13750701 Canada Inc.

PDEV 4646 County Road 2 WHA

Z0022445

WATERMAIN HYDRAULIC ANALYSIS

CIMA+ file number: Z0022445
05 May 2025 – Review 02

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Prepared by:

Maria Rincon, EIT

Matt Phillips, P. Eng.

Verified by:

Samuel Ziemann, P. Eng.

900–101 Frederick Street, Kitchener, ON N2H 6R2 CANADA T 519 772-2299 F 519 772-2298

CIMA+ file number: Z0022445
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Table of involved resources

In addition to the signatories of this report, the following individuals have also been involved in the study and writing of the report as technical experts within the project team:

Name	Engineering License Number	Discipline

Register of issues			
Issue No.	Reviewed by	Date	Description of the review
01	S. Ziemann	2025-01-24	QA/QC Review - Draft
02	S. Ziemann	2025-05-05	QA/QC Review - Final

Confidentiality and ownership

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1. Introduction

CIMA Canada Inc. (CIMA+) has been requested to conduct a hydraulic assessment of the proposed subdivision at 4646 County Road 2 and its impact on the existing water distribution system. The proposed development is located in Pressure Zone 2 in the Municipality of Port Hope (Municipality). The property is approximately 3.93 ha (9.71 ac) in size with various lot frontage ranging between 26.6 m and 67.5 m. The development includes the creation of 12 residential lots, open space, and an internal roadway (denoted currently as 'Street A') that will provide access to County Road 2 located in the Hamlet of Welcome. The development is bound by existing residential land to the west and north, and existing agricultural land to the east and south. Existing ground elevations across the proposed development site range from 134 m at the north end of the site to 139 m at the south end of the site. Figure 1-1 illustrates the location of the proposed development. Appendix A shows the concept plan.

An existing 150mm diameter watermain runs north along County Road 2 from Port Hope into the Hamlet of Welcome. The existing water distribution system in Welcome was established to meet domestic demands only and is not sized to provide fire protection. To maintain water quality, automatic flushing stations exist at the ends of the eastern and western branches of the Welcome system. Further description of the existing water distribution system is provided in Section 2.

Figure 1-1: Proposed Development Area (CCS 2024)

The proposed development area was assessed with the Municipality's InfoWater model using the existing (2022) scenario. The purpose of this report is to:

- Determine water demands associated with the proposed development based on building types and design guidelines.
- Confirm watermain sizing for connections within the site of interest.
- Provide estimates of system pressures, head losses and water age in the vicinity of the site as generated from the hydraulic model.

1.1 Limitations

This report is intended to provide servicing results for the proposed development based on the Municipality's hydraulic water model. This water model was updated by CIMA+ in 2022 but has not been calibrated. 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. Existing Distribution System

The Port Hope Drinking Water System is classified as a Large Municipal Residential drinking water system that serves the urban community of Port Hope with a current estimated population of 12,500. The serviced area includes a wide range of ground elevations varying between 75 m and 150 m. As a result, the water distribution system is divided into two (2) pressure zones (Pressure Zone 1 and Pressure Zone 2).

Pressure Zone 1 (Zone 1) covers the area within the Ganaraska River valley and including the lands east of the river with elevations ranging from 75 m along the shoreline of Lake Ontario to 120 m along the boundary of the pressure zones. The Dorset Street Standpipe provides storage and helps regulate the pressure in Zone 1.

Pressure Zone 2 (Zone 2) covers the area west of the Ganaraska River valley with elevations ranging from 95 m to 150 m. Zone 2 includes the Jocelyn Street Reservoir (2,270 m^3), the Fox Road Elevated Tank (ET) (3,000 m^3), and two (2) booster pumping stations (BPS). The Victoria Street BPS and the Jocelyn Street BPS maintain system pressure and flow in Zone 2, while the Fox Road ET elevated tank provides storage and helps regulate the pressure in Zone 2. The Hamlet of Welcome is connected to Zone 2 by a 300mm diameter watermain that crosses under Highway 401 at Fox Road and runs northwesterly towards the north side of the Toronto Road / County Road 2 interchange. North of the interchange the watermain diameter is reduced to 150mm.

Raw water is obtained from Lake Ontario, treated at the Port Hope Water Treatment Plant (WTP) and distributed to the two pressure zones. Figure 2-1 defines the boundary between the pressure zones and the location of other key facilities within the Port Hope water distribution system.

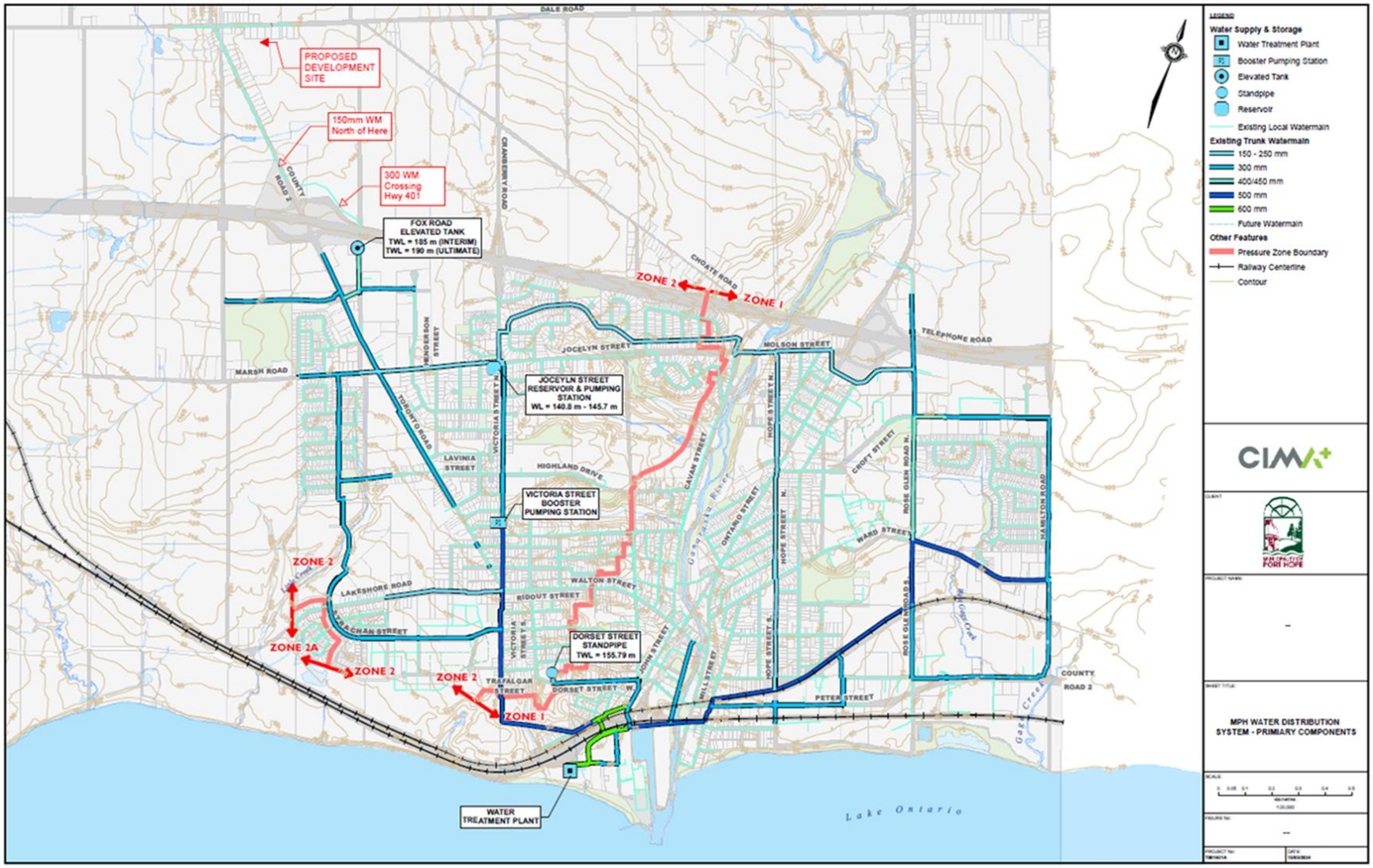


Figure 2-1: Port Hope Water Distribution System

3. Design Criteria

3.1 Pressure Guidelines

The Design Guidelines for Drinking Water Systems (MECP 2008) provides the following recommendations for pressures within municipal water distribution systems, as shown in Table 3-1.

Table 3-1: MECP Design Guidelines

Pressure Requirements	Minimum	Maximum
Maximum Day Demands + Fire Flow	20 psi	
Normal Operating Conditions	40 psi	50 - 70 psi

Pressures outside of the normal operation range may be dictated by distribution system size and/or topography. The maximum pressures in the distribution system should not exceed 700 kPa (100 psi) to avoid damage to household plumbing and unnecessary water and energy consumption (MECP 2008).

3.2 Domestic Demand

Water demands for the proposed development were estimated based on following the parameters from the MECP design guidelines:

- Population density at a design population of 3.5 people per single estate residential.
- Average Day Demand of 450 L/person/day

See Appendix B for the detailed preliminary demand calculation.

The maximum day demand (MDD) and peak hour demand (PHD) was calculated using peaking factors of 1.90 and 2.85 (1.5 x MDD), respectively, from the Design Guidelines for Drinking Water Systems (MECP 2008) based on the design population. Since the Zone 2 demand pattern set in the Port Hope Model had a peak hour factor of 1.86 x MDD, the pattern was left unchanged in the model to provide a more conservative result. The ADD, MDD and PHD for the development are summarized in Table 3-2.

Table 3-2: Estimated Domestic Demands for the Proposed Development

4646 County Road 2 Development	Demand (L/s)		
	ADD	MDD	PHD
Total	0.2	0.4	0.6
Per Junction	0.036	0.069	0.104

As shown above in Table 3-2, the ADD and PHD range between 0.2 L/s to 0.6 L/s for the proposed development. These demands are split across six demand nodes within the model as shown below in Figure 3-1.

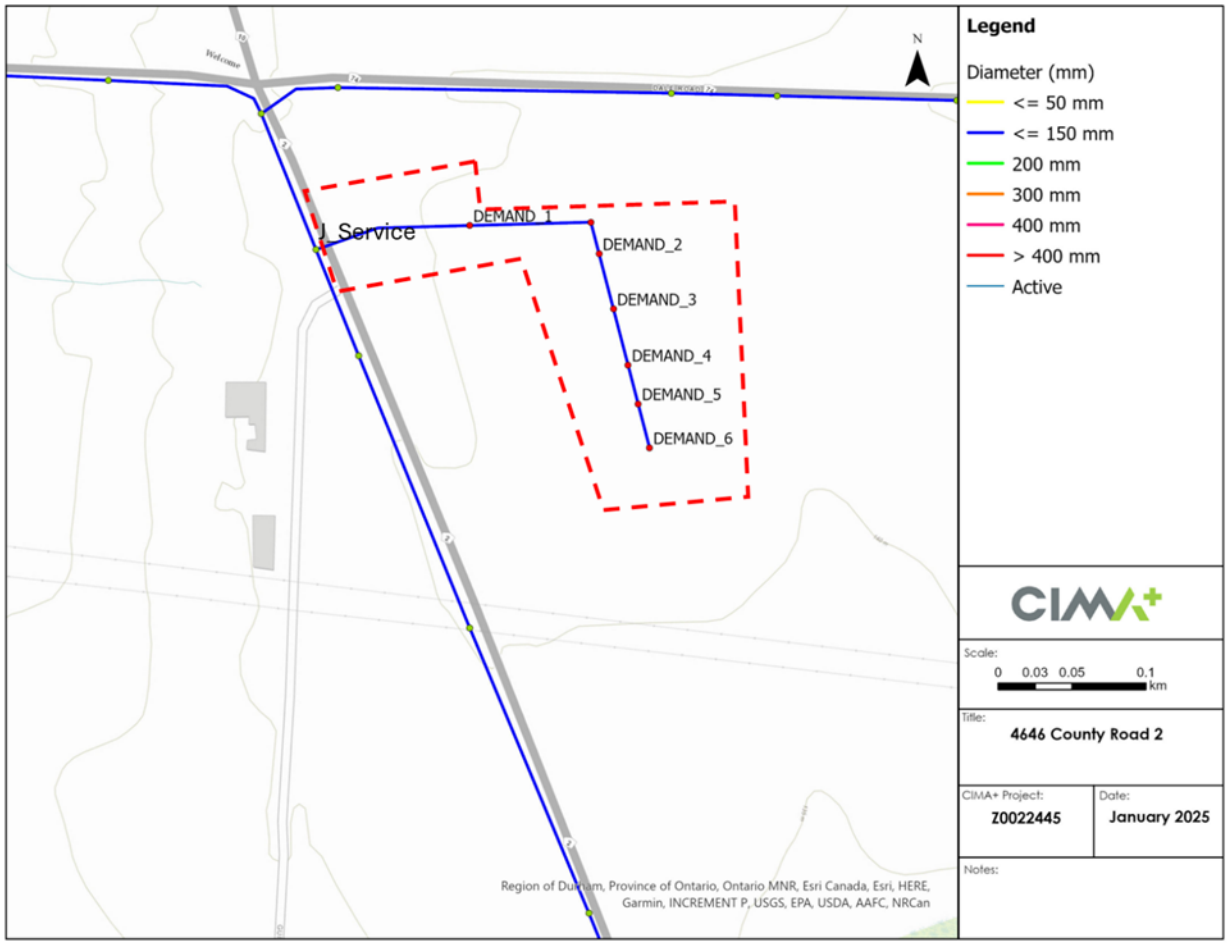


Figure 3-1: Demand Nodes in the Development

3.3 Fire Flow

Within the Hamlet of Welcome Water Servicing Strategy Municipal Class Environmental Assessment (AECOM, 2016) and the Municipality of Port Hope Official Plan, it is stated that a water supply system may only be extended to areas beyond the urban area if required to address existing water supply problems that pose a hazard to public health and safety and that it should only be sized to address domestic water supply demands. Therefore, fire flow servicing is not considered for the proposed development.

4. Hydraulic Analysis

4.1 System Pressures

Pressure results are summarized in Table 4-1 and Table 4-2 under pre-development and post development conditions, respectively. Under pre-development and post development scenarios, the pressures ranged between 64.4 – 69.6 and 62.7 – 69.6 psi, respectively, which are within the MECP's recommended operating pressure range of 50 – 70 psi. The minimum pressures observed during MDD reflect peak hour demand conditions.

Table 4-1: Pressure Results (psi) Pre-Development

Node	ADD			MDD		
	Max	Min	Avg	Max	Min	Avg
J_SERVICE	69.5	64.4	68.6	69.6	67.1	68.5

Table 4-2: Pressure Results (psi) Post Development

Node	ADD			MDD		
	Max	Min	Avg	Max	Min	Avg
J_SERVICE	69.6	64.2	68.6	69.6	66.9	68.4
DEMAND_6	68.2	62.7	67.1	68.1	65.4	66.9
DEMAND_5	68.2	62.7	67.1	68.1	65.4	66.9
DEMAND_4	68.2	62.7	67.1	68.1	65.4	66.9
DEMAND_3	68.2	62.7	67.1	68.1	65.4	66.9
DEMAND_2	68.2	62.7	67.1	68.1	65.4	66.9
DEMAND_1	68.8	63.4	67.8	68.7	66.1	67.5

4.2 Head Loss

Pressure loss (or head loss) can be used to evaluate sections of watermain that may cause restrictions in flow across the system. Typically, head loss should not exceed 3 m/km, excluding fire flow conditions. Pipes with small diameters and poor roughness condition (due to material or old age) can negatively impact pressure and flow.

Figure 4-1 and Figure 4-2 below shows the head loss under pre-development and post development MDD conditions. The 150mm watermain has a head loss <1.0 m/km, which indicates that the watermain performs well under the post-development conditions.

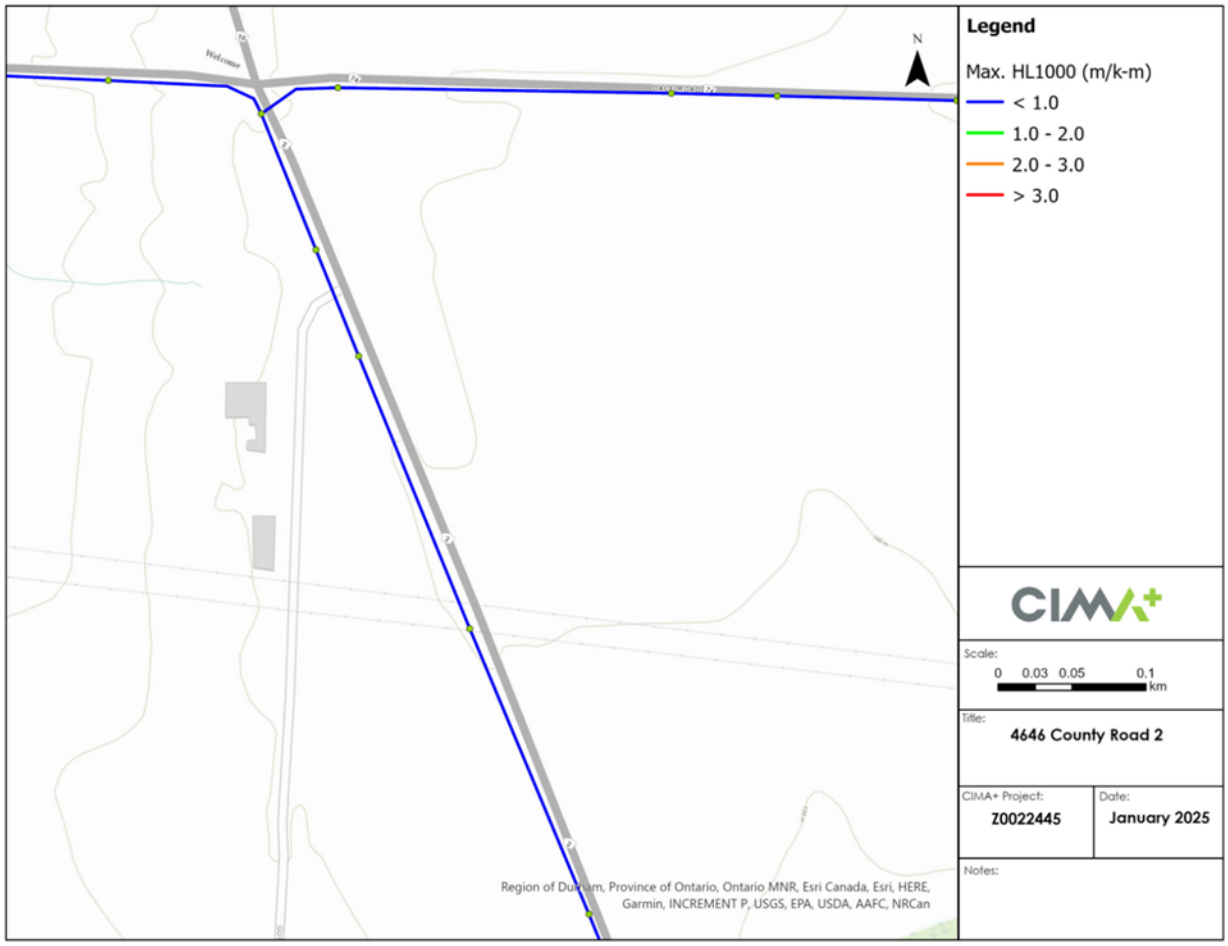


Figure 4-1: MDD Head Loss Pre-Development

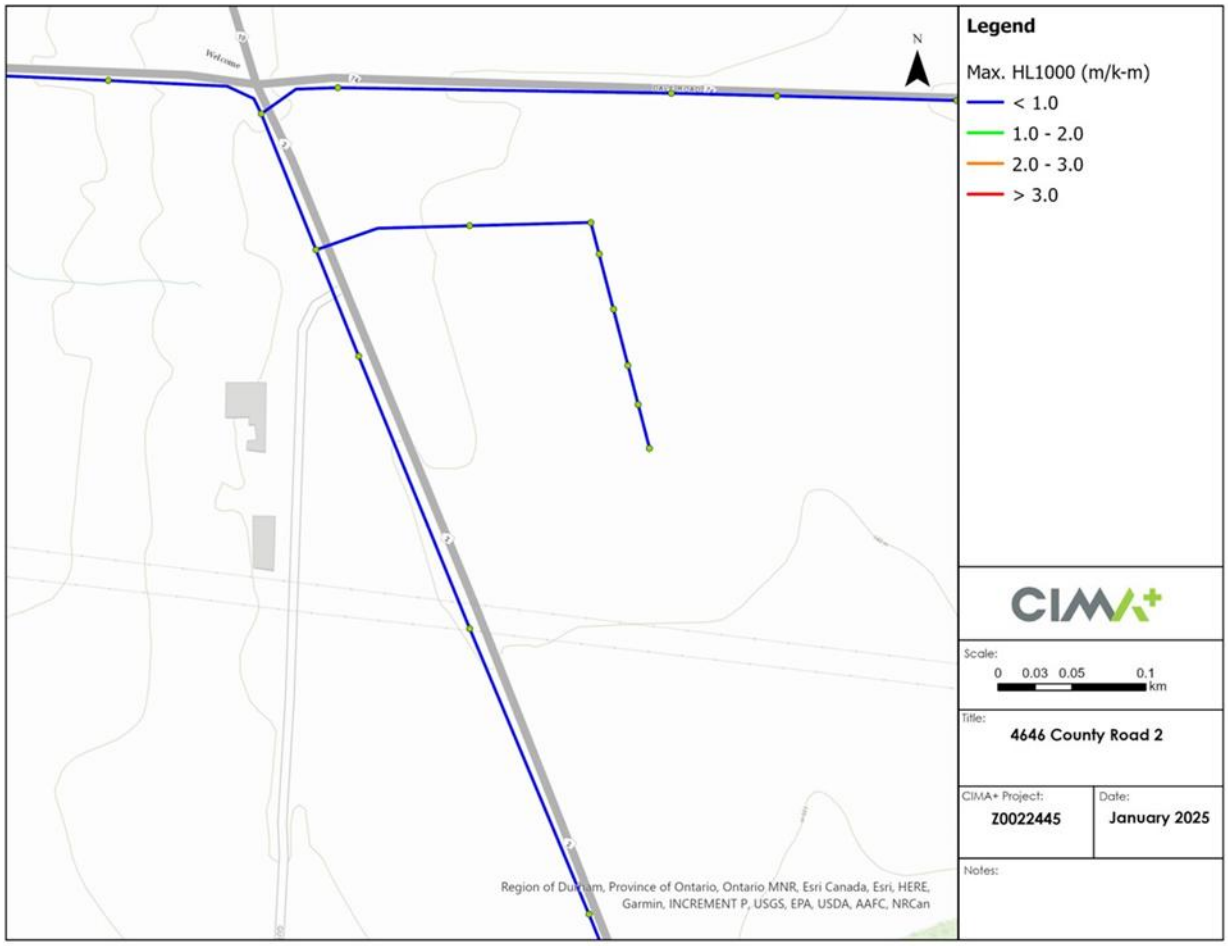


Figure 4-2: MDD Head Loss Post-Development

4.3 Water Age

Water age results under the ADD scenario are summarized in Table 4-3 under pre-development and post development conditions, respectively. The analysis was run for a 20-day duration in the model and the last 2 days of results were assessed for the maximum water age. For the analysis, the demands from the auto flushers at the ends of the eastern and western branches of the existing system in Welcome were included in the model. The Hydro-Guard HG-8 auto flushers were assumed to flush up to 9.5 L/s, every other day for one hour based on the device specifications and information from the Municipality. If more local data becomes available about the typical flow rate, this can be updated in the model. Water age was set to 0 at the Jocelyn Street BPS based on the presence of a chlorination system that doses water with sodium hypochlorite as it flows between the Jocelyn Street Reservoir and the pumps at the Jocelyn Street BPS.

Table 4-3: Water Age Results (days) Pre-Development and Post Development

Node	Max Water Age (Days)	
	Pre-Development	Post-Development
J_SERVICE	6.1	5.8
DEMAND_6	-	6.3
DEMAND_5		6.2
DEMAND_4		6.1
DEMAND_3	-	6.0
DEMAND_2	-	6.0
DEMAND_1	-	5.9

Under pre-development conditions, the water age was found to be up to 6.1 days, and under post-development conditions was found to be up to 6.3 days at the farthest end of the development. For comparison, the average maximum water age in Pressure Zone 2 is 3.3 days. Typically, a maximum water age of 3 days is targeted but may differ from community to community (AWWA 2002).

The water age in this part of the system is expected to be relatively high due to the significant travel distance between the closest re-chlorination site at the Jocelyn Street BPS and the development, combined with the relatively low demands.

Under existing conditions, auto flushers were installed to manage water age in this part of the system and the Municipality currently does not have concerns with chlorine residual levels in Welcome.

The turnover time in the new watermain was calculated as 0.5 days, as the difference between the max water age at the beginning (5.8 days) and the end of the watermain (6.3 days). This is within the typical target of 2 days for individual dead end watermains.

5. Conclusions

The hydraulic assessment of the proposed development 4646 County Road 2 demonstrated the following:

- The service pressures under pre-development and post development scenarios, ranged between 64.4 – 69.6 and 62.7 – 69.6 psi, respectively. The service pressures are acceptable within the guidelines established by the MECP.
- The maximum water age under post-development conditions was 6.3 days (at the furthest reach of the proposed development). At the proposed development connection point to the existing watermain on County Road 2 the water age is expected to be reduced from 6.1 to 5.8 days. The Municipality provided information related to the auto-flushers in the

area and did not have existing concerns related to maintenance of chlorine residuals within the Welcome portion of the Port Hope water distribution system.

- The watermain connection servicing the proposed development was sized as a 150mm diameter pipe and is consistent with the sizing of nearby watermains. The pipe sizing meets the pressure and head loss requirements for the system, whereby the head loss was found to be less than 1 m/km.

6. References

Effects of Water Age on Distribution System Water Quality (2002) American Water Works Association (AWWA).

Design Guidelines for Drinking Water Systems (2008) Ministry of the Environment (MOE).

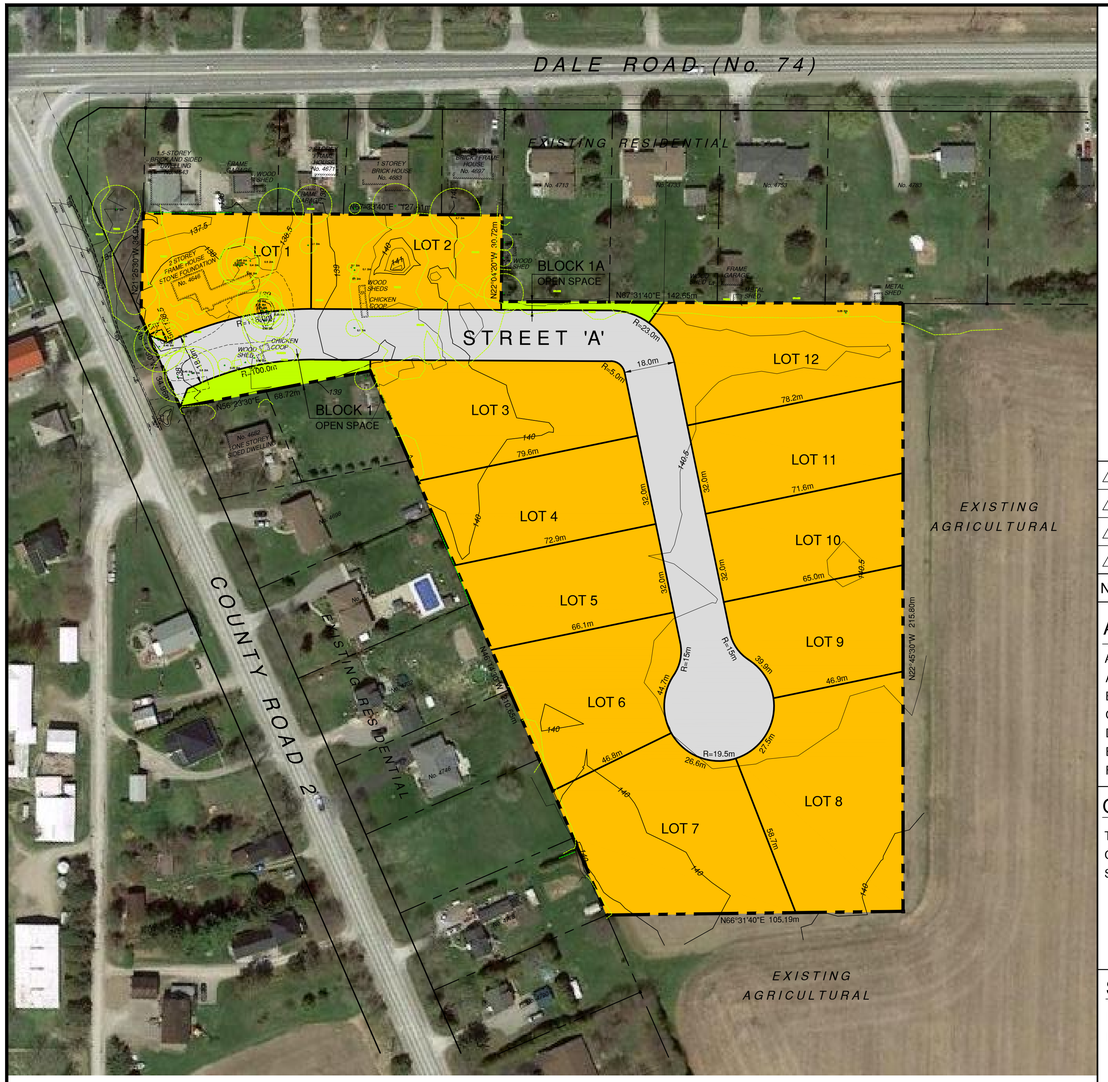
Planning Justification Report (2024) Clark Consulting Services (CCS).

Hamlet of Welcome Water Servicing Strategy Municipal Class Environmental Assessment (2016) AECOM.

A

Appendix A
Concept Plan

SETUP 1:1000m 24x24



KEY PLAN
1:15,000

NO.	DESCRIPTION	DATE	BY
△			
△			
△			
△			

REVISIONS

ADDITIONAL INFORMATION

AS REQUIRED UNDER SECTION 51(17) OF THE PLANNING ACT (R.S.O. 1990 C.P. 13)

A) AS SHOWN ON DRAFT PLAN.
B) AS SHOWN ON DRAFT AND KEY PLAN.
C) AS SHOWN ON KEY PLANS.
D) AS SHOWN IN LAND USE SCHEDULE.
E) AS SHOWN ON DRAFT PLAN.
F) AS SHOWN ON DRAFT PLAN.
G) AS SHOWN ON DRAFT AND KEY PLANS.
H) MUNICIPAL SERVICES TO BE PROVIDED.
I) SOIL IS CLAYEY SILT.
J) AS SHOWN ON DRAFT PLAN.
K) MUNICIPAL SERVICES TO BE PROVIDED.
L) NONE.

OWNER'S AUTHORIZATION:

THE UNDERSIGNED, BEING THE OWNER OF THE SUBJECT LANDS HEREBY AUTHORIZE CANDEVCON GROUP INC. TO ACT ON OUR BEHALF AS AGENTS AND TO PREPARE AND SUBMIT A DRAFT PLAN OF SUBDIVISION FOR APPROVAL.

DATE

13750701 CANADA INC.

SURVEYOR'S CERTIFICATE:

I HEREBY CERTIFY THAT THE BOUNDARIES OF THE LAND TO BE SUBDIVIDED AND THEIR RELATIONSHIP TO THE ADJOINING PROPERTIES ARE CORRECTLY SHOWN ON THIS PLAN

DATE

BRETT COONES O.L.S.
J. D. BARNES LIMITED, LAND INFORMATION SPECIALISTS
T: (905) 723-1212 F: (905) 723-4234 www.jdbarnes.com

LOT / BLOCK AREA SCHEDULE

LAND USE	LOT / BLOCK	MINIMUM FRONTAGE	MINIMUM DEPTH	AREA
RESIDENTIAL	LOT 1	52.8m	33.7m	0.23 ha.
RESIDENTIAL	LOT 2	67.5m	33.7m	0.23 ha.
RESIDENTIAL	LOT 3	28.2m	79.6m	0.30 ha.
RESIDENTIAL	LOT 4	32.0m	72.9m	0.24 ha.
RESIDENTIAL	LOT 5	32.0m	66.1m	0.22 ha.
RESIDENTIAL	LOT 6	44.7m	46.8m	0.27 ha.
RESIDENTIAL	LOT 7	26.6m	46.8m	0.37 ha.
RESIDENTIAL	LOT 8	27.5m	46.9m	0.39 ha.
RESIDENTIAL	LOT 9	39.9m	46.9m	0.21 ha.
RESIDENTIAL	LOT 10	32.0m	65.0m	0.22 ha.
RESIDENTIAL	LOT 11	32.0m	71.6m	0.24 ha.
RESIDENTIAL	LOT 12	44.4m	78.2m	0.30 ha.
OPEN SPACE	BLOCKS 1-1A	-	-	0.07 ha.
ROADS	STREET 'A'	-	-	0.63 ha.
TOTAL				3.93 ha.

DRAFT PLAN OF SUBDIVISION

PART OF LOT 13, REGISTERED PLAN No. 52
GEOGRAPHIC TOWNSHIP OF HOPE
MUNICIPALITY OF PORT HOPE
COUNTY OF NORTHUMBERLAND

13750701 CANADA INC.
RESIDENTIAL SUBDIVISION

No. 4646 COUNTY ROAD 2
PORT HOPE

CANDEVCON GROUP INC.
CONSULTING ENGINEERS AND PLANNERS
TEL. (905) 794-0600 FAX (905) 794-0611

SCALE: 1:1000 0m 10 20 30 40 DWG. No. PL-1 △
DATE: APRIL 25th 2024 PROJECT No. W23089

B

Appendix B
Demand Calculation

Water Demand Calculation

Assumptions:
- Units will all be estate residential

	Value	Unit
Average Day Consumption Rate	450	Lpcd

Peak Factors	Value
Maximum Day (MD)	1.9
Peak Hour (PH)	2.9

Unit Type	Unit Count	PPU
Estate residential	12	3.5

	Value	Unit
Population	42	people

Average Daily Flow (ADF)	18900	L/d	**(Per Junction in Model)**
	0.2	**L/s**	0.036 L/s
Maximum Daily Flow (MDD)	**0.4**	**L/s**	0.069 L/s
Peak Hour Flow (PHD)	**0.6**	**L/s**	0.104 L/s