11
4.0	Analysis .....	12
4.1	Available Fire Flow .....	12
4.2	System Pressures.....	13
5.0	Conclusions .....	13

## List of Figures

Figure 1-1.	Proposed Development Area Layout (Approximate) .....	5
Figure 1-2.	Existing Watermains in the Development Area .....	6
Figure 3-1.	Field Testing Hydrant used for Model Verification .....	9
Figure 3-2.	Verification Results - Hydrant HC49H001 on Limeridge Road West.....	11
Figure 3-3.	Model Layout for the Proposed Development Area.....	12



## List of Tables

Table 2-1. Pressure Requirements .....	7
Table 2-2. Demand Calculation Parameters .....	7
Table 2-3. Estimated Domestic Demands for the Proposed Development .....	7
Table 2-4. Hamilton Residential Fire Flow Requirements .....	8
Table 3-1: PD6 Boundary Conditions .....	8
Table 3-2. Hydrant Field Testing Results – Oct. 31, 2022 .....	9
Table 3-3. Summary of Boundary Conditions at Time of Hydrant Testing .....	10
Table 4-1. Available Fire Flow Results (L/s) - 2021 and 2031 MDD – Tank 50% .....	12
Table 4-2. Pressure Results (psi) - Tank 50% .....	13
Table 4-3. Pressure Results (psi) - Tank 70% .....	13

## List of Appendices

<b>APPENDIX A</b>	Site Plan
<b>APPENDIX B</b>	Hydrant Field Testing Report
<b>APPENDIX C</b>	Model Results – Fire Flow
<b>APPENDIX D</b>	Model Results – Pressure

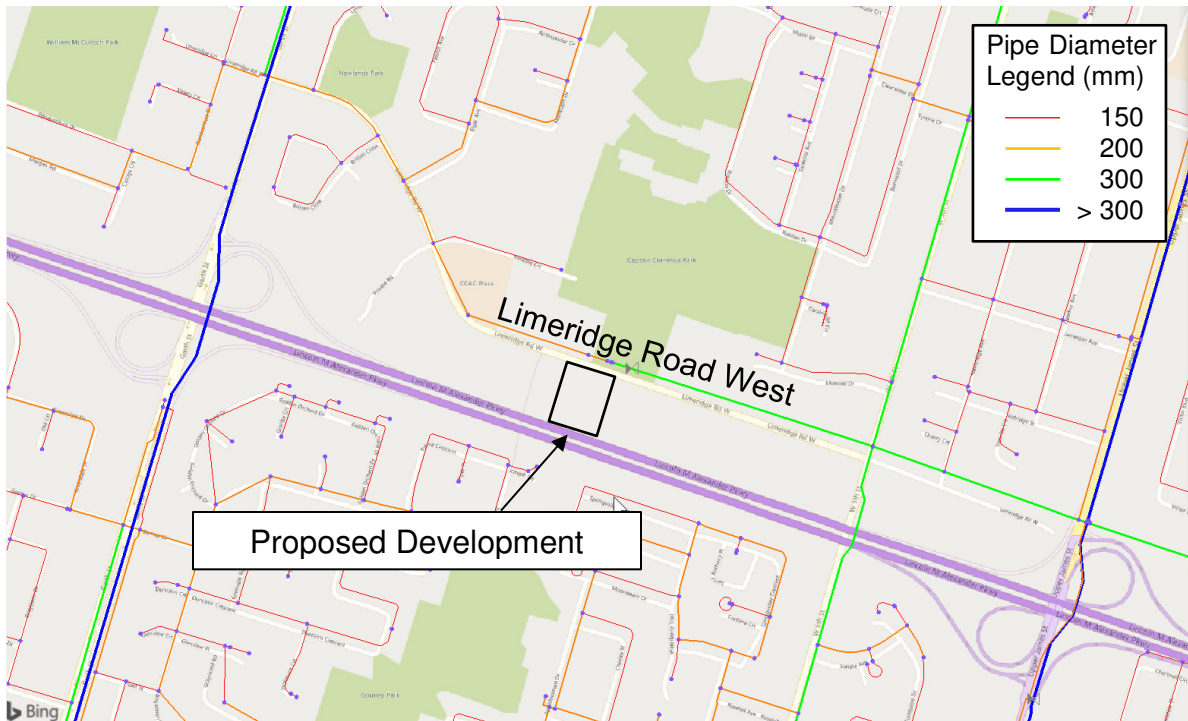
## 1.0 INTRODUCTION

### 1.1 Background

The proposed development at 253 & 259 Limeridge Road West is located in Pressure District 6 (PD6) in the City of Hamilton (City). The development area is located south of Limeridge Road West and north of Lincoln M. Alexander Parkway. Figure 1-1 illustrates the approximate layout of the proposed development. Figure 1-2 shows the existing watermain in the development area. The development includes 23 townhouse units and is currently supplied by a 200 mm watermain on Limeridge Road West. A site plan is available in Appendix A.



**Figure 1-1. Proposed Development Area Layout (Approximate)**



**Figure 1-2. Existing Watermains in the Development Area**

PD6 is a closed zone with no floating storage. Currently, PD6 supply is drawn from PD5 (reservoir HDR05) by pump stations HD06A and HD06B.

C3 Water Inc (C3W) has been retained by Urban Solutions to complete a watermain hydraulic analysis for the proposed development. This report provides the watermain hydraulic analysis in accordance with the City of Hamilton’s Comprehensive Development Guidelines (2018) (Hamilton Guidelines) and the Ministry of Environment, Conservation and Parks (MECP) Design Guidelines for Drinking-Water Systems (2008) (MECP Guidelines). The hydraulic assessment was completed using the City’s full pipe model, titled “Hamilton\_EPS\_200625\_include\_PD9\_10” using Bentley WaterCAD Connect Edition Update 3 10.03.02.75 software.

## 1.2 Limitations

This TM is intended to provide servicing results for the proposed development based on the City’s hydraulic water model. This water model was built and coarsely calibrated by others. As with any modelling assignment, limitations related to the state of the model, the software capabilities, and theoretical data inputs should be considered. The model software also has inherent limitations and assumptions related to the calculation engine and inputs.

## 2.0 CRITERIA

### 2.1 Pressure Requirements

The MECP Guidelines outline maximum and minimum system pressures for standard operating conditions as well as fire flow conditions. As outlined in the City of Hamilton’s Water and Wastewater Masterplan (KMK, 2006), acceptable hydrant and service connection pressures under normal conditions range from 275 kPa to 690 kPa. Standard operating conditions were assessed for the proposed development to ensure that water services maintained acceptable pressure under various demand and fire flow conditions for existing (2021) and future (2031) scenarios. Table 2-1 provides the pressure criteria that were utilized.

**Table 2-1. Pressure Requirements**

Pressure Requirement	Minimum	Preferred	Maximum
Standard Operating Conditions	275 kPa (40 psi)	350 to 480 kPa (50 to 70 psi)	690 kPa (100 psi)
Maximum Day Demands + Fire Flows	140 kPa (20 psi)		

### 2.2 Domestic Demand

The domestic demands for the proposed development were calculated based on the daily water demand per capita and the peak factors from the City’s Water and Wastewater Master Plan. The total population of the development was 69, with the assumption of 3 people per townhouse unit. The detailed parameters used in the demand calculation can be found in Table 2-2 below.

**Table 2-2. Demand Calculation Parameters**

Parameter		Value
Population per Unit	Townhouse	3
Demand (L/c/d)		300
Peak Factor	MDD	1.9
	PHD	3

The Average Day Demand (ADD), Maximum Day Demand (MDD), and Peak Hour Demand (PHD) for the development are summarized in Table 2-3.

**Table 2-3. Estimated Domestic Demands for the Proposed Development**

Development	Demand (L/s)		
	ADD	MDD	PHD
253 & 259 Limeridge Road W	0.21	0.40	0.63





### 2.3 Fire Flow Demand

The fire flow requirements for the proposed development were estimated by the Hamilton Watermain Fire Flow Requirement Design Guidelines Policy (PW19096). The City’s residential fire flow requirements are summarized in Table 2-3 below. The development is required to meet a minimum fire flow of 150 L/s at a residual pressure of 140 kPa (20 psi) under MDD conditions, as specified in Table 2-4.

**Table 2-4. Hamilton Residential Fire Flow Requirements**

Development Type	Target Fire Flow (L/s)
<b>Residential Multi (&gt; 3 Units)</b>	<b>150</b>
Residential Medium (≤ 3 Units)	125
Residential Single	75
Residential Single (Dead End)	50

## 3.0 HYDRAULIC WATER MODEL

### 3.1 Boundary Conditions

The proposed development was modelled under the following demand scenarios under both existing (2021) and ultimate build-out (currently 2031) conditions:

- Average Day Demand (ADD)
- Maximum Day Demand (MDD)
- MDD plus Fire Flow
- Peak Hour Demand (PHD)

Initial boundary conditions for PD6 were applied based on input from the City and are summarized in Table 3-1 below. The pumps at the water treatment plant (WTP) were turned off (reservoir only conditions). The City has specified that HD06A and HD06B pump stations should be modelled each with one of the largest pumps turned off at each station to represent firm capacity. If pressure results are above the preferred operating conditions, additional pumps may be turned off. Each station also has a recirculation valve to relieve pressures into HDR05 during periods of low demand. The City specified pressure setpoints for the recirculation lines of 430 kPa (271m HGL) and 675 kPa (277m HGL) for HD06A and HD06B, respectively.

**Table 3-1: PD6 Boundary Conditions**

Element	Initial Status – HGL	
Tank HDR05 level	232.32 m (50%)	233.88 m (70%)
HD06A-PMP-1	On	On
HD06A-PMP-3	On	On
HD06A-PMP-4	Off	Off
HD06A-PMP-5	On	On



Element	Initial Status – HGL	
HD06B-PMP-1	On	On
HD06B-PMP-2	On	On
HD06B-PMP-4	Off	Off

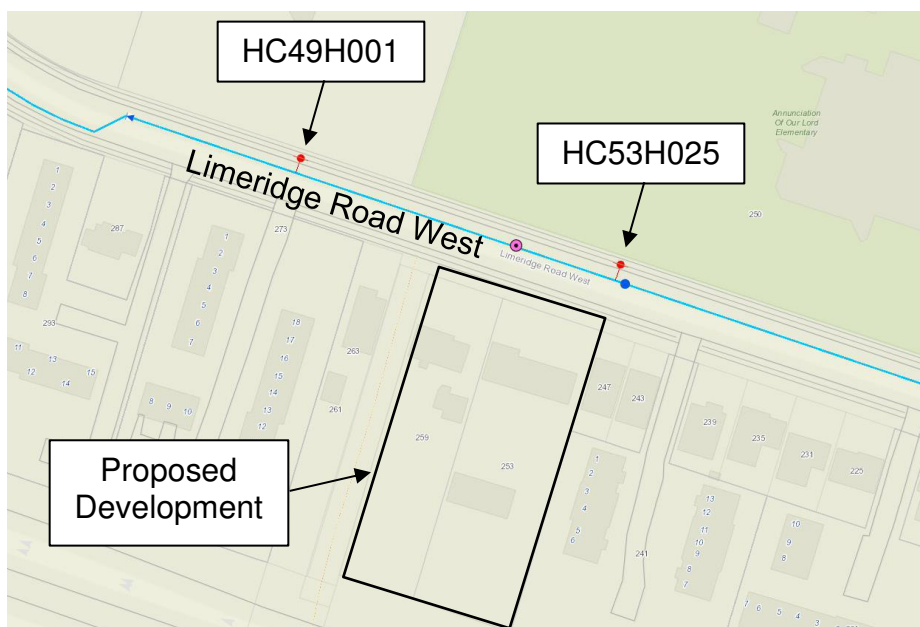
### 3.2 Model Verification

The accuracy of the model in the proposed development area was verified using hydrant field test results, completed by Watermark on Oct. 31, 2022. The hydrant field test results on Limeridge Road West are summarized in Table 3-2.

Figure 3-1 provides the location of the residual and flow hydrant that were used for verification. Pressures were measured at the residual hydrant. The hydrant testing reports are available in Appendix B. Hydrant elevations in the model were extrapolated to be 224.93 m and 224.79 m for HC49H001 and HC53H025, respectively.

**Table 3-2. Hydrant Field Testing Results – Oct. 31, 2022**

Limeridge Road West	
Flow (L/s) at Hydrant HC49H001	Pressure at Hydrant HC53H025
0	434 kPa (63 psi)
52	421 kPa (61 psi)
88	400 kPa (58 psi)
Theoretical Flow at 20 psi	
277.2	138 kPa (20 psi)



**Figure 3-1. Field Testing Hydrant used for Model Verification**

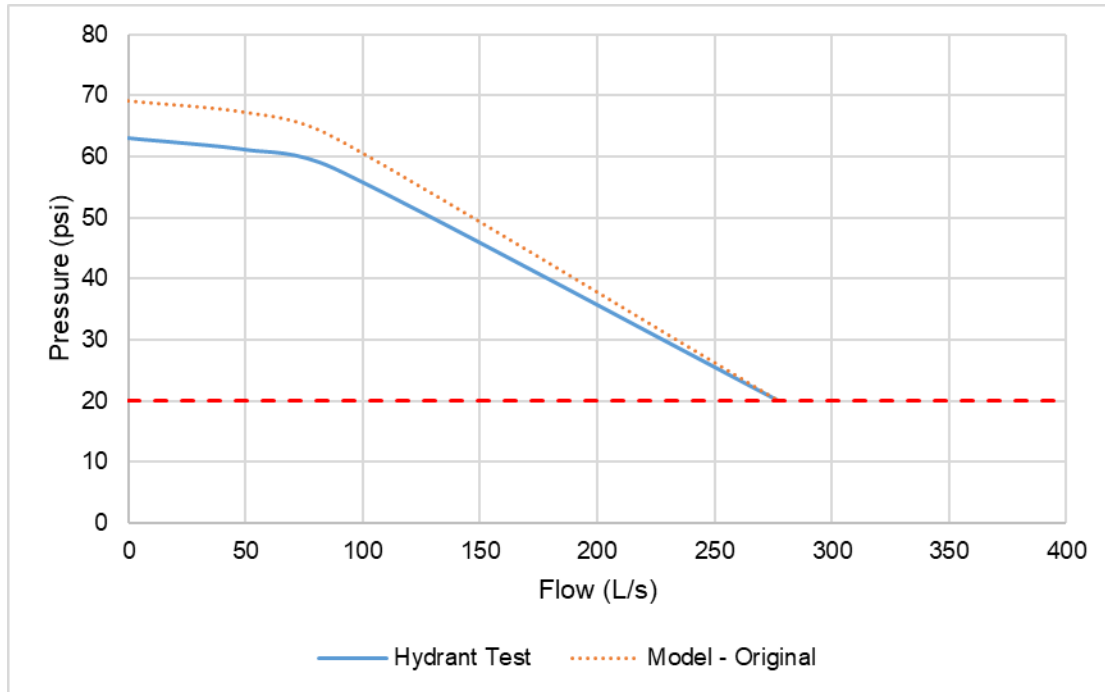


PD6 SCADA data was requested from the City to determine the boundary conditions during the field testing. A summary of the boundary conditions used for model verification is provided in Table 3-3. The model was compared to the hydrant test results under 2021 ADD conditions.

**Table 3-3. Summary of Boundary Conditions at Time of Hydrant Testing**

Element		Flow Hydrant
		HC49H001
Time of Test		9:30 AM
HDR05	Average Tank Level	233.11 m
HD05A	HLP01	OFF
	HLP02	ON
	HLP04	OFF
	Discharge Flow	412 L/s
	Discharge Pressure	177.8 psi
HD005	HLP1	OFF
	HLP2	OFF
	HLP3	ON
	HLP4	OFF
	Discharge Flow	498 L/s
	Discharge Pressure	174.2 psi
HD06A	HLP01	ON
	HLP03	OFF
	HLP04	OFF
	HLP05	ON
	Discharge Flow	853 L/s
	Discharge Pressure	65.6 psi
	Recirculation Flow	43 L/s
HD06B	HLP01	OFF
	HLP02	OFF
	HLP04	OFF
	HLP01	OFF
	Discharge Flow	0 L/s

Figure 3-2 illustrates the field test and model verification results for the hydrant on Limeridge Road West (HC49H001). Field results beyond maximum testing flows are extrapolated. The focus of the model verification was on the drop in pressure caused by the hydrant test.



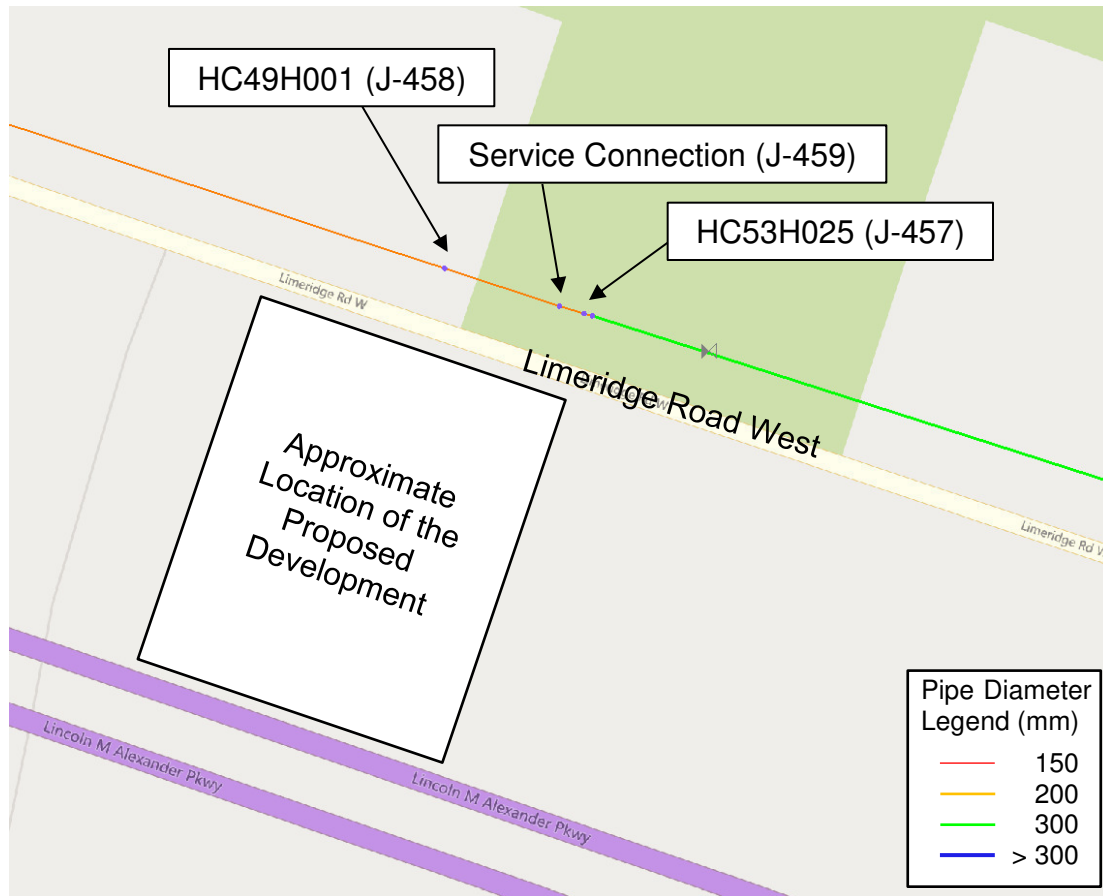
**Figure 3-2. Verification Results - Hydrant HC49H001 on Limeridge Road West**

When using the original C-factors in the City’s model, the pressure drop caused by the hydrant flows on Limeridge Road West was found to be more conservative than the field results. The original C-factors in the model closely represented the field test results and were not adjusted.

### 3.3 Development

Figure 3-3 illustrates the location of the proposed development. The development will be serviced by a connection on the existing 200 mm watermain on Limeridge Road West.

The elevation of the development node (J-459) was estimated using Hamilton’s existing water model and the elevations of the surrounding nodes. The elevation of the demand node is 224.8 m.



**Figure 3-3. Model Layout for the Proposed Development Area**

## 4.0 ANALYSIS

### 4.1 Available Fire Flow

The model was used to determine the available fire flow at the development node (J-459) and the existing hydrants on Limeridge Road West (HC49H001, J-458; HC53H025, J-457).

Table 4-1 summarizes the available fire flows under MDD 2021 and 2031 conditions, at a residual pressure of 140 kPa (20 psi), and HDR05 tank level set at 50%. The minimum available fire flow of 150 L/s can be achieved at the development node and existing hydrants on Limeridge Road West under all scenarios. The complete fire flow results are available in Appendix C.

**Table 4-1. Available Fire Flow Results (L/s) - 2021 and 2031 MDD – Tank 50%**

Location	Available Fire Flow (L/s)		Meet Fire Flow Requirement?
	2021	2031	
HC53H025 (J-457)	246	248	TRUE
Service Connection (J-459)	236	238	TRUE
HC49H001 (J-458)	213	215	TRUE

## 4.2 System Pressures

The pressure results for the development node (J-459) are summarized in Table 4-2 and Table 4-3 with HDR05 tank levels set to 50% and 70%, respectively. The pressure results were modelled under the boundary conditions specified by the City from Section 3.1. Under each of the scenarios, the pressures ranged between 61-82 psi. This is above the City’s preferred operating range of 40-80 psi but below maximum allowable operating pressure of 100 psi. The detailed pressure results are included in Appendix D.

**Table 4-2. Pressure Results (psi) - Tank 50%**

Node	ADD		MDD		PHD	
	2021	2031	2021	2031	2021	2031
J-459	80	79	71	70	64	61

**Table 4-3. Pressure Results (psi) - Tank 70%**

Node	ADD		MDD		PHD	
	2021	2031	2021	2031	2021	2031
J-459	82	82	73	72	66	63

## 5.0 CONCLUSIONS

This analysis was based on the City’s existing hydraulic water model. The model was verified using field test results and the City’s historical SCADA data. The original C-factors of the watermains near the development area were shown to provide a close representation of the hydraulic capacity of the water system, based on field testing data provided.

The proposed development was modelled with a new service connection to the existing 200 mm watermain on Limeridge Road West. The watermain hydraulic assessment of the proposed development demonstrated that:

1. Under the proposed development conditions, the minimum available fire flow requirement of 150 L/s was achieved the development service connection and the existing hydrants on Limeridge Road West (HC49H001 and HC53H025) under MDD 2021 or MDD 2031 conditions.
2. The service pressures under existing conditions, and ultimate build-out (currently 2031\*) conditions are expected to range from 61 psi to 82 psi. This is above the City’s preferred operating range of 40-80 psi, but below the maximum allowable operating pressure of 100 psi.

\* As amended from time to time as per Official Plan Report Content



## **APPENDIX A – Site Plan**



253 & 269 LIMERIDGE ROAD WEST

CONTRACTOR MUST CHECK AND VERIFY ALL DIMENSIONS AND JOB CONDITIONS BEFORE PROCEEDING WITH WORK. ALL DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF THE ARCHITECTS AND MUST BE RETURNED AT THE COMPLETION OF THE WORK. THE CONTRACTOR WORKING FROM DRAWINGS NOT SPECIFICALLY MARKED FOR CONSTRUCTION MUST ASSUME FULL RESPONSIBILITY AND BEAR COSTS FOR ANY CORRECTIONS OR DAMAGES RESULTING FROM HIS OR HER WORK.

KEY TO DETAIL LOCATION	
No.	DETAIL NUMBER
No.	DRAWING SHEET NUMBER

PRINTS ISSUED		DATE	BY
No.		(DD,MM,YY)	

REVISIONS TO DRAWING		DATE	BY
No.		(DD,MM,YY)	

BUILDING PERMIT NUMBER:  
NOT FOR CONSTRUCTION WITHOUT PERMIT

**KNYMH**  
ARCHITECTURE  
SOLUTIONS

3190 HARVESTER ROAD • SUITE 202  
BURLINGTON, ONTARIO • L7N3T1  
T 905.639.6595  
F 905.639.0394

www.knymh.com info@knymh.com

PROJECT NORTH  
TRUE NORTH

**PRELIMINARY**

**TOWNHOUSE DEVELOPMENT**  
253 & 259 LIMERIDGE ROAD WEST  
HAMILTON, ONTARIO

DRAWING SHEET TITLE:  
**SITE PLAN**

DRAWING SCALE: 1:200  
MH PROJECT NUMBER: 22048

DRAWN BY: --  
ISSUED DATE: Issue Date  
PLOT DATE: October 27, 2022  
DRAWING SHEET NUMBER: **SP1**







## **APPENDIX B – Hydrant Field Testing Report**



# Hydrant Flow Test Report

Residual Hydrant Number \_\_\_\_\_

Date: 31-Oct-22 Time: 9:30 AM Operator: Colin Powell  
 Witness: City of Hamilton

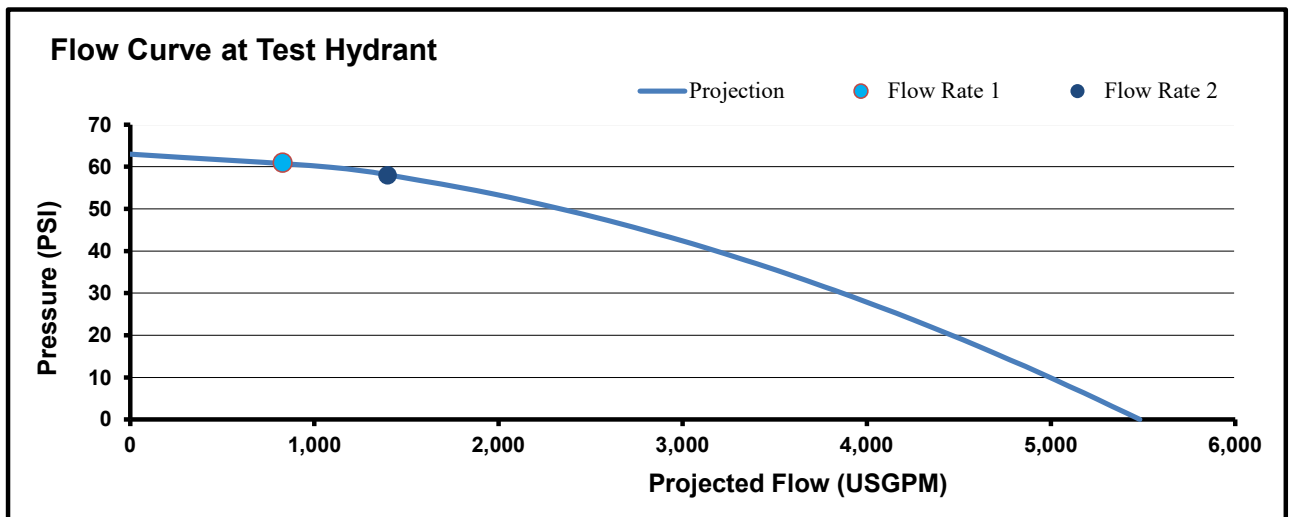
<b>Residual Test Hydrant:</b>	opposite 247 Limeridge Road West	
<b>Hydrant Number:</b>		NFPA Colour Code: <b>CLASS AA - BLUE</b>
<b>Owner:</b>	City of Hamilton	

STATIC PRESSURE:	63 psi	434 kPa	Pressure Drop	
RESIDUAL PRESSURE 1:	61 psi	421 kPa		3.2%
RESIDUAL PRESSURE 2:	58 psi	400 kPa		7.9%

Flow Hydrants:		Hydrant Number
A	280 Limeridge Road West	
B		
C		

Hydrant No.	Flow Device	Outlet Dia. (in.)	Flow Rate 1		Flow Rate 2	
			Reading (psi)	(USGPM)	Reading (psi)	(USGPM)
A	Pitot	2.5	28	825	20	698
A	Pitot	2.5		0	20	698
A	HoseMonster	4"		0		
Total Flow (USGPM)			825		1395	
Total Flow (L/second)			52		88	
Available Flow At Test Hydrant at 20 psi			4,327 USGPM		4,460 USGPM	
			273 L/second		281 L/second	

Average Projection at 20 PSI **4,393 USGPM**



**Comments/Discrepancies/Diagram:**  
 May have called on booster pumps during flow testing. Static pressure remained at 70 PSI after flow test was completed.



## **APPENDIX C – Model Results – Fire Flow**

Fire Flow

2021 MDD

Label	Zone	Fire Flow Iterations	Satisfies Fire Flow Constraints?	Fire Flow (Needed) (L/s)	Fire Flow (Available) (L/s)	Flow (Total Needed) (L/s)	Flow (Total Available) (L/s)	Pressure (Residual Lower Limit) (psi)	Pressure (Calculated Residual) (psi)
J-457	6	4	TRUE	150	246	150	246	20	20
J-459	6	4	TRUE	150	236	150	237	20	20
J-458	6	4	TRUE	150	213	150	213	20	20

2031 MDD

Label	Zone	Fire Flow Iterations	Satisfies Fire Flow Constraints?	Fire Flow (Needed) (L/s)	Fire Flow (Available) (L/s)	Flow (Total Needed) (L/s)	Flow (Total Available) (L/s)	Pressure (Residual Lower Limit) (psi)	Pressure (Calculated Residual) (psi)
J-457	6	4	TRUE	150	248	150	248	20	20
J-459	6	4	TRUE	150	238	150	238	20	20
J-458	6	4	TRUE	150	215	150	215	20	20



## **APPENDIX D – Model Results - Pressure**

## Pressure

2021

ADD Tank 50%

ID	Label	Elevation (m)	Zone	Demand Collection	Demand (L/s)	Notes	Hydraulic Grade (m)	Pressure (psi)	Fire Flow (Available) (L/s)
33464	J-459	224.81	6	<Collection: 1 item>	0.21	253 & 259 Limeridge Service Connection	281.12	80	(N/A)

ADD Tank 70%

ID	Label	Elevation (m)	Zone	Demand Collection	Demand (L/s)	Notes	Hydraulic Grade (m)	Pressure (psi)	Fire Flow (Available) (L/s)
33464	J-459	224.81	6	<Collection: 1 item>	0.21	253 & 259 Limeridge Service Connection	282.68	82	(N/A)

MDD Tank 50%

ID	Label	Elevation (m)	Zone	Demand Collection	Demand (L/s)	Notes	Hydraulic Grade (m)	Pressure (psi)	Fire Flow (Available) (L/s)
33464	J-459	224.81	6	<Collection: 1 item>	0.4	253 & 259 Limeridge Service Connection	275.01	71	(N/A)

MDD Tank 70%

ID	Label	Elevation (m)	Zone	Demand Collection	Demand (L/s)	Notes	Hydraulic Grade (m)	Pressure (psi)	Fire Flow (Available) (L/s)
33464	J-459	224.81	6	<Collection: 1 item>	0.4	253 & 259 Limeridge Service Connection	276.52	73	(N/A)

PHD Tank 50%

ID	Label	Elevation (m)	Zone	Demand Collection	Demand (L/s)	Notes	Hydraulic Grade (m)	Pressure (psi)	Fire Flow (Available) (L/s)
33464	J-459	224.81	6	<Collection: 1 item>	0.63	253 & 259 Limeridge Service Connection	269.55	64	(N/A)

PHD Tank 70%

ID	Label	Elevation (m)	Zone	Demand Collection	Demand (L/s)	Notes	Hydraulic Grade (m)	Pressure (psi)	Fire Flow (Available) (L/s)
33464	J-459	224.81	6	<Collection: 1 item>	0.63	253 & 259 Limeridge Service Connection	271.02	66	(N/A)

2031

ADD Tank 50%

ID	Label	Elevation (m)	Zone	Demand Collection	Demand (L/s)	Notes	Hydraulic Grade (m)	Pressure (psi)	Fire Flow (Available) (L/s)
33464	J-459	224.81	6	<Collection: 1 item>	0.21	253 & 259 Limeridge Service Connection	280.71	79	(N/A)

ADD Tank 70%

ID	Label	Elevation (m)	Zone	Demand Collection	Demand (L/s)	Notes	Hydraulic Grade (m)	Pressure (psi)	Fire Flow (Available) (L/s)
33464	J-459	224.81	6	<Collection: 1 item>	0.21	253 & 259 Limeridge Service Connection	282.27	82	(N/A)

MDD Tank 50%

ID	Label	Elevation (m)	Zone	Demand Collection	Demand (L/s)	Notes	Hydraulic Grade (m)	Pressure (psi)	Fire Flow (Available) (L/s)
33464	J-459	224.81	6	<Collection: 1 item>	0.4	253 & 259 Limeridge Service Connection	274.32	70	(N/A)

MDD Tank 70%

ID	Label	Elevation (m)	Zone	Demand Collection	Demand (L/s)	Notes	Hydraulic Grade (m)	Pressure (psi)	Fire Flow (Available) (L/s)
33464	J-459	224.81	6	<Collection: 1 item>	0.4	253 & 259 Limeridge Service Connection	275.81	72	(N/A)

PHD Tank 50%

ID	Label	Elevation (m)	Zone	Demand Collection	Demand (L/s)	Notes	Hydraulic Grade (m)	Pressure (psi)	Fire Flow (Available) (L/s)
33464	J-459	224.81	6	<Collection: 1 item>	0.63	253 & 259 Limeridge Service Connection	268.05	61	(N/A)

PHD Tank 70%

ID	Label	Elevation (m)	Zone	Demand Collection	Demand (L/s)	Notes	Hydraulic Grade (m)	Pressure (psi)	Fire Flow (Available) (L/s)
33464	J-459	224.81	6	<Collection: 1 item>	0.63	253 & 259 Limeridge Service Connection	269.52	63	(N/A)