Functional Servicing & Stormwater Management Report

127 Ardagh Road
City of Barrie

WMI 24-836

June 2024

Prepared by

WMI & Associates Limited
119 Collier Street, Barrie Ontario L4M 1H5

Table of Contents

Appendices

1.0 Background

1.1 General

WMI & Associates Limited has been retained by Fitchal Incorporated to prepare a Functional Servicing and Stormwater Management Report in support of the proposed residential development (herein referred to as the 'site') located at 127 & 131 Ardagh Road in the City of Barrie.

This report presents an investigation of existing services and drainage patterns, and conceptual designs for proposed watermains, sanitary sewers, and stormwater management controls. The level of detail presented is sufficient to support planning level approvals and shall serve as the basis for detailed design.

Fundamental servicing and drainage objectives detailed in this report are based on drainage and servicing constraints, pre-consultation information from the City of Barrie, Lake Simcoe Region Conservation Authority (LSRCA), as well as design guidelines and best management practices as set out by the Ministry of the Environment, Conservation and Parks (MECP). Various external servicing plans, obtained from the City of Barrie were also referenced to determine area wide drainage patterns and the extent of municipal infrastructure.

1.2 Site Description

The property comprises 0.43ha and is located on the south side of Ardagh Road between Patterson Road and Crawford Street. It is located in a primarily residential area consisting of low density residential properties immediately to the east, west, as well as north and south. The subject site is presently 2 residential lots, consisting of two 1-storey residential buildings, 2 driveways onto Ardagh Road, and landscaped areas in the front and back yards.

The proposed development includes 3 residential townhouse blocks, two of which comprise 7 units, and another which comprises 5 units, for a total 19 units. The site also includes an internal roadway, dedicated visitor parking, a turnaround area, an amenity space, and sidewalks connecting to Ardagh Road. All of the townhome blocks / units are to have frontage onto the internal road.

This report is based upon a Conceptual Site Plan dated January 22, 2024 prepared by Innovative Planning Solutions. The Conceptual Site Plan, and Site Location Plan are contained in **Appendix A** for reference. Also, refer to the conceptual Site Servicing and Grading Plans contained in **Appendix A** for pertinent design details which are discussed throughout this report.

2.0 Stormwater Management

2.1 Existing Topography and Pre-Development Drainage

Existing grades within the site are relatively steep with prevailing slopes in the range of 5%-10%. Retaining walls are present along the frontage of Ardagh Road, serving as a grade separation between the front yards (higher elevation) and municipal road (lower elevation). The subject site is drained by overland sheet flow from the south to the north, ultimately for capture and conveyance by municipal storm sewers on Ardagh road. There is an area of external drainage from residential backyards to the south which also drains through the subject site via sheet flow.

Ardagh Road is an urbanized arterial road that contains full municipal services, including a 450mm diameter storm sewer across the frontage of the site that drains storm flows to the west and then north on Crawford Street, ultimately to a tributary of Hotchkiss Creek, and Lake Simcoe.

For the purposes of the stormwater assessment contained herein, the site is delineated into a single catchment area, herein referred to as a catchment PRE. The external area to the south is referred to as catchment EXT.

Refer to the Pre-development Drainage Plan, **Figure 2**, included in **Appendix A**. Plan and profile drawings of Ardagh Road are also contained in **Appendix A** for reference.

2.2 Subsurface Conditions

Based on data from the Soils Map of Simcoe County, published by the Canada Department of Agriculture (1959), the predominant soil deposit in the area is identified as Tioga Loamy sand and Dundonald sandy loam. These soils are considered to have good drainage characteristics, and are both classified within Hydrologic Soils Group ‘A’ and ‘AB’, respectively.

Based on the local knowledge of the area, it is anticipated that a shallow groundwater table exists, to the extent that deep services construction could encounter groundwater. As such, the conceptual designs contained herein accounts for this condition.

2.3 Design Criteria Guidelines

The stormwater management design principles for the proposed development incorporates the policies and criteria of the Ministry of the Environment, Conservation and Parks (MECP), the Lake Simcoe Region Conservation Authority (LSRCA), the Lake Simcoe Protection Plan (LSPP), the City of Barrie, and utilizes best management practices for the conceptual design of the stormwater management system. The conceptual designs presented herein utilize Low Impact Development (LID) design initiatives where possible in order to minimize the environmental impact of the proposed development.

Key stormwater management design criteria for the subject development are summarized as follows:

- The City of Barrie rainfall intensity-duration-frequency (IDF) curves will be used to determine the peak design flows and runoff volumes for each of the design storm events analyzed.
- Quantity controls are to be provided to attenuate peak flows to pre-development levels for all storm events.
- Quality control is to be provided at an ‘enhanced’ level as defined by The Ministry of the Environment’s (MOE) Stormwater Management Planning and Design Manual (March 2003).
- Phosphorus reduction, water balance controls, and runoff volume control will be achieved to the greatest extent possible on-site as per LSRCA and City of Barrie guidelines.
- Erosion and sediment control measures will be implemented prior to and during the construction of the development and maintained until the site is stabilized.

2.4 Post-Development Drainage

Post-development drainage conditions will generally strive to match the pre-development conditions as closely as possible. In particular, the desire is to maintain the site’s south to north drainage characteristic, at or near the prevailing 5-10% slopes.

The majority of the proposed development area, including the internal roads, amenity area, driveways, buildings, and most landscape areas will drain via swales and internal storm sewers to an onsite detention tank prior to outletting to Ardagh Road. This internal drainage area is herein referred to as catchment A1. The perimeter backyard areas, as well as the external drainage area that drains into the site will be conveyed by swales and ultimately captured by internal storm sewers (in order to minimize the drainage area across multiple backyards) however these peak flows will not be attenuated to pre-development levels. The internal perimeter drainage area is herein referred to as catchment A2.

Table 1 below summarizes the uncontrolled pre- and post-development peak flows for various return period design storms.

Table 1: Pre- and Post-Development Uncontrolled Peak Flows

Catchment I.D.	A (ha)	T_C (min.)	C	Q_2 (m^3/s)	Q_5 (m^3/s)	Q_{10} (m^3/s)	Q_{25} (m^3/s)	Q_{50} (m^3/s)	Q_{100} (m^3/s)
EXT	0.44	10.0	0.26	0.026	0.035	0.040	0.052	0.063	0.072
PRE	**0.43**	**10.0**	**0.21**	**0.021**	**0.027**	**0.032**	**0.041**	**0.049**	**0.057**
A1	0.32	10.0	0.82	0.061	0.080	0.092	0.119	0.144	0.160
A2	0.11	10.0	0.24	0.006	0.008	0.009	0.012	0.014	0.017
A1+A2	**0.43**	**10.0**	**0.67**	**0.067**	**0.088**	**0.101**	**0.131**	**0.158**	**0.181**
Allowable A1 =PRE-A2				***0.015***	***0.019***	***0.022***	***0.029***	***0.035***	***0.040***

Since the post-development peak flows for catchments A1 + A2 are in excess of catchment PRE flows, quantity controls are required to attenuate post-development peak flows. Since catchment A2 flows are to be unattenuated, the targeted release rate for the catchment A1 flow outletting to the Ardagh road storm sewer is equal to catchment PRE less catchment A2 flows.

Refer to **Figure 3** for the Post-Development Drainage Plan, contained in **Appendix A**. Also refer to the storm drainage calculations contained in **Appendix B.**

2.5 Quantity Control

To achieve the target release rate for catchment A1, peak flow attenuation is required. This will be achieved by an underground storm detention system located within the internal road. This system is proposed to consist of an underground storage tank (such as a Stormtech tank or equivalent system) and a connecting storm sewer system consisting of storm pipes, catchbasins and catchbasin manholes. Flow control will be achieved by a single orifice located in the control manhole.

Table 2 below provides a summary of the post-development controlled peak flows and maximum storage volumes.

Table 2: Post-Development Controlled Peak Flows and Max Storage Volumes

Catchment I.D.	A (ha)	Q_2 (m^3/s)	Q_5 (m^3/s)	Q_{10} (m^3/s)	Q_{25} (m^3/s)	Q_{50} (m^3/s)	Q_{100} (m^3/s)	Max Storage (m^3)
A1	0.32	0.008	0.011	0.012	0.014	0.016	0.019	158.5
A2*	0.11	0.006	0.008	0.009	0.012	0.014	0.017	-
A1 + A2	**0.43**	**0.014**	**0.019**	**0.021**	**0.026**	**0.030**	**0.036**	-

*uncontrolled flows

In comparing pre-development peak flows from Table 1 and the controlled (catchment A1+A2) flows from Table 2, it can be seen that the total post-development release rates for all storm events can be achieved to allowable levels for catchments A1 and A2.

Specifically, peak flow attenuation from Area A1 will be achieved by underground detention storage to a maximum volume of $158.5m^3$ during the 100 year storm event.

Refer to **Appendix B** for supporting conceptual storm drainage and stormwater management calculations.

2.6 Quality Control & Low Impact Development Initiatives

In determining the best approach to providing quality controls and the associated LIDs for the proposed development, various factors were considered, including the following:

- Existing land characteristics and uses (soils, topography, treatment area, location, etc.).
- The sources of stormwater runoff and degree of contamination from each (i.e. road/ parking areas vs. rooftop);
- The magnitude of the increase in impervious area from pre-development conditions;
- Utilizing an 'integrated treatment train' approach to treat stormwater runoff;
- Ability to utilize landscaped areas and providing water balance and nutrient uptake benefits.
- Consideration of water table elevations, and spatial separation from LIDs (i.e. 1.0m minimum vertical separation);
- The nature of the native soils and the ability to infiltrate;
- Local requirements and maintenance considerations;
- Constructability / practicality considerations.

Through this investigation it has been determined that the native soils are likely conducive to support infiltration, however due to the expected high groundwater table and site area/ built form constraints, implemented infiltration-based LIDs will be limited to select areas.

In consideration of these factors, the chosen form of LIDs are perimeter grass swales, perforated storm sewers (for landscape area runoff only) and treatment of impervious-surface runoff by an oil & grit separator. These LIDs will provide the maximum possible quality control benefit within the confines of site constraints as it promotes the treatment train approach to stormwater management.

The following sub-sections describe how various forms of stormwater quality control will be implemented within the proposed development.

2.6.1 Total Suspended Solids Removal

To provide effective runoff quality controls for roadway and parking area runoff, an oil/grit separator (OGS) designed to Enhanced Verification Treatment (ETV) standards is proposed. Additional pre-treatment can be provided by installing point of entry traps (i.e. POET or goss traps) within all catchbasins and catchbasin manholes.

Perforated pipes are proposed to be utilized to provide infiltration of stormwater runoff from landscape areas, where there is a sufficient horizontal separation distance from the townhome units and vertical separation distance to the groundwater table. The proposed grass swales located around the perimeter of the site will provide additional quality control via filtering and infiltration processes.

Detailed quality control calculations will be provided at the detailed design stage.

2.7 Water Balance Controls

Water balance measures for the subject site are proposed to be implemented to the greatest extent possible and reasonable given the proposed built form and site constraints. The preferred method to provide such measures is via the infiltration of stormwater into the native soils.

The targeted volume of retention is 5mm over the site area of 0.43ha, in accordance with City standards for development sites <5ha, which equates to a volume of 21.5m^3. This retention is proposed to be achieved within the perforated pipe and stone bedding jacket proposed within the southern catchbasin leads (which captures only landscaped area runoff), subject to groundwater table spatial separation requirements. The details of the perforated pipe system(s) will be determined at the detailed design stage.

It is further noted that infiltration and evapotranspiration will occur through the proposed grass swales, lawns and the perimeter landscaped areas, which further promotes water balance and supports the integrated treatment train approach for stormwater management.

2.8 Phosphorus Removal Initiatives

In accordance with LSRCA’s Technical Guidelines, and the Lake Simcoe Protection Plan, phosphorous loading reduction initiatives are to be implemented to the greatest extent possible for any major development in an effort to reduce phosphorous loading into Lake Simcoe from its tributaries. The target is that phosphorous loading be reduced to pre-development levels.

Phosphorous reduction will be achieved by filtration, nutrient capture, detention, and infiltration processes (where possible) throughout the site. The greatest benefits will be through the proposed perforated storm pipes and the stormwater detention tank.

To quantify the effectiveness of the proposed LIDs, a pre- and post-development phosphorous loading analysis was undertaken using the Lake Simcoe Phosphorous Loading Development Tool (TP Tool), prepared for the Ontario Ministry of the Environment. This tool uses a weighted area method that is based on inputted catchment areas and the chosen BMP for each area to determine the overall percentage reduction of phosphorous loading.

The Phosphorous removal efficiency of a perforated pipe infiltration/exfiltration system is 87% and removal efficiency of an underground storage facility is 25%, as determined through studies referenced in support of the development of the TP Tool. Additionally, a 20% phosphorous removal efficiency is accredited for oil/grit separators with ETV treatment capability as per the LSRCA's Technical Guideline for Stormwater Management Submissions.

Pre-development phosphorous loading is determined to be 0.06kg/yr. Considering the drainage characteristics of the site, the total post-development phosphorous export from the site without LIDs is determined to be 0.57kg/yr. The total post-development phosphorous export from the site with the LIDs and using the above noted removal efficiencies is estimated to be 0.34kg/yr. In summary, the total phosphorus load reduction from the site with the implementation of the proposed LID is determined to be 0.23kg/yr, which is a reduction of 40% (0.23kg/yr / 0.57kg/yr) however phosphorous loadings are greater than that of pre-development conditions. Since phosphorous loadings with the LIDs are increased over pre-development conditions, phosphorous offsetting fees may apply.

For supporting calculations, refer to the Lake Simcoe Phosphorous Loading Development Tool Project Development Summary sheet located in **Appendix B**.

2.9 Runoff Volume Controls

Runoff volume controls are also proposed to be provided in accordance with the LSRCA Technical Guidelines.

The objective of runoff volume control is to provide runoff volume reduction through stormwater retention (via practices such as infiltration, evapotranspiration), runoff filtration, and through the application rate control LIDs, in this order of priority. The primary method of providing runoff volume control for this project is by retention and infiltration through the proposed exfiltration/ perforated pipe system.

Due to the restricted space that is available for implementing LIDs due to the close proximity of buildings to property lines and the congestion of other services and utilities proposed within the internal road, it is not reasonably possible to retain a 25mm or

12.5mm rainfall depth over all impervious areas (the main criterion and ‘alternative #1’ criterion in accordance with LSRCA Technical Guidelines, respectively). It is envisioned that it will be possible to provide LIDs that are capable of retaining a minimum 5mm rainfall depth, in accordance with LSRCA ‘alternative #2’ criteria.

The total impervious area from catchments A1 + A2 (the internal post development catchment areas) is equal to 2900m^2. A rainfall depth of 5mm over this area equates to a total volume of 14.5m^3 that is required to be retained onsite. The LIDs proposed onsite will be designed to retain this volume.

2.10 Other Contaminants

It is noted that other contaminants such as heavy metals, oil, grease, pesticides, bacteria and other nutrients could be present in stormwater runoff. These contaminants are not expected in significant concentrations due to the proposed land use (residential development), therefore are will not be a concern that requires any additional/ specific form of quality controls that the proposed LID’s within the treatment train will already provide.

The application of winter salt is expected to occur onsite to address safety concerns. Directing the majority of rooftop drainage to rear yards will inherently reduce the need for heavy salt application on sidewalks.

The temperature of stormwater is not expected to be a concern as the site is located a fair distance away from the receiving watercourse.

3.0 Site Grading

The proposed grading for the residential development is based on site constraints, proposed built form, and the stormwater management strategy. Specifics of proposed grading features are as follows:

- Internal road grades will be highest at the south end of the site and slope northward towards Ardagh Road. Internal road grades are proposed at or near typical maximum slopes, to match the prevailing topography and to minimize cut/fill requirements.
- The grading design around the townhomes blocks is such that grades are high in the rear and lower in the front, which is conducive to a ‘walk-up’ style of housing. This grading scheme is proposed to match existing grades at the south, west, and east property lines without the use of retaining walls.
- Front yard and driveway slopes for the townhome units will be in the order of 2.0% to 5.0%.
- An extension of the existing retaining wall along the frontage of Ardagh Road will be required along the northern property boundary to achieve the grade

separation between the site and Ardagh Road, similar to existing conditions for various residential properties along this portion of Ardagh Road.

- Due to a possible high groundwater table condition, the site may need to be raised to facilitate servicing and townhome construction.

Refer to **Figure 5** for the Conceptual Grading Plan, contained in **Appendix A**.

4.0 Sanitary Servicing

The site currently contains two (2) residential sanitary service connections from the existing 250mm diameter sanitary sewer on Ardagh Road, to service the existing homes.

It is proposed to decommission these services and provide a new 200mm diameter sanitary sewer extended from the Ardagh Road sewer. A network of new internal sanitary sewers will then be constructed to service the Townhomes. Each townhome will be serviced by individual sanitary service connections to the internal sewers.

The existing sanitary sewage design flow from the existing residential detached dwellings is estimated to be 0.12L/s, whereas the proposed sanitary sewage flows from the Townhome units are estimated to be 0.55L/s, thus representing an increase of 0.43L/s. This flow increase is considered negligible and it is expected that it can be accommodated by the existing municipal sanitary sewers.

Refer to **Appendix C** for supporting sanitary sewage flow calculations. Also refer to Figure 4 in **Appendix A** for the Conceptual Site Servicing Plan, and the plan and profile drawings for Ardagh Road.

5.0 Water Servicing

There is an existing 300mm diameter watermain on Ardagh Road along with local fire hydrants, which provide potable water and fire protection to the area. The site currently contains two (2) residential water service connections to the existing dwelling units.

It is proposed to service the proposed development by extending a new 200mm diameter watermain into the site from the existing watermain on Ardagh Road. A new on-site fire hydrant will be provided, as will a network of internal 50mm diameter watermains and individual service connections to provide water servicing to each unit. The Maximum Day Demand (MDD) for all townhome units is calculated to be 1.22L/s.

5.1 Fire Protection

Fire protection will be provided via a new internal fire hydrant that will be fed from the proposed 200mm diameter watermain. The position of the hydrant will be such that there is sufficient distance to the main entrance of each residential unit in accordance with minimum OBC and municipal criteria.

The building specific water demand for the subject site, based on the anticipated built form of the townhome units is calculated to be 66.7L/s based on Fire Underwriters Survey (FUS) criteria. The minimum required fire flow for Townhomes is 155L/s as per the City of Barrie design flow requirements. The City standard requirement for fire water supply is that the minimum supply of water shall be provided in accordance with the City of Barrie's land use designation, or that supply be in accordance with the site-specific fire water demand as determined by a Fire Underwriter's Survey (FUS) demand calculation, whichever is greater. For this development, the land-use fire water demand of 155L/s is the governing requirement.

A hydrant flow test was completed on April 26, 2024 utilizing the fire hydrants located at Ardagh Road and Crawford Street (residual hydrant) and at Ardagh Road and Patterson Road (Flow hydrant). The results from this test indicates that the local municipal water system is generally capable of supplying the City-standard 155L/s fire flow (for Townhomes) at 20 PSI.

A head loss calculation that considers the fire flow + maximum day demand relative to the anticipated static watermain pressure available from the Ardagh Road watermain further confirms that the proposed internal water system is sufficient to supply the proposed development in the event of a fire.

Refer to **Appendix C** for water servicing calculations and supporting information, and Figure 4 in **Appendix A** for the Conceptual Site Servicing Plan.

6.0 Utilities

Existing hydro, gas and telecom infrastructure is presently servicing the existing residences within and adjacent to the subject site along Ardagh Road.

Based on the utility services that currently service the existing residential area, it is anticipated that utility servicing can be provided for all units within the proposed development. Specific utility servicing requirements will be confirmed at the detailed design stage.

7.0 Sediment and Erosion Controls

Effective erosion and sediment control must be established prior to construction commencement and maintained until the site has been stabilized. Pro-active measures will be required to limit the amount of sediment travelling downstream. Where site grading is required, exposure of the soil during construction should be minimized to avoid erosion and sedimentation.

<u>Silt Fence:</u> Silt fence to be placed on the down slope of all excavated material to prevent sediment transport onto adjacent properties and municipal roadways. Periodic inspections and repairs to the silt fence should be performed regularly, as well as after every rainfall event.

<u>Storm Sewer Inlets:</u> Filter cloth complete with clear stone cover at storm sewer inlet structures (i.e. catchbasins) will ensure any construction related sediment laden overland runoff is treated before entering the municipal storm sewer system.

<u>Mud Mat:</u> Mud tracking from construction traffic to be controlled through the use of a construction site access mud-mat (consisting of large diameter rip-rap).

<u>Vegetated Buffers:</u> Existing treed and lawn areas along the development limits are to be maintained wherever possible. These areas provide a natural barrier to filter potentially sediment-laden overland flow.

<u>Monitoring and Inspection:</u> Erosion monitoring and sediment removal should be undertaken weekly and after every rainfall event. All damaged or clogged control devices to be repaired immediately.

8.0 Summary

This Functional Servicing and Stormwater Management Report demonstrates how the proposed town home development at 127 & 131 Ardagh Road in the City of Barrie can be serviced by existing municipal services and how storm runoff can be controlled without imposing negative or adverse impacts to the surrounding lands.

Specifically:

- Storm drainage for the site will be accomplished by an internal drainage system that will discharge to the existing storm sewer on Ardagh Road. External flows will be accommodated through swales and catchbasin inlets located around the perimeter of the site.
- Peak flow attenuation for the majority of the site will be provided by underground storm detention tank within the internal road.

- An enhanced level of quality control (80% TSS Removal) will be provided by on-site LIDs and an oil/grit separator.
- Water balance, phosphorus, and runoff volume controls will be provided by perforated pipes, the oil & grit separator, and the underground detention tank.
- Fire and potable water servicing will be provided by a new watermain extended from the existing municipal watermain on Ardagh Road and establishing individual service connections to each unit.
- Sanitary sewer servicing will be provided by extending a new sanitary sewer into the site from the existing Ardagh Road sewer and establishing individual service connections to each unit.
- The use of silt fence, clear stone and filter cloth inlet protection, vegetated buffer strips and a construction mud mat, will provide adequate sediment and erosion controls during construction.

Based on the above, we recommend that this report be accepted in support of planning level approvals. Should you have any questions, or require additional information, please contact the undersigned.

Prepared by:

WMI & Associates Limited

Jonathan Reimer, P. Eng.

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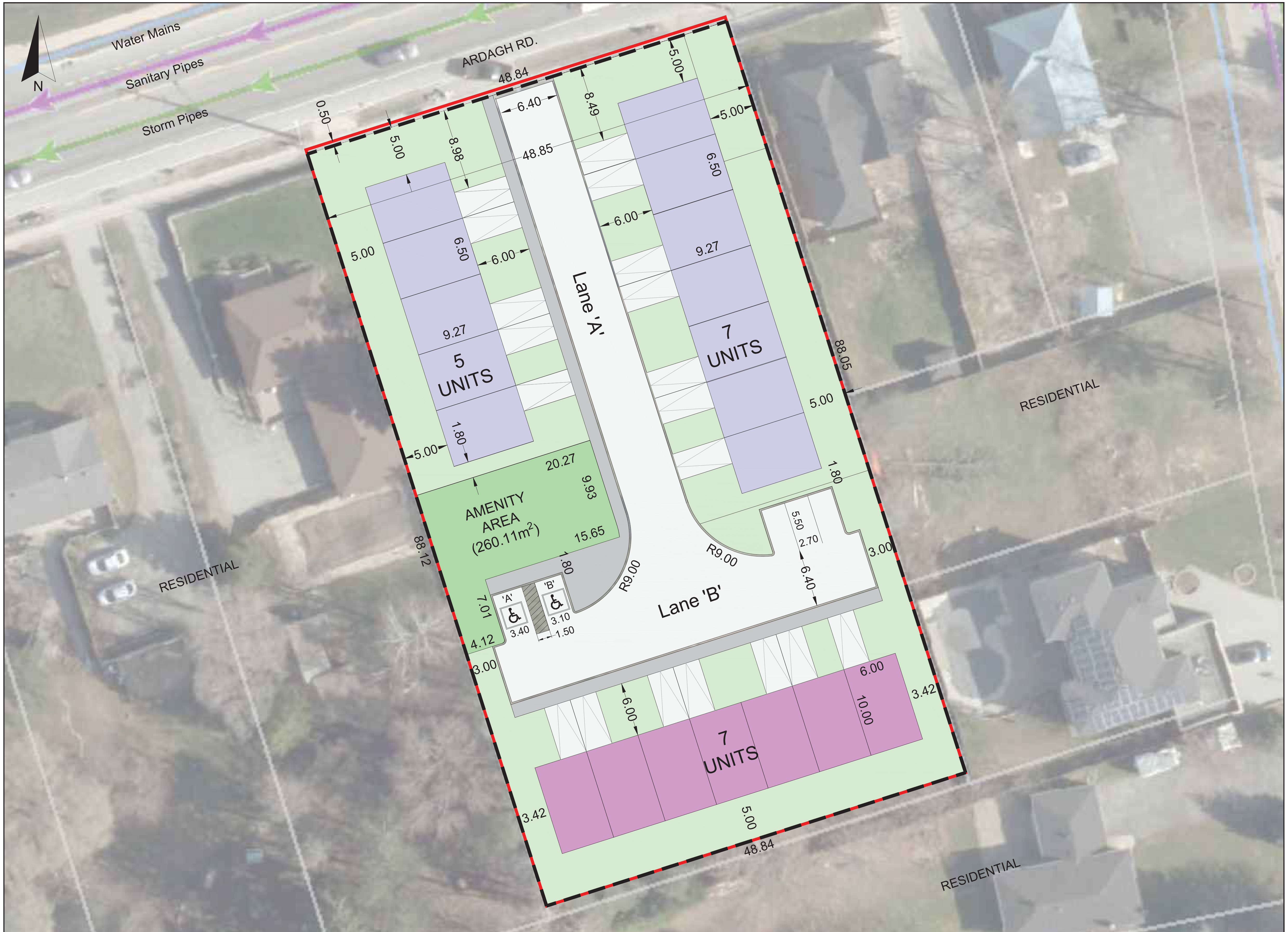
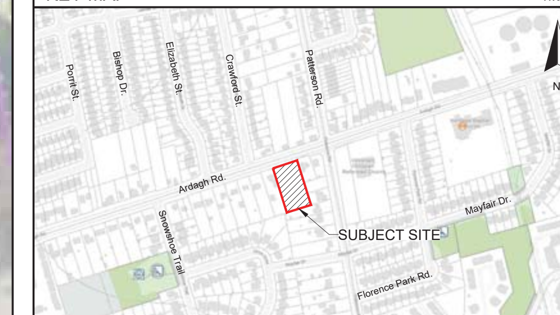
APPENDIX A

FIGURES AND DRAWINGS



KEY MAP n.t.s.



CONCEPTUAL SITE PLAN

127, 131 Ardagh Rd., Barrie

Scale

0 5 10 15 20m

LEGEND

- Subject Site (4,301.58m^2 / 0.43ha)
- Developable Area (4,277.55m^2 / 0.42ha)
- Potential Road Widening (24.41m^2)
- 3 Storey Townhouse Dwelling (20 units)
  - Bldg. Size: 6.50m x 9.27m
  - Bldg. Area: 60.25m^2
  - Bldg. G.F.A.: 162.75m^2 (excl. private garage)
- 3 Storey Townhouse Dwelling (20 units)
  - Bldg. Size: 6.00 x 10.00m
  - Bldg. Area: 60.00m^2
  - Bldg. G.F.A.: 162.00m^2 (excl. private garage)
- Amenity Area (260.11m^2)

RESIDENTIAL MULTIPLE DWELLING SECOND DENSITY

Provisions	Required	Provided
Densities (5.2.5.1a)	A max. of 40 units / ha of block/cluster townhouse development is permitted	45.2 units / ha
Outdoor Amenity Area (min.) (5.2.5.1.b)	228.00m^2 (A min. outdoor amenity area of 12.00m2 / unit in a consolidated form is required)	315.49m^2 (in a consolidated form)
Driveway Length (min.) (5.2.5.1.d)	6.00m	6.00m
Internal Private Roadway Width (min.) (5.2.5.1.e)	6.4m	6.40m
Lot Area (min.)	720.00m^2	4,253.13m^2
Lot Frontage (min.)	21.00m	48.85m
Front Yard to Dwelling Unit (min.)	7.00m	5.00m
Front Yard to Attached Garage (min.)	7.00m	7.98m
Side Yards (min.)	1.80m	3.42m
Rear Yard (min.)	7.00m	5.00m
Landscaped Open Space (min. % of lot area)	35%	45.8% (1,949.78m^2)
Lot Coverage (max. % of lot area)	45%	26.8% (1,140.00m^2)
Height of Main Bldg. (max.)	10.00m	< 10.00m
Required Parking: Residential building containing more than 3 residential units	29 spaces (1.5 spaces / unit - tandem parking not permitted)	24 spaces incl. 2 B.F. - not incl. private garage (1.26 space / unit)
Required B.F. parking spaces	1 Type 'A' B.F. space / 1 Type 'B' B.F. Space	1 Type 'A' B.F. space / 1 Type 'B' B.F. Space

Source: Barrie, Discover More, 2022 Imagery

Note: Information shown is approximate and subject to change.

CONCEPTUAL SITE PLAN - 19 UNITS

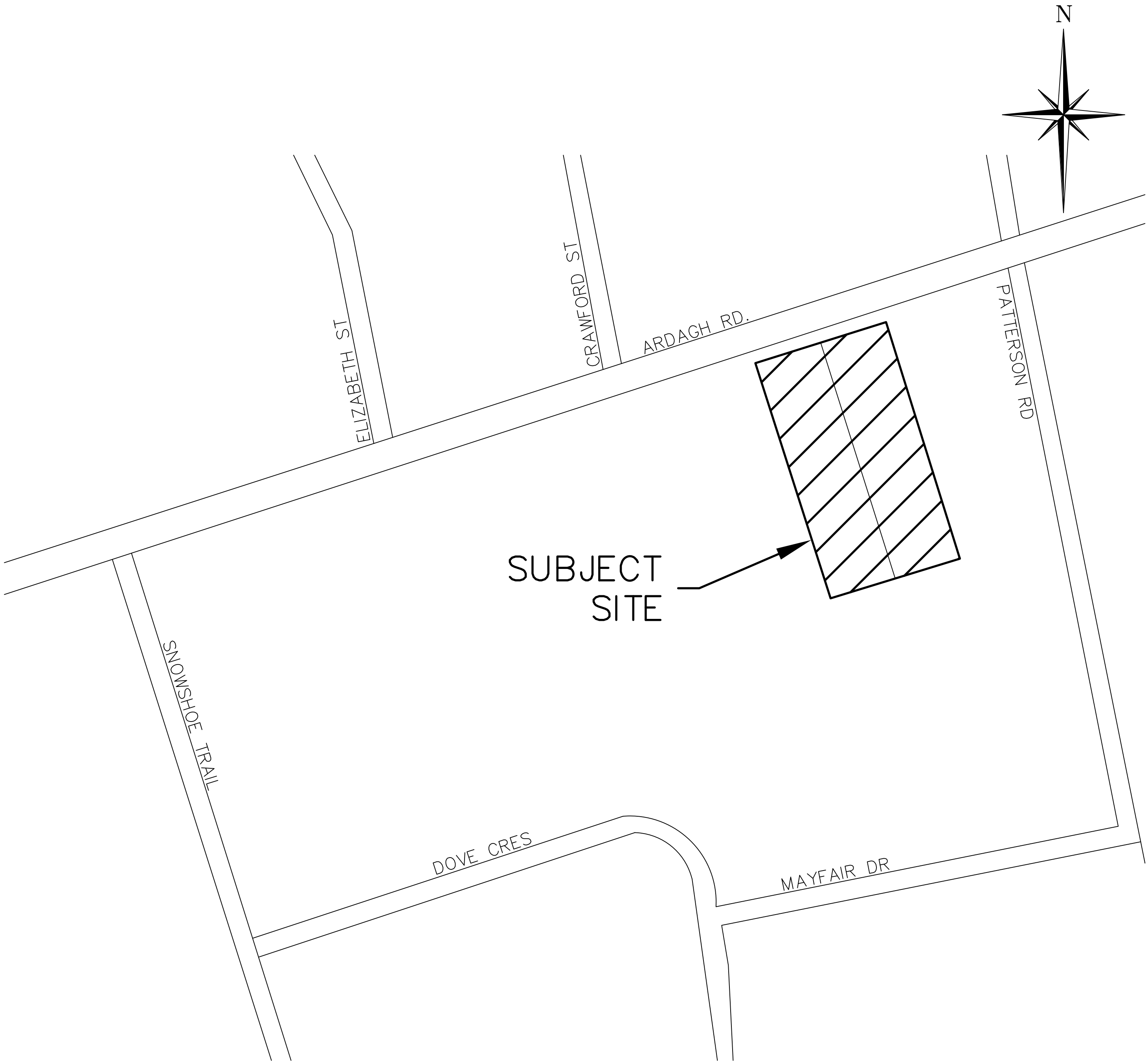
127, 131 ARDAGH RD.

SCHEDULE OF REVISIONS

No.	Date	Description	By

IPS INNOVATIVE PLANNING SOLUTIONS
PLANNERS • PROJECT MANAGERS • LAND DEVELOPERS
647 WELHAM ROAD, UNIT 9, BARRIE, ON, L4N 0B7
tel: 705 • 812 • 3281 fax: 705 • 812 • 3438 e: info@ipsconsultinginc.com www.ipsconsultinginc.com

Date:	January 22, 2024	Drawn By:	A.G.
File:	23 - 1351	Checked:	G.B.



Drawing Title

SITE LOCATION PLAN

Project Title

127 ARDAGH RD, CITY OF BARRIE

WMI & Associates Limited
119 Collier Street
Barrie, Ontario
L4M 1H5
705-797-2027
www.wmiengineering.ca

Drawn By	Checked By	Figure No.
EC	JR	FIG1
Scale N.T.S.	Project No. 24–836	

NOTE:
LOCATION OF EXISTING MUNICIPAL INFRASTRUCTURE AND EXISTING TOPOGRAPHY IS APPROXIMATE.

Legend:

0	CATCHMENT IDENTIFICATION
0.00	CATCHMENT AREA (HA)
	LIMITS OF CATCHMENT AREA
	OVERLAND FLOW DIRECTION

Drawing Title
PRE-DEVELOPMENT DRAINAGE PLAN

Project Title
127 ARDAGH ROAD
CITY OF BARRIE

WMI & Associates Limited
119 Collier Street
Barrie, Ontario
L4M 1H5
705-797-2027
www.wmiengineering.ca

Drawn By	Checked By	Figure No.
EC	JR	FIG 2
Scale 1:750	Project No. 24-836	

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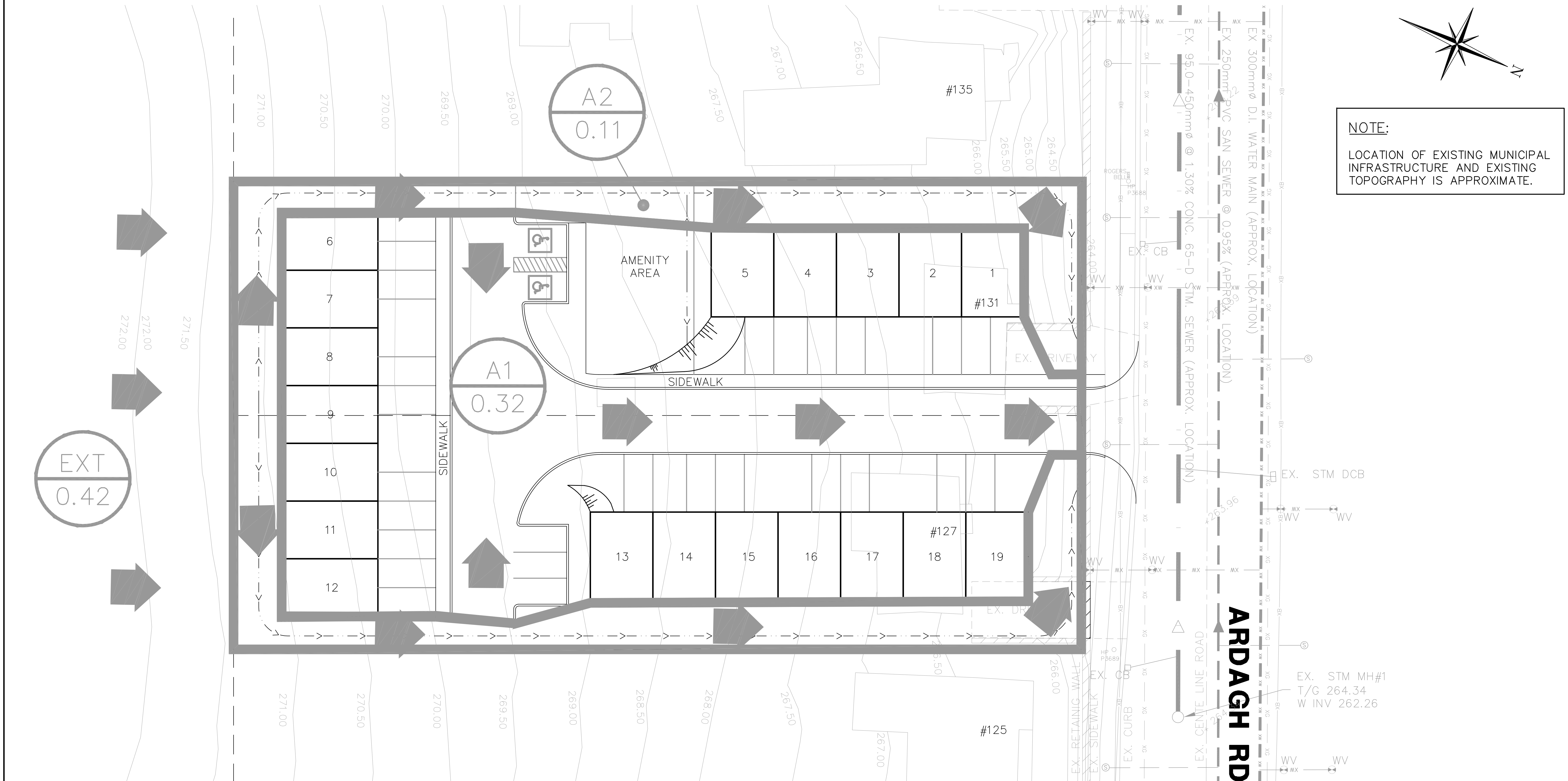


NOTE:

LOCATION OF EXISTING MUNICIPAL INFRASTRUCTURE AND EXISTING TOPOGRAPHY IS APPROXIMATE.

Legend:

0	CATCHMENT IDENTIFICATION
0.00	CATCHMENT AREA (HA)
	LIMITS OF CATCHMENT AREA
	OVERLAND FLOW DIRECTION

Drawing Title

POST-DEVELOPMENT DRAINAGE PLAN

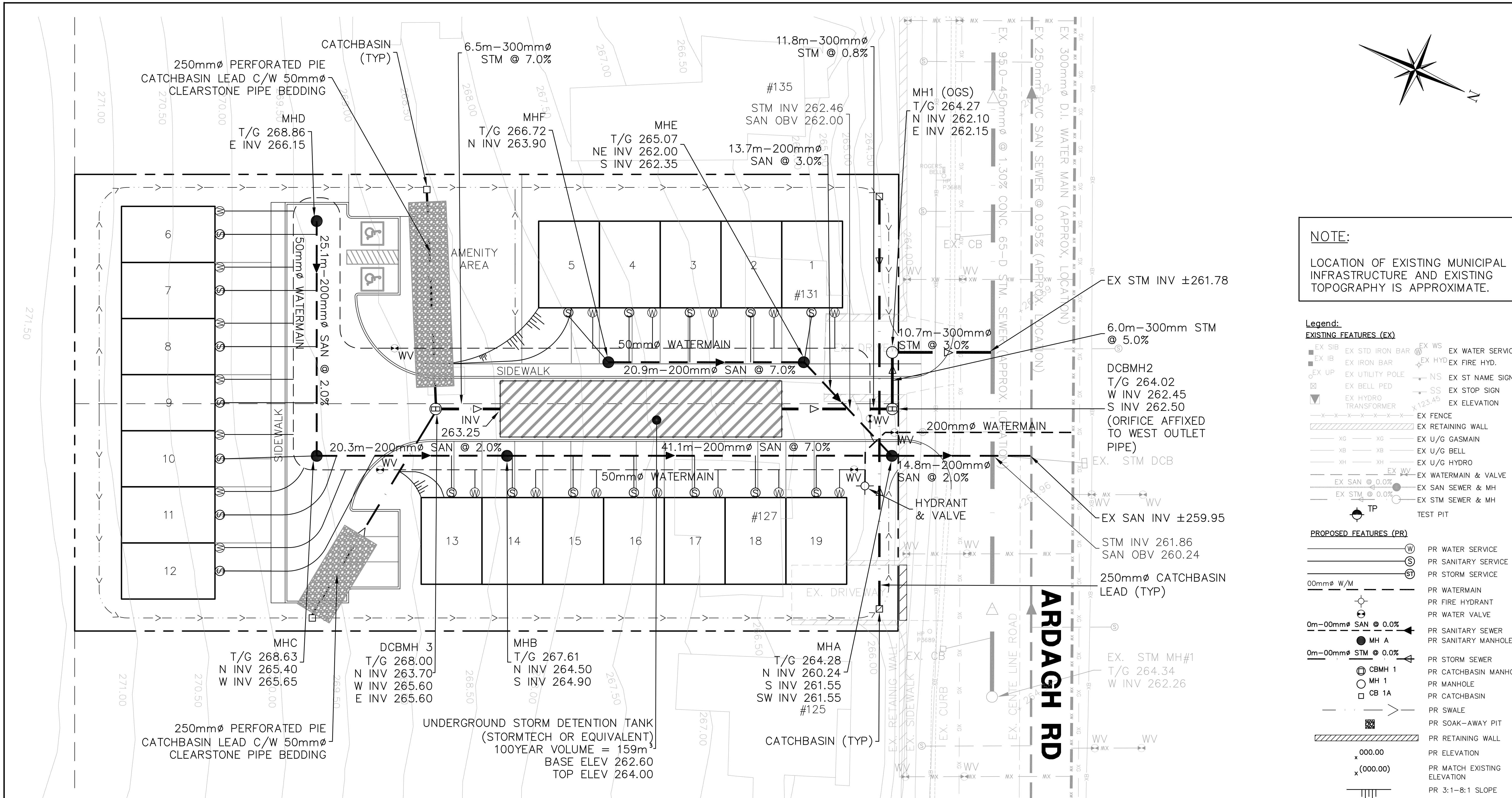
Project Title

127 ARDAGH ROAD
CITY OF BARRIE

WMI & Associates Limited
119 Collier Street
Barrie, Ontario
L4M 1H5
705-797-2027
www.wmiengineering.ca

Drawn By	Checked By	Figure No.
EC	JR	FIG 3
Scale 1:400	Project No. 24-836	

Z:\Projects\2024\24-836\CAD\WMI\Issue_No1\24-836_SWM_Figures_POST.dwg, FIG3, 1:1



ROOF DRAINAGE NOTE:

DOWNSPOUTS INLETS AND COLLECTOR PIPES ARE TO BE PROVIDED FOR ALL UNITS PIPES TO CONVEY REAR ROOF LEADER DRAINAGE TO ADJACENT CATCHBASINS.

Drawing Title

SITE SERVICING CONCEPT PLAN

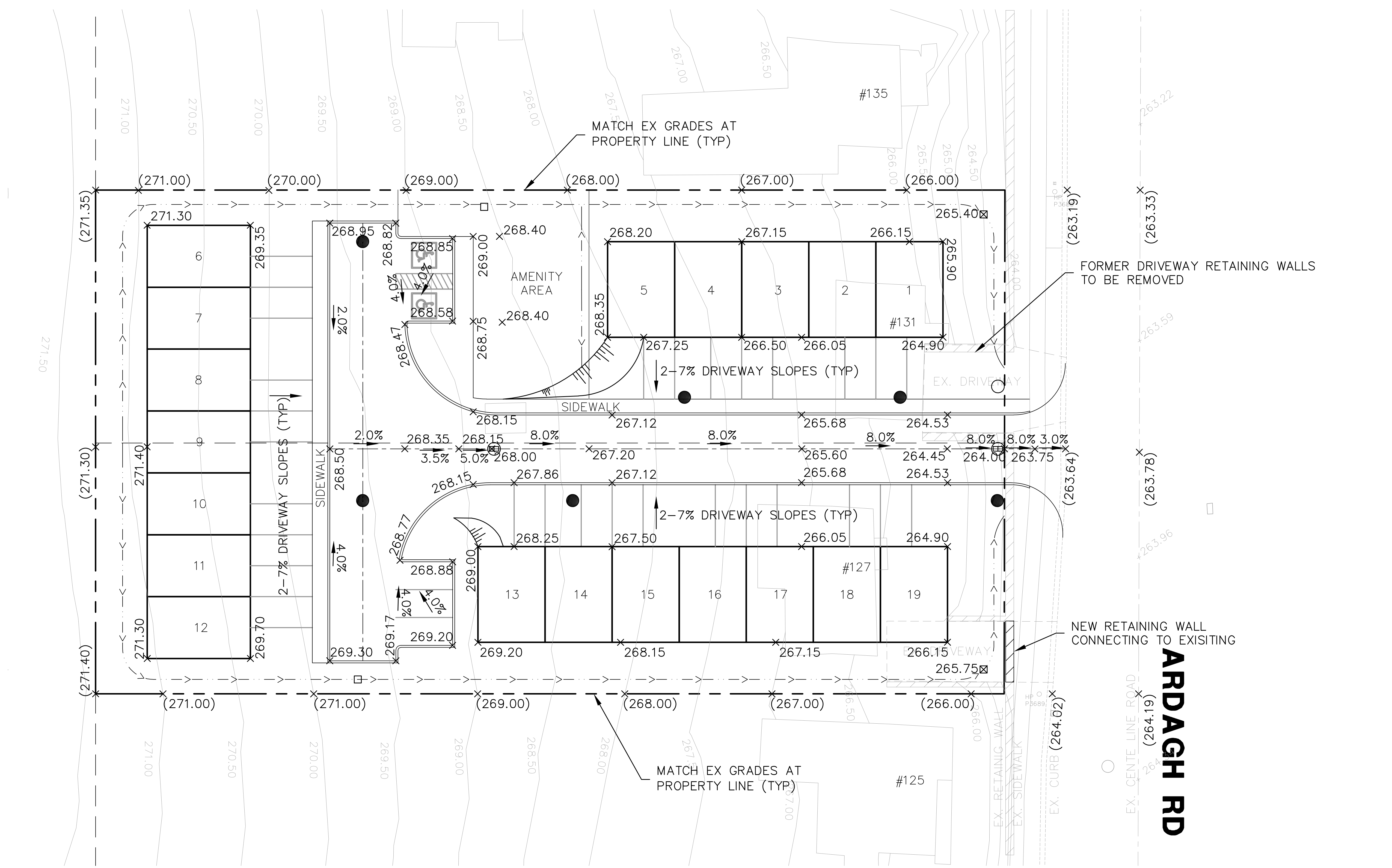
Project Title

127 ARDAGH ROAD
CITY OF BARRIE

WMI & Associates Limited
119 Collier Street
Barrie, Ontario
L4M 1H5
705-797-2027
www.wmiengineering.ca

Drawn By	Checked By	Figure No.
EC	JR	FIG 4
Scale 1:400	Project No. 24-836	

Z:\Projects\2024\24-836\CAD\WMI\Issue_No1\24-836_SS.dwg, FIG4, 1:1



NOTE:

LOCATION OF EXISTING MUNICIPAL INFRASTRUCTURE AND EXISTING TOPOGRAPHY IS APPROXIMATE.

Legend:

EXISTING FEATURES (EX)

- EX STD IRON BAR
- EX IRON BAR
- EX UTILITY POLE
- EX BELL PED
- EX HYDRO TRANSFORMER
- EX WATER SERVICE
- EX FIRE HYD.
- EX ST NAME SIGN
- EX STOP SIGN
- EX ELEVATION
- EX FENCE
- EX RETAINING WALL
- EX U/G GASMAIN
- EX U/G BELL
- EX U/G HYDRO
- EX WATERMAIN & VALVE
- EX SAN SEWER & MH
- EX STM SEWER & MH
- TEST PIT

PROPOSED FEATURES (PR)

- PR WATER SERVICE
- PR SANITARY SERVICE
- PR STORM SERVICE
- PR WATERMAIN
- PR FIRE HYDRANT
- PR WATER VALVE
- PR SANITARY SEWER
- PR SANITARY MANHOLE
- PR STORM SEWER
- PR CATCHBASIN MANHOLE
- PR MANHOLE
- PR CATCHBASIN
- PR SWALE
- PR SOAK-AWAY PIT
- PR RETAINING WALL
- PR ELEVATION
- PR MATCH EXISTING ELEVATION
- PR 3:1–8:1 SLOPE

Drawing Title

GRADING CONCEPT PLAN

Project Title

127 ARDAGH ROAD
CITY OF BARRIE

WMI & Associates Limited
119 Collier Street
Barrie, Ontario
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Drawn By	Checked By	Figure No.
EC	JR	FIG 5
Scale 1:400	Project No. 24-836	

APPENDIX B

STORM DRAINAGE & STORMWATER MANAGEMENT CALCULATIONS

WMI & Associates Limited
119 Collier Street, Barrie, Ontario L4M 1H5
p (705) 797-2027 f (705) 797-2028

RUNOFF COEFFICIENT CALCULATIONS
"C" SPREADSHEET

Date: 05-Jun-24 **Project No.:** 24-836

Project: 127 Ardagh Road **Prepared By:** JR

RUNOFF COEFFICIENT NUMBERS

Land Cover		Hydrologic Soil Groups		
		A-AB	B-BC	C-D
Cultivated Land	0 - 5% grade	0.22	0.35	0.55
	5 - 10% grade	0.3	0.45	0.6
	10 - 30% grade	0.4	0.65	0.7
Pasture Land	0 - 5% grade	0.1	0.28	0.4
	5 - 10% grade	0.15	0.35	0.45
	10 - 30% grade	0.22	0.4	0.55
Woodlot or Cutover	0 - 5% grade	0.08	0.25	0.35
	5 - 10% grade	0.12	0.3	0.42
	10 - 30% grade	0.18	0.35	0.52
Lakes and Wetlands		0.05	0.05	0.05
Impervious Area	(i.e. buildings, roads, parking lot, etc.)	0.95	0.95	0.95
Gravel	(not used for proposed parking or storage areas)	0.4	0.5	0.6
Residential	Single Family	0.3	0.4	0.5
	Multiple (i.e. semi, townhouse, apartment, etc.)	0.5	0.6	0.7
Industrial	Light	0.55	0.65	0.75
	Heavy	0.65	0.75	0.85
Commercial		0.6	0.7	0.8
Unimproved Areas		0.1	0.2	0.3
Lawn	< 2% grade	0.05	0.11	0.17
	2 - 7% grade	0.1	0.16	0.22
	> 7% grade	0.15	0.25	0.35

Ref: Runoff Coefficient Numbers - Adapted from Design Chart 1.07, Ontario Ministry of Transportation, "MTO Drainage Management Manual", MTO. (1997)

<<< **Elements Requiring Input Information**

PRE-DEVELOPMENT CONDITION- CATCHMENT EXT

Land Cover		Hydrologic Soil Groups		
		A-AB	B-BC	C-D
Cultivated Land	0 - 5% grade			
	5 - 10% grade			
	10 - 30% grade			
Pasture Land	0 - 5% grade			
	5 - 10% grade			
	10 - 30% grade			
Woodlot or Cutover	0 - 5% grade			
	5 - 10% grade			
	10 - 30% grade			
Lakes and Wetlands				
Impervious Area	(i.e. buildings, roads, parking lot, etc.)	0.08		
Gravel	(not used for proposed parking or storage areas)			
Residential	Single Family			
	Multiple (i.e. semi, townhouse, apartment, etc.)			
Industrial	Light			
	Heavy			
Commercial				
Unimproved Areas				
Lawn	< 2% grade			
	2 - 7% grade	0.36		
	> 7% grade			

Total Area (ha) = 0.44 **Runoff Coefficient, C =** **0.26**

PRE-DEVELOPMENT CONDITION- CATCHMENT PRE

Land Cover		Hydrologic Soil Groups		
		A-AB	B-BC	C-D
Cultivated Land	0 - 5% grade			
	5 - 10% grade			
	10 - 30% grade			
Pasture Land	0 - 5% grade			
	5 - 10% grade			
	10 - 30% grade			
Woodlot or Cutover	0 - 5% grade			
	5 - 10% grade	0.13		
	10 - 30% grade			
Lakes and Wetlands				
Impervious Area	(i.e. buildings, roads, parking lot, etc.)	0.04		
Gravel	(not used for proposed parking or storage areas)			
Residential	Single Family			
	Multiple (i.e. semi, townhouse, apartment, etc.)			
Industrial	Light			
	Heavy			
Commercial				
Unimproved Areas				
Lawn	< 2% grade			
	2 - 7% grade	0.13		
	> 7% grade	0.13		

Total Area (ha) = 0.43 **Runoff Coefficient, C =** **0.21**

POST-DEVELOPMENT CONDITION- CATCHMENT A1

Land Cover		Hydrologic Soil Groups		
		A-AB	B-BC	C-D
Cultivated Land	0 - 5% grade			
	5 - 10% grade			
	10 - 30% grade			
Pasture Land	0 - 5% grade			
	5 - 10% grade			
	10 - 30% grade			
Woodlot or Cutover	0 - 5% grade			
	5 - 10% grade			
	10 - 30% grade			
Lakes and Wetlands				
Impervious Area	(i.e. buildings, roads, parking lot, etc.)	0.27		
Gravel	(not used for proposed parking or storage areas)			
Residential	Single Family			
	Multiple (i.e. semi, townhouse, apartment, etc.)			
Industrial	Light			
	Heavy			
Commercial				
Unimproved Areas				
Lawn	< 2% grade			
	2 - 7% grade	0.05		
	> 7% grade			

Total Area (ha) = 0.32 **Runoff Coefficient, C =** **0.82**

POST-DEVELOPMENT CONDITION- CATCHMENT A2

Land Cover		Hydrologic Soil Groups		
		A-AB	**B-BC**	**C-D**
Cultivated Land	0 - 5% grade			
	5 - 10% grade			
	10 - 30% grade			
Pasture Land	0 - 5% grade			
	5 - 10% grade			
	10 - 30% grade			
Woodlot or Cutover	0 - 5% grade			
	5 - 10% grade			
	10 - 30% grade			
Lakes and Wetlands				
Impervious Area	(i.e. buildings, roads, parking lot, etc.)	0.02		
Gravel	(not used for proposed parking or storage areas)			
Residential	Single Family			
	Multiple (i.e. semi, townhouse, apartment, etc.)			
Industrial	Light			
	Heavy			
Commercial				
Unimproved Areas				
Lawn	< 2% grade			
	2 - 7% grade	0.05		
	> 7% grade	0.05		

Total Area (ha) = 0.11 **Runoff Coefficient, C =** **0.24**

Z:\Projects\2024\24-836\Design\Storm\[240605_C_CALCS.xlsx]C CALCS

WMI & Associates Limited
119 Collier Street, Barrie, Ontario L4M 1H5
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RATIONAL METHOD CALCULATIONS

Date: 05-Jun-24 **Project No.:** 24-836

Project: 127 Ardagh Road **Prepared By:** JR

<<< **Elements Requiring Input Information**

Rainfall Intensity-Duration-Frequency Coefficients from: Barrie WPCC Station + 15% to account for climate change

2-year		5-year		10-year		25-year		50-year		100-year	
A =	675.586	A =	843.019	A =	976.898	A =	1133.123	A =	1251.473	A =	1383.628
B =	4.681	B =	4.582	B =	4.745	B =	4.734	B =	4.847	B =	4.905
C =	0.780	C =	0.763	C =	0.760	C =	0.756	C =	0.753	C =	0.754

Rational Method Formula

$$Q = \frac{C \times I \times A}{360} \quad (m^3/s)$$

where, C = Runoff Coefficient
I = Rainfall Intensity, (mm/hr)
A = Drainage Area, (ha)

Rainfall Intensity Equation (2-100 year storm events)

$$I_{2\text{-}100} = \frac{A}{(B + T_C)^C} \quad (mm/hr)$$

where, A = Rainfall IDF Coefficient
B = Rainfall IDF Coefficient
C = Rainfall IDF Coefficient
T_C = Time of Concentration, (min)

Runoff Coefficient Equations
Based on MTO Drainage Manual (1984), page BD-4

2-year	C_2 =	C
5-year	C_5 =	C
10-year	C_{10} =	C
25-year	C_{25} =	1.10 x C
50-year	C_{50} =	1.20 x C
100-year	C_{100} =	1.25 x C

For storms having a return period of more than 10 years, the Runoff Coefficient, C, will be increased as indicated above, up to a maximum value of 1.

Rainfall Intensity Equation (25mm storm event)
Based on the MOE SWMP Manual (2003), Eq'n 4.9

$$I_{25mm} = (43 \times C) + 5.9 \quad (mm/hr)$$

where, C = Runoff Coefficient

Catchment I.D.	A (ha)	T_C (min.)	C	Q_{25mm} (m^3/s)	Q_2 (m^3/s)	Q_5 (m^3/s)	Q_{10} (m^3/s)	Q_{25} (m^3/s)	Q_{50} (m^3/s)	Q_{100} (m^3/s)
EXT	0.44	10.0	0.26	0.005	0.026	0.035	0.040	0.052	0.063	0.072
PRE	0.43	10.0	0.21	0.004	0.021	0.027	0.032	0.041	0.049	0.057
A1	0.32	10.0	0.82	0.030	0.061	0.080	0.092	0.119	0.144	0.160
A2	0.11	10.0	0.24	0.001	0.006	0.008	0.009	0.012	0.014	0.017
A1+A2	*0.43*	*10.0*	*0.67*	*0.028*	*0.067*	*0.088*	*0.101*	*0.131*	*0.158*	*0.181*

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MODIFIED RATIONAL METHOD CALCULATIONS
2-year Design Storm Event

Date: 05-Jun-24 **Project No.:** 24-836

Project: 127 Ardagh Road **Prepared By:** JR

<<< **Elements Requiring Input Information**

Rainfall Intensity-Duration-Frequency Coefficients from: Barrie WPCC Station + 15% to account for climate change

2-year		5-year		10-year		25-year		50-year		100-year	
A =	675.586	A =	843.019	A =	976.898	A =	1133.123	A =	1251.473	A =	1383.628
B =	4.681	B =	4.582	B =	4.745	B =	4.734	B =	4.847	B =	4.905
C =	0.780	C =	0.763	C =	0.760	C =	0.756	C =	0.753	C =	0.754

Rational Method Formula

$$Q = \frac{C \times I \times A}{360} \quad (m^3/s)$$

where, C = Runoff Coefficient
I = Rainfall Intensity, (mm/hr)
A = Drainage Area, (ha)

Rainfall Intensity Equation (2-100 year storm events)

$$I_{2\text{-}100} = \frac{A}{(B + t_d)^C} \quad (mm/hr)$$

where, A = Rainfall IDF Coefficient
B = Rainfall IDF Coefficient
C = Rainfall IDF Coefficient
t_d = Storm Duration, (min)

Runoff Coefficient Equations
Based on MTO Drainage Manual (1984), page BD-4

2-year	C_2 =	C
5-year	C_5 =	C
10-year	C_{10} =	C
25-year	C_{25} =	1.10 x C
50-year	C_{50} =	1.20 x C
100-year	C_{100} =	1.25 x C

For storms having a return period of more than 10 years, the Runoff Coefficient, C, will be increased as indicated above, up to a maximum value of 1.

Runoff Volume

$$V_{Runoff} = Q_{Runoff} \times t_d \quad (m^3)$$

where, Q_{Runoff} = Runoff Peak Flow Rate, (m^3/sec)
t_d = Storm Duration, (sec)

Released Volume

$$V_{Released} = Q_{Released} \times (t_d + T_C)/2 \quad (m^3)$$

where, $Q_{Released}$ = Max. Release Rate, (m^3/sec)
t_d = Storm Duration, (sec)
T_C = Time of Concentration, (sec)

Max. Storage Required

$$V_{Storage} = V_{Runoff} - V_{Released} \quad (m^3)$$

V_{Runoff} = Runoff Volume, (m^3)
$V_{Released}$ = Released Volume, (m^3)

Z:\Projects\2024\24-836\Design\Storm\[240605_Rational_Method_Calcs(A,B,C).xlsx]Rational Method

Catchment I.D.	Storm Event	Area A (ha)	Runoff Coeff. C	Runoff Coeff. C_{MOD}	Time of Conc. T_C (min.)	Storm Time Step (min.)	Release Rate (m^3/s)
A1	2-year	0.32	0.82	0.82	10	10	0.008

NOTES: 2-year pre-development target is 0.015 m^3/s

Storm Duration t_d (min.)	Rainfall Intensity (mm/hr)	Runoff Peak Flow Rate (m^3/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)	Max. Storage Required (m^3)
10	83.1	0.0606	36.34	4.80	31.54	
20	55.4	0.0404	48.47	7.20	41.27	
30	42.5	0.0310	55.76	9.60	46.16	
40	34.9	0.0254	61.02	12.00	49.02	
50	29.8	0.0217	65.16	14.40	50.76	
60	26.1	0.0191	68.59	16.80	51.79	
70	23.4	0.0170	71.53	19.20	52.33	
80	21.2	0.0154	74.12	21.60	52.52	**52.5**
90	19.4	0.0142	76.43	24.00	52.43	
100	18.0	0.0131	78.52	26.40	52.12	
110	16.7	0.0122	80.44	28.80	51.64	
120	15.7	0.0114	82.21	31.20	51.01	
130	14.8	0.0108	83.86	33.60	50.26	
140	13.9	0.0102	85.41	36.00	49.41	
150	13.2	0.0097	86.86	38.40	48.46	
160	12.6	0.0092	88.23	40.80	47.43	
170	12.0	0.0088	89.53	43.20	46.33	
180	11.5	0.0084	90.77	45.60	45.17	
190	11.1	0.0081	91.95	48.00	43.95	
200	10.6	0.0078	93.09	50.40	42.69	
210	10.3	0.0075	94.17	52.80	41.37	
220	9.9	0.0072	95.21	55.20	40.01	
230	9.6	0.0070	96.22	57.60	38.62	
240	9.3	0.0067	97.18	60.00	37.18	
250	9.0	0.0065	98.12	62.40	35.72	
260	8.7	0.0063	99.02	64.80	34.22	
270	8.5	0.0062	99.90	67.20	32.70	
280	8.2	0.0060	100.75	69.60	31.15	
290	8.0	0.0058	101.58	72.00	29.58	
300	7.8	0.0057	102.38	74.40	27.98	
310	7.6	0.0055	103.16	76.80	26.36	

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MODIFIED RATIONAL METHOD CALCULATIONS
5-year Design Storm Event

Date: 05-Jun-24 **Project No.:** 24-836

Project: 127 Ardagh Road **Prepared By:** JR

<<< **Elements Requiring Input Information**

Rainfall Intensity-Duration-Frequency Coefficients from: Barrie WPCC Station + 15% to account for climate change

2-year		5-year		10-year		25-year		50-year		100-year	
A =	675.586	A =	843.019	A =	976.898	A =	1133.123	A =	1251.473	A =	1383.628
B =	4.681	B =	4.582	B =	4.745	B =	4.734	B =	4.847	B =	4.905
C =	0.780	C =	0.763	C =	0.760	C =	0.756	C =	0.753	C =	0.754

Rational Method Formula

$$Q = \frac{C \times I \times A}{360} \quad (m^3/s)$$

where, C = Runoff Coefficient
I = Rainfall Intensity, (mm/hr)
A = Drainage Area, (ha)

Rainfall Intensity Equation (2-100 year storm events)

$$I_{2\text{-}100} = \frac{A}{(B + t_d)^C} \quad (mm/hr)$$

where, A = Rainfall IDF Coefficient
B = Rainfall IDF Coefficient
C = Rainfall IDF Coefficient
t_d = Storm Duration, (min)

Runoff Coefficient Equations
Based on MTO Drainage Manual (1984), page BD-4

2-year C_2 = C
5-year C_5 = C
10-year C_{10} = C
25-year C_{25} = 1.10 x C
50-year C_{50} = 1.20 x C
100-year C_{100} = 1.25 x C

For storms having a return period of more than 10 years, the Runoff Coefficient, C, will be increased as indicated above, up to a maximum value of 1.

Runoff Volume

$$V_{Runoff} = Q_{Runoff} \times t_d \quad (m^3)$$

where, Q_{Runoff} = Runoff Peak Flow Rate, (m^3/sec)
t_d = Storm Duration, (sec)

Released Volume

$$V_{Released} = Q_{Released} \times (t_d + T_C)/2 \quad (m^3)$$

where, $Q_{Released}$ = Max. Release Rate, (m^3/sec)
t_d = Storm Duration, (sec)
T_C = Time of Concentration, (sec)

Max. Storage Required

$$V_{Storage} = V_{Runoff} - V_{Released} \quad (m^3)$$

V_{Runoff} = Runoff Volume, (m^3)
$V_{Released}$ = Released Volume, (m^3)

Z:\Projects\2024\24-836\Design\Storm\[240605_Rational_Method_Calcs(A,B,C).xlsx]Rational Method

Catchment I.D.	Storm Event	Area A (ha)	Runoff Coeff. C	Runoff Coeff. C_{MOD}	Time of Conc. T_C (min.)	Storm Time Step (min.)	Release Rate (m^3/s)
A1	5-year	0.32	0.82	0.82	10	10	0.011

NOTES: 5-year pre-development target is 0.019 m^3/s

Storm Duration t_d (min.)	Rainfall Intensity (mm/hr)	Runoff Peak Flow Rate (m^3/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)	Max. Storage Required (m^3)
10	109.1	0.0795	47.72	6.60	41.12	
20	73.2	0.0534	64.07	9.90	54.17	
30	56.5	0.0411	74.07	13.20	60.87	
40	46.5	0.0339	81.36	16.50	64.86	
50	39.9	0.0290	87.15	19.80	67.35	
60	35.1	0.0255	91.98	23.10	68.88	
70	31.4	0.0229	96.15	26.40	69.75	
80	28.5	0.0208	99.82	29.70	70.12	**70.1**
90	26.2	0.0191	103.12	33.00	70.12	
100	24.3	0.0177	106.12	36.30	69.82	
110	22.6	0.0165	108.88	39.60	69.28	
120	21.2	0.0155	111.43	42.90	68.53	
130	20.0	0.0146	113.81	46.20	67.61	
140	19.0	0.0138	116.04	49.50	66.54	
150	18.0	0.0131	118.14	52.80	65.34	
160	17.2	0.0125	120.14	56.10	64.04	
170	16.4	0.0120	122.03	59.40	62.63	
180	15.7	0.0115	123.83	62.70	61.13	
190	15.1	0.0110	125.55	66.00	59.55	
200	14.5	0.0106	127.20	69.30	57.90	
210	14.0	0.0102	128.78	72.60	56.18	
220	13.5	0.0099	130.31	75.90	54.41	
230	13.1	0.0095	131.78	79.20	52.58	
240	12.7	0.0092	133.20	82.50	50.70	
250	12.3	0.0090	134.57	85.80	48.77	
260	12.0	0.0087	135.90	89.10	46.80	
270	11.6	0.0085	137.19	92.40	44.79	
280	11.3	0.0082	138.44	95.70	42.74	
290	11.0	0.0080	139.65	99.00	40.65	
300	10.7	0.0078	140.83	102.30	38.53	
310	10.5	0.0076	141.98	105.60	36.38	

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MODIFIED RATIONAL METHOD CALCULATIONS
10-year Design Storm Event

Date: 05-Jun-24 **Project No.:** 24-836

Project: 127 Ardagh Road **Prepared By:** JR

<<< **Elements Requiring Input Information**

Rainfall Intensity-Duration-Frequency Coefficients from: Barrie WPCC Station + 15% to account for climate change

2-year		5-year		10-year		25-year		50-year		100-year	
A =	675.586	A =	843.019	A =	976.898	A =	1133.123	A =	1251.473	A =	1383.628
B =	4.681	B =	4.582	B =	4.745	B =	4.734	B =	4.847	B =	4.905
C =	0.780	C =	0.763	C =	0.760	C =	0.756	C =	0.753	C =	0.754

Rational Method Formula

$$Q = \frac{C \times I \times A}{360} \quad (m^3/s)$$

where, C = Runoff Coefficient
I = Rainfall Intensity, (mm/hr)
A = Drainage Area, (ha)

Rainfall Intensity Equation (2-100 year storm events)

$$I_{2-100} = \frac{A}{(B + t_d)^C} \quad (mm/hr)$$

where, A = Rainfall IDF Coefficient
B = Rainfall IDF Coefficient
C = Rainfall IDF Coefficient
t_d = Storm Duration, (min)

Runoff Coefficient Equations
Based on MTO Drainage Manual (1984), page BD-4

2-year C_2 = C
5-year C_5 = C
10-year C_{10} = C
25-year C_{25} = 1.10 x C
50-year C_{50} = 1.20 x C
100-year C_{100} = 1.25 x C

For storms having a return period of more than 10 years, the Runoff Coefficient, C, will be increased as indicated above, up to a maximum value of 1.

Runoff Volume

$$V_{Runoff} = Q_{Runoff} \times t_d \quad (m^3)$$

where, Q_{Runoff} = Runoff Peak Flow Rate, (m^3/sec)
t_d = Storm Duration, (sec)

Released Volume

$$V_{Released} = Q_{Released} \times (t_d + T_C)/2 \quad (m^3)$$

where, $Q_{Released}$ = Max. Release Rate, (m^3/sec)
t_d = Storm Duration, (sec)
T_C = Time of Concentration, (sec)

Max. Storage Required

$$V_{Storage} = V_{Runoff} - V_{Released} \quad (m^3)$$

V_{Runoff} = Runoff Volume, (m^3)
$V_{Released}$ = Released Volume, (m^3)

Z:\Projects\2024\24-836\Design\Storm\[240605_Rational_Method_Calcs(A,B,C).xlsx]Rational Method

Catchment I.D.	Storm Event	Area A (ha)	Runoff Coeff. C	Runoff Coeff. C_{MOD}	Time of Conc. T_C (min.)	Storm Time Step (min.)	Release Rate (m^3/s)
A1	10-year	0.32	0.82	0.82	10	10	0.012

NOTES: 10-year pre-development target is 0.022 m^3/s

Storm Duration t_d (min.)	Rainfall Intensity (mm/hr)	Runoff Peak Flow Rate (m^3/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)	Max. Storage Required (m^3)
10	126.4	0.0921	55.27	7.20	48.07	
20	85.3	0.0622	74.58	10.80	63.78	
30	65.9	0.0480	86.44	14.40	72.04	
40	54.4	0.0396	95.09	18.00	77.09	
50	46.6	0.0340	101.97	21.60	80.37	
60	41.1	0.0299	107.72	25.20	82.52	
70	36.8	0.0268	112.68	28.80	83.88	
80	33.5	0.0244	117.05	32.40	84.65	
90	30.7	0.0224	120.98	36.00	84.98	**85.0**
100	28.5	0.0208	124.55	39.60	84.95	
110	26.6	0.0194	127.84	43.20	84.64	
120	24.9	0.0182	130.88	46.80	84.08	
130	23.5	0.0171	133.71	50.40	83.31	
140	22.3	0.0162	136.37	54.00	82.37	
150	21.2	0.0154	138.88	57.60	81.28	
160	20.2	0.0147	141.26	61.20	80.06	
170	19.3	0.0141	143.51	64.80	78.71	
180	18.5	0.0135	145.66	68.40	77.26	
190	17.8	0.0130	147.71	72.00	75.71	
200	17.1	0.0125	149.68	75.60	74.08	
210	16.5	0.0120	151.57	79.20	72.37	
220	15.9	0.0116	153.39	82.80	70.59	
230	15.4	0.0112	155.14	86.40	68.74	
240	14.9	0.0109	156.84	90.00	66.84	
250	14.5	0.0106	158.48	93.60	64.88	
260	14.1	0.0103	160.06	97.20	62.86	
270	13.7	0.0100	161.60	100.80	60.80	
280	13.3	0.0097	163.09	104.40	58.69	
290	13.0	0.0095	164.54	108.00	56.54	
300	12.6	0.0092	165.96	111.60	54.36	
310	12.3	0.0090	167.33	115.20	52.13	

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MODIFIED RATIONAL METHOD CALCULATIONS
25-year Design Storm Event

Date: 05-Jun-24 **Project No.:** 24-836

Project: 127 Ardagh Road **Prepared By:** JR

<<< **Elements Requiring Input Information**

Rainfall Intensity-Duration-Frequency Coefficients from: Barrie WPCC Station + 15% to account for climate change

2-year		5-year		10-year		25-year		50-year		100-year	
A =	675.586	A =	843.019	A =	976.898	A =	1133.123	A =	1251.473	A =	1383.628
B =	4.681	B =	4.582	B =	4.745	B =	4.734	B =	4.847	B =	4.905
C =	0.780	C =	0.763	C =	0.760	C =	0.756	C =	0.753	C =	0.754

Rational Method Formula

$$Q = \frac{C \times I \times A}{360} \quad (m^3/s)$$

where, C = Runoff Coefficient
I = Rainfall Intensity, (mm/hr)
A = Drainage Area, (ha)

Runoff Coefficient Equations
Based on MTO Drainage Manual (1984), page BD-4

2-year C_2 = C
5-year C_5 = C
10-year C_{10} = C
25-year C_{25} = 1.10 x C
50-year C_{50} = 1.20 x C
100-year C_{100} = 1.25 x C

For storms having a return period of more than 10 years, the Runoff Coefficient, C, will be increased as indicated above, up to a maximum value of 1.

Rainfall Intensity Equation (2-100 year storm events)

$$I_{2-100} = \frac{A}{(B + t_d)^C} \quad (mm/hr)$$

where, A = Rainfall IDF Coefficient
B = Rainfall IDF Coefficient
C = Rainfall IDF Coefficient
t_d = Storm Duration, (min)

Runoff Volume

$$V_{Runoff} = Q_{Runoff} \times t_d \quad (m^3)$$

where, Q_{Runoff} = Runoff Peak Flow Rate, (m^3/sec)
t_d = Storm Duration, (sec)

Released Volume

$$V_{Released} = Q_{Released} \times (t_d + T_C)/2 \quad (m^3)$$

where, $Q_{Released}$ = Max. Release Rate, (m^3/sec)
t_d = Storm Duration, (sec)
T_C = Time of Concentration, (sec)

Max. Storage Required

$$V_{Storage} = V_{Runoff} - V_{Released} \quad (m^3)$$

V_{Runoff} = Runoff Volume, (m^3)
$V_{Released}$ = Released Volume, (m^3)

Z:\Projects\2024\24-836\Design\Storm\[240605_Rational_Method_Calcs(A,B,C).xlsx]Rational Method

Catchment I.D.	Storm Event	Area A (ha)	Runoff Coeff. C	Runoff Coeff. C_{MOD}	Time of Conc. T_C (min.)	Storm Time Step (min.)	Release Rate (m^3/s)
A1	25-year	0.32	0.82	0.90	10	10	0.014

NOTES: 25-year pre-development target is 0.029 m^3/s

Storm Duration t_d (min.)	Rainfall Intensity (mm/hr)	Runoff Peak Flow Rate (m^3/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)	Max. Storage Required (m^3)
10	148.3	0.1189	71.32	8.40	62.92	
20	100.2	0.0804	96.42	12.60	83.82	
30	77.5	0.0622	111.89	16.80	95.09	
40	64.0	0.0513	123.21	21.00	102.21	
50	55.0	0.0441	132.23	25.20	107.03	
60	48.4	0.0388	139.77	29.40	110.37	
70	43.4	0.0348	146.29	33.60	112.69	
80	39.5	0.0317	152.04	37.80	114.24	
90	36.3	0.0291	157.21	42.00	115.21	
100	33.7	0.0270	161.92	46.20	115.72	
110	31.4	0.0252	166.24	50.40	115.84	**115.8**
120	29.5	0.0236	170.25	54.60	115.65	
130	27.8	0.0223	174.00	58.80	115.20	
140	26.4	0.0211	177.51	63.00	114.51	
150	25.1	0.0201	180.82	67.20	113.62	
160	23.9	0.0192	183.96	71.40	112.56	
170	22.9	0.0183	186.94	75.60	111.34	
180	21.9	0.0176	189.78	79.80	109.98	
190	21.1	0.0169	192.49	84.00	108.49	
200	20.3	0.0163	195.10	88.20	106.90	
210	19.6	0.0157	197.60	92.40	105.20	
220	18.9	0.0152	200.01	96.60	103.41	
230	18.3	0.0147	202.33	100.80	101.53	
240	17.7	0.0142	204.57	105.00	99.57	
250	17.2	0.0138	206.74	109.20	97.54	
260	16.7	0.0134	208.84	113.40	95.44	
270	16.2	0.0130	210.88	117.60	93.28	
280	15.8	0.0127	212.86	121.80	91.06	
290	15.4	0.0123	214.78	126.00	88.78	
300	15.0	0.0120	216.65	130.20	86.45	
310	14.6	0.0117	218.47	134.40	84.07	

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MODIFIED RATIONAL METHOD CALCULATIONS
50-year Design Storm Event

Date: 05-Jun-24 **Project No.:** 24-836

Project: 127 Ardagh Road **Prepared By:** JR

<<< **Elements Requiring Input Information**

Rainfall Intensity-Duration-Frequency Coefficients from: Barrie WPCC Station + 15% to account for climate change

2-year		5-year		10-year		25-year		50-year		100-year	
A =	675.586	A =	843.019	A =	976.898	A =	1133.123	A =	1251.473	A =	1383.628
B =	4.681	B =	4.582	B =	4.745	B =	4.734	B =	4.847	B =	4.905
C =	0.780	C =	0.763	C =	0.760	C =	0.756	C =	0.753	C =	0.754

Rational Method Formula

$$Q = \frac{C \times I \times A}{360} \quad (m^3/s)$$

where, C = Runoff Coefficient
I = Rainfall Intensity, (mm/hr)
A = Drainage Area, (ha)

Runoff Coefficient Equations
Based on MTO Drainage Manual (1984), page BD-4

2-year	$C_2 =$	C
5-year	$C_5 =$	C
10-year	$C_{10} =$	C
25-year	$C_{25} =$	1.10 x C
50-year	$C_{50} =$	1.20 x C
100-year	$C_{100} =$	1.25 x C

For storms having a return period of more than 10 years, the Runoff Coefficient, C, will be increased as indicated above, up to a maximum value of 1.

Rainfall Intensity Equation (2-100 year storm events)

$$I_{2\text{-}100} = \frac{A}{(B + t_d)^C} \quad (mm/hr)$$

where, A = Rainfall IDF Coefficient
B = Rainfall IDF Coefficient
C = Rainfall IDF Coefficient
t_d = Storm Duration, (min)

Runoff Volume

$$V_{Runoff} = Q_{Runoff} \times t_d \quad (m^3)$$

where, Q_{Runoff} = Runoff Peak Flow Rate, (m^3/sec)
t_d = Storm Duration, (sec)

Released Volume

$$V_{Released} = Q_{Released} \times (t_d + T_C)/2 \quad (m^3)$$

where, $Q_{Released}$ = Max. Release Rate, (m^3/sec)
t_d = Storm Duration, (sec)
T_C = Time of Concentration, (sec)

Max. Storage Required

$$V_{Storage} = V_{Runoff} - V_{Released} \quad (m^3)$$

V_{Runoff} = Runoff Volume, (m^3)
$V_{Released}$ = Released Volume, (m^3)

Z:\Projects\2024\24-836\Design\Storm\[240605_Rational_Method_Calcs(A,B,C).xlsx]Rational Method

Catchment I.D.	Storm Event	Area A (ha)	Runoff Coeff. C	Runoff Coeff. C_{MOD}	Time of Conc. T_C (min.)	Storm Time Step (min.)	Release Rate (m^3/s)
A1	50-year	0.32	0.82	0.98	10	10	0.016

NOTES: 50-year pre-development target is 0.035 m^3/s

Storm Duration t_d (min.)	Rainfall Intensity (mm/hr)	Runoff Peak Flow Rate (m^3/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)	Max. Storage Required (m^3)
10	164.1	0.1436	86.13	9.60	76.53	
20	111.4	0.0974	116.90	14.40	102.50	
30	86.3	0.0755	135.92	19.20	116.72	
40	71.4	0.0624	149.87	24.00	125.87	
50	61.4	0.0537	160.99	28.80	132.19	
60	54.1	0.0473	170.30	33.60	136.70	
70	48.5	0.0425	178.34	38.40	139.94	
80	44.2	0.0386	185.46	43.20	142.26	
90	40.6	0.0355	191.85	48.00	143.85	
100	37.7	0.0329	197.67	52.80	144.87	
110	35.2	0.0308	203.02	57.60	145.42	
120	33.0	0.0289	207.98	62.40	145.58	**145.6**
130	31.2	0.0273	212.61	67.20	145.41	
140	29.5	0.0258	216.96	72.00	144.96	
150	28.1	0.0246	221.06	76.80	144.26	
160	26.8	0.0234	224.94	81.60	143.34	
170	25.6	0.0224	228.63	86.40	142.23	
180	24.6	0.0215	232.16	91.20	140.96	
190	23.6	0.0207	235.52	96.00	139.52	
200	22.7	0.0199	238.75	100.80	137.95	
210	21.9	0.0192	241.85	105.60	136.25	
220	21.2	0.0185	244.83	110.40	134.43	
230	20.5	0.0179	247.71	115.20	132.51	
240	19.9	0.0174	250.49	120.00	130.49	
250	19.3	0.0169	253.18	124.80	128.38	
260	18.7	0.0164	255.78	129.60	126.18	
270	18.2	0.0159	258.31	134.40	123.91	
280	17.7	0.0155	260.77	139.20	121.57	
290	17.3	0.0151	263.15	144.00	119.15	
300	16.9	0.0147	265.47	148.80	116.67	
310	16.5	0.0144	267.74	153.60	114.14	

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MODIFIED RATIONAL METHOD CALCULATIONS
100-year Design Storm Event

Date: 05-Jun-24 **Project No.:** 24-836

Project: 127 Ardagh Road **Prepared By:** JR

<<< **Elements Requiring Input Information**

Rainfall Intensity-Duration-Frequency Coefficients from: Barrie WPCC Station + 15% to account for climate change

2-year		5-year		10-year		25-year		50-year		100-year	
A =	675.586	A =	843.019	A =	976.898	A =	1133.123	A =	1251.473	A =	1383.628
B =	4.681	B =	4.582	B =	4.745	B =	4.734	B =	4.847	B =	4.905
C =	0.780	C =	0.763	C =	0.760	C =	0.756	C =	0.753	C =	0.754

Rational Method Formula

$$Q = \frac{C \times I \times A}{360} \quad (m^3/s)$$

where,
C = Runoff Coefficient
I = Rainfall Intensity, (mm/hr)
A = Drainage Area, (ha)

Runoff Coefficient Equations
Based on MTO Drainage Manual (1984), page BD-4

2-year	C_2 =	C
5-year	C_5 =	C
10-year	C_{10} =	C
25-year	C_{25} =	1.10 x C
50-year	C_{50} =	1.20 x C
100-year	C_{100} =	1.25 x C

For storms having a return period of more than 10 years, the Runoff Coefficient, C, will be increased as indicated above, up to a maximum value of 1.

Rainfall Intensity Equation (2-100 year storm events)

$$I_{2\text{-}100} = \frac{A}{(B + t_d)^C} \quad (mm/hr)$$

where,
A = Rainfall IDF Coefficient
B = Rainfall IDF Coefficient
C = Rainfall IDF Coefficient
t_d = Storm Duration, (min)

Runoff Volume

$$V_{Runoff} = Q_{Runoff} \times t_d \quad (m^3)$$

where,
Q_{Runoff} = Runoff Peak Flow Rate, (m^3/sec)
t_d = Storm Duration, (sec)

Released Volume

$$V_{Released} = Q_{Released} \times (t_d + T_C)/2 \quad (m^3)$$

where,
$Q_{Released}$ = Max. Release Rate, (m^3/sec)
t_d = Storm Duration, (sec)
T_C = Time of Concentration, (sec)

Max. Storage Required

$$V_{Storage} = V_{Runoff} - V_{Released} \quad (m^3)$$

V_{Runoff} = Runoff Volume, (m^3)
$V_{Released}$ = Released Volume, (m^3)

Z:\Projects\2024\24-836\Design\Storm\[240605_Rational_Method_Calcs(A,B,C).xlsx]Rational Method

Catchment I.D.	Storm Event	Area A (ha)	Runoff Coeff. C	Runoff Coeff. C_{MOD}	Time of Conc. T_C (min.)	Storm Time Step (min.)	Release Rate (m^3/s)
A1	100-year	0.32	0.82	1.00	10	10	0.019

NOTES: 100-year pre-development target is 0.04 m^3/s

Storm Duration t_d (min.)	Rainfall Intensity (mm/hr)	Runoff Peak Flow Rate (m^3/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)	Max. Storage Required (m^3)
10	180.4	0.1604	96.23	11.40	84.83	
20	122.5	0.1089	130.69	17.10	113.59	
30	95.0	0.0844	151.99	22.80	129.19	
40	78.6	0.0698	167.59	28.50	139.09	
50	67.5	0.0600	180.02	34.20	145.82	
60	59.5	0.0529	190.42	39.90	150.52	
70	53.4	0.0475	199.40	45.60	153.80	
80	48.6	0.0432	207.34	51.30	156.04	
90	44.7	0.0397	214.48	57.00	157.48	
100	41.4	0.0368	220.97	62.70	158.27	
110	38.7	0.0344	226.94	68.40	158.54	**158.5**
120	36.3	0.0323	232.48	74.10	158.38	
130	34.3	0.0305	237.64	79.80	157.84	
140	32.5	0.0289	242.49	85.50	156.99	
150	30.9	0.0275	247.06	91.20	155.86	
160	29.5	0.0262	251.39	96.90	154.49	
170	28.2	0.0250	255.50	102.60	152.90	
180	27.0	0.0240	259.42	108.30	151.12	
190	26.0	0.0231	263.18	114.00	149.18	
200	25.0	0.0222	266.77	119.70	147.07	
210	24.1	0.0214	270.22	125.40	144.82	
220	23.3	0.0207	273.55	131.10	142.45	
230	22.6	0.0201	276.75	136.80	139.95	
240	21.9	0.0194	279.85	142.50	137.35	
250	21.2	0.0189	282.85	148.20	134.65	
260	20.6	0.0183	285.75	153.90	131.85	
270	20.0	0.0178	288.56	159.60	128.96	
280	19.5	0.0173	291.29	165.30	125.99	
290	19.0	0.0169	293.95	171.00	122.95	
300	18.5	0.0165	296.54	176.70	119.84	
310	18.1	0.0161	299.06	182.40	116.66	

Database Version: V 2.0 Release Update
Update Date: 30-Mar-12

Ontario

MINISTRY OF THE ENVIRONMENT

Project DEVELOPMENT Summary

DEVELOPMENT: 24-836: 127 Ardagh Road
Subwatershed: Barrie Creeks

Total Pre-Development Area (ha):	**0.430**	Total Pre-Development Phosphorus Load (kg/yr):	**0.06**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
Low Intensity Development	0.43	0.13	0.06

POST-DEVELOPMENT LOAD

Post-Development Land Use	Area (ha)	P coeff. (kg/ha)	Best Management Practice applied with P Removal Efficiency		P Load (kg/yr)
High Intensity - Residential	0.32	1.32	Treatment Train Approach	40%	0.25

underground stormwater storage eff. 25% + ETV OGS 20% eff. Equates to 40% overall efficiency (75% x 80% not removed = 60% not removed,= 40% composite removal eff.)

High Intensity - Residential	0.055	1.32	NONE	0%	0.07

No treatment for ~1/2 of catchment A2 (0.11ha)

High Intensity - Residential	0.055	1.32	Perforated Pipe Infiltration/Exfiltration Systems	87%	0.01

Perforated pipes capturing ~1/2 of catchment A2 (0.11ha)

Post-Development Area Altered: **0.43**
Total Pre-Development Area: **0.43**
Unaffected Area: **0**

	P Load (kg/yr)
Pre-Development:	**0.06**
Post-Development:	**0.57**
Change (Pre - Post):	**-0.51**

915% Net Increase in Load

Post-Development (with BMPs):	**0.34**
Change (Pre - Post):	**-0.28**

500.14% Net Increase in Load

DEVELOPMENT: **24-836: 127 Ardagh Road**
Subwatershed: **Barrie Creeks**

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**0.06**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**0.34**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**-0.28**
Conclusion:	**500% Increase in Load**
Pre-Development Load - (Post-Development + Amortized Construction Load):	**to be determined**
Conclusion:	**to be determined**

Based on a comparison of Pre-Development and Post-Development loads, and in consideration of Construction Phase loads, the Ministry would encourage the Municipality to:

APPENDIX C

WATER & SANITARY SERVICING CALCULATIONS

WMI & Associates Limited
119 Collier Street, Barrie, Ontario L4M 1H5
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TOTAL DAILY SANITARY DESIGN FLOW CALCULATIONS

EXISTING DWELLINGS

Date: 05-Jun-24 **Project No.:** 24-836

Project: 127 Ardagh Road **Prepared By:** JR

<<< **Elements Requiring Input Information**

Total Daily Design Flow Calculations

References:
- Ontario Building Code (OBC), 2012, Division B, Part 8, Table 8.2.1.3.A. Residential Occupancy & Table 8.2.1.3.B. Other Occupancies
- Ministry of the Environment (MOE), Design Guidelines for Sewage Works (2008), Chapter 5
- City of Barrie Drinking Sanitary Infrastructure Design Standard (2023)

Proposed Condition:

Establishment:	# of people	# of water closets	# of fuel outlets	# of seats	Gross Floor Area (m^2)	Land Area (ha)	Total Daily Design Sanitary Sewage Volume		Total Daily Design Sanitary Sewage Flow (L/day)
Residential Uses:									
Detached homes 2 units @ 3.13 ppu	7						225	L/person	1,575
Subtotal =	7								1,575

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

where, P = Design population in 1000s

Peaking Factor, M =	4.43
Peak Total Daily Design Sanitary Sewage Flow (L/day) =	6,977
Peak Extraneous Unit Flow (L/s/ha) =	0.10
Land Area (ha) =	0.43
Peak Extraneous Flow (L/day) =	3715
Peak Total Daily Design Flow (L/day) =	10,692
Total Average Daily Design Flow (L/day) =	1,575
Peak Total Daily Design Flow (L/sec) =	0.12

Notes:

-Detached Dwellings have density of 3.13ppu, daily per capita residential flows are 225L/ca/day, and extraneous flows are 0.10L/s/ha as per the City of Barrie Drinking Sanitary Infrastructure Design Standard (2023).

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TOTAL DAILY SANITARY DESIGN FLOW CALCULATIONS

PROPOSED TOWNHOMES

Date: 05-Jun-24 **Project No.:** 24-836

Project: 127 Ardagh Road **Prepared By:** JR

<<< **Elements Requiring Input Information**

Total Daily Design Flow Calculations

References:
- Ontario Building Code (OBC), 2012, Division B, Part 8, Table 8.2.1.3.A. Residential Occupancy & Table 8.2.1.3.B. Other Occupancies
- Ministry of the Environment (MOE), Design Guidelines for Sewage Works (2008), Chapter 5
- City of Barrie Drinking Sanitary Infrastructure Design Standard (2023)

Proposed Condition:

Establishment:		# of people	# of water closets	# of fuel outlets	# of seats	Gross Floor Area (m^2)	Land Area (ha)	Total Daily Design Sanitary Sewage Volume		Total Daily Design Sanitary Sewage Flow (L/day)
Residential Uses:										
Townhouses 19 units @ 2.34 ppu		**45**						**225**	L/person	10,125
	Subtotal =	**45**								**10,125**

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

where, P = Design population in 1000s

Peaking Factor, M =	**4.32**
Peak Total Daily Design Sanitary Sewage Flow (L/day) =	**43,740**
Peak Extraneous Unit Flow (L/s/ha) =	**0.10**
Land Area (ha) =	**0.43**
Peak Extraneous Flow (L/day) =	**3715**
Peak Total Daily Design Flow (L/day) =	**47,455**
Total Average Daily Design Flow (L/day) =	**10,125**
Peak Total Daily Design Flow (L/sec) =	**0.55**

Notes:

-Residential Townhomes have density of 2.34ppu, daily per capita residential flows are 225L/ca/day, and extraneous flows are 0.10L/s/ha as per the City of Barrie Drinking Sanitary Infrastructure Design Standard (2023).

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MANNING'S PIPE EQUATION
PROPOSED SANITARY SEWER: SAN MHA - EX. ARDAGH RD. SEWER

Date: 05-Jun-24 **Project No.:** 24-836

Project: 127 Ardagh Road **Prepared By:** JR

Mannings' Equation		
Pipe Diameter (mm) =	200	
Area =	0.031	m^2
Slope (%) =	2.00	
Manning 'n' =	0.013	
Nom'l Pipe Capacity, Q =	0.046	m^3/sec
Actual Pipe Capacity, Q =	**0.048**	m^3/sec
	48.39	**L/sec**

Box Culvert	
Height =	0.00
Width =	0
Q =	0.00

Velocity	
1.48	m/s
1.54	m/s
R=	**0.05**
Sf=	**0.0200**

NOTE: The proposed sanitary flows are 0.55L/s which is within the sanitary sewer capacity.

Z:\Projects\2024\24-836\Design\Sanitary\[240605_Mannings_Pipe_Eqn.xlsx]Mannings_Pipe

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TOTAL DAILY DOMESTIC WATER DEMAND CALCULATIONS

Date: 05-Jun-24 **Project No.:** 24-836

Project: 127 Ardagh Road **Prepared By:** JR

<<< **Elements Requiring Input Information**

Total Daily Design Flow Calculations

References:
- Ontario Building Code (OBC), 2012, Division B, Part 8, Table 8.2.1.3.A. Residential Occupancy & Table 8.2.1.3.B. Other Occupancies
- Ministry of the Environment (MOE), Design Guidelines for Drinking-Water Systems (2008), Chapter 3
- City of Barrie Drinking Water Infrastructure Design Standard (2024)

Proposed Condition:

Establishment:	# of people	# of water closets	# of fuel outlets	# of seats	Gross Floor Area (m^2)	Land Area (ha)	Total Daily Design Volume		Avg Day Demand ADD (L/s)	Max Day Demand MDD (L/s)	Peak Hourly Demand PHD (L/s)
Residential Uses:											
Townhome								L/person	0.00	0.00	0.00
19 units @ 2.57 ppu	**49**						**225**	L/person	0.13	1.12	1.69
Subtotal =	**49**								**0.13**	**1.12**	**1.69**
							Peaking Factor =			**8.8**	**13.2**
							Total flows:		**0.13**	**1.12**	**1.69**

Notes:

-Residential Townhomes have density of 2.57ppu and daily per capita residential flows are 225L/ca/day as per the City of Barrie Drinking Water Infrastructure Design Standard (2024).

Z:\Projects\2024\24-836\Design\Water\[240605_Total_Daily_Domestic_Water_Supply_Flow_Calc.xlsx]Water_Supply_Flows

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FIRE PROTECTION WATER STORAGE
FIRE UNDERWRITERS SURVEY METHOD

Date: 05-Jun-24 **Project No.:** 24-836

Project: 127 Ardagh Road **Prepared By:** JR

[ ] **<<< Elements Requiring Input Information**

Fire Protection Water Storage

Reference: Part 2- Water Supply for Public Fire Protection, Fire Underwriters Survey, 2020 (FUS 2020 document).
$RFF=220*C*\sqrt{A}$
where RFF=the required fire flow in litres per minute
C=coefficient related to the type of construction of the building
A= the total effective floor area in square metres of the building

C=	1.5		
A=	163		
RFF=	4213	litres/min	
RFF [c] =	4000	litres/min	*-RFF rounded to the nearest 1000LPM*
Apply reduction for low contents fire hazard	-15%		
RFF [d]=	3400		*-RFF with occupancy adjustment factor*
Apply reduction for automatic sprinklers designed to NFPA 13 (30%), systems with water supply (10%) and fully supervised systems (10%)	0%		
Exposure Adjustment Charge (max 75%)	20%		
RFF=	4080	litres/min	*-RFF subtracting sprinklers reduction and adding exposure charge*
RFF [g]=	**4000**	litres/min	*-RFF rounded to the nearest 1000LPM*
=	**66.7**	litres/sec	

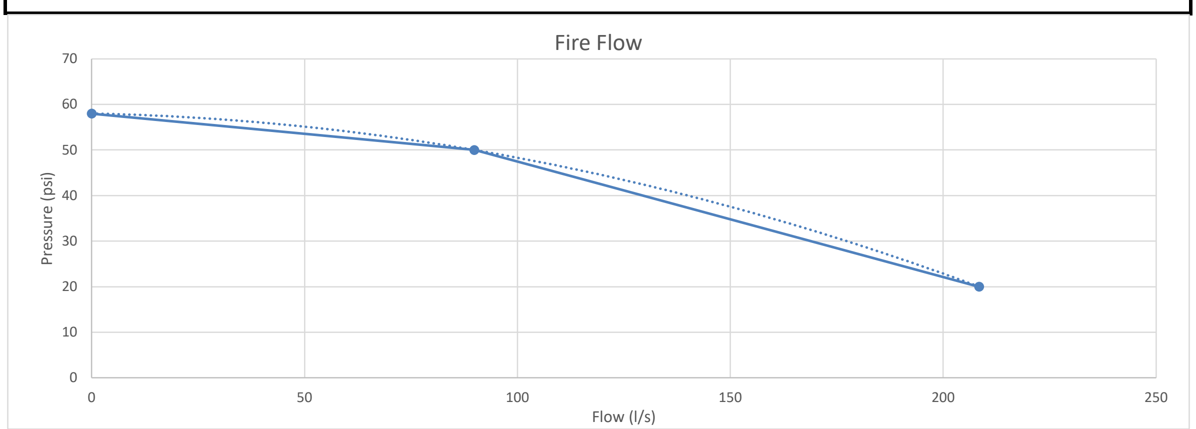
Note:
-RFF [c], [d]… etc. refers to the fire flow calculation procedure points as detailed on page 19 of the FUS 2020 document
-Floor area of the largest single unit in each Townhouse block (assumed to be 3 storeys)
-The RFF calculation assumes that the townhome units will be subdivided via firewalls with a fire resistance rating of not less than 2 hours
-

Fire Flow Test (W501 v1.1)
City of Barrie
5-Jun-2024

Hydrant Number (Residual and Static Pressure)	1143	
Hydrant Number(s) (Flow)	1131	
Hydrant Street / Address (Residual and Static Pressure)	Elizabeth& Ardagh Rd.	
Hydrant Street / Address (Flow)	Patterson & Ardagh Rd.	
Hydrant Locations Figure (Residual/Static and Flow)	??	
Date of Test (DD/MM/YYYY)	26-04-2024	
Time (HH:MM AM or PM)	??	
Time (HH:MM AM or PM)	??	
Company Name	Vipond	
Employee Name(s)	Len. K	
City of Barrie Employee Name(s)	?? ??	
Static Pressure	58	psi
Residual Pressure	50	psi
Hydrant Elevation (Residual and Static Pressure)	262	m
Hydrant Elevation (Flow)	264.5	m
Elevation Difference (m)	-2.5	m
Pitot Pressure - Outlet 1	18	psi
Pitot Pressure - Outlet 2	18	psi
Outlet Size	2.5	inch
Outlet Coefficient	0.9	
Pressure Drop Check (NFPA 291)	13.79	% Minimum pressure drop of 25% is recommended, please consider opening other outlets or flowing additional hydrants
Pressure Drop Check (AWWA M17)	8.00	psi Minimum pressure drop of 10 psi is recommended, please consider opening other outlets or flowing additional hydrants
Q Hydrant Flow - Outlet 1	712.13	US gpm
Q Hydrant Flow - Outlet 2	712.13	US gpm
Q Total Flow	89.86	l/s
Pressure at Desired Fire Flow	20.00	psi
Q Outlet 1_R	1651.86	US gpm
Q Outlet 2_R	1651.86	US gpm
Q $Total_R$	3303.71	US gpm
Q $Total_R$	208.43	l/s
Have any Cell formulas been changed? (Yes/No)	No	If Yes please indicate which ones and why
Hydrant Colour:	Blue	

Boundary Conditions (ET, Reservoir, BPS, PRV, Wells etc):
??

Other Considerations (flushing, fire, operational issues, outlet coefficient etc):
??



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Watermain Headloss Calculations
Fire watermain

<<< **Elements Requiring Input Information**

Velocity, $V = \frac{Q}{A}$ (m/s)

where, Q = Flow (m^3/s)
A = Cross-Sectional Area (m^2)

Minor Head Loss, $H_L = (K_1+K_2+K_3\ldots) \times V^2/2g$

where, $\sum K = (K_1+K_2+K_3\ldots)$
V = mean velocity (m/s)
g = 9.81 (acceleration due to gravity, m/s^2)

Hazen -Williams Equation (re-arranged for Friction Slope)
(Friction Head Loss Calculation)

Friction Slope, $S = \frac{(V)^{1/0.54}}{(0.85CR^{0.63})^{1/0.54}} \times 100$ (m/100m)

where, V = mean velocity (m/s)
k = 0.85 for SI units
C = Roughness Coefficient
R = hydraulic radius (m)

Total Head Loss = Friction Head Loss + Minor Head Loss

Pressure (psi) = Pressure Head (m) x 1.422

Total HGL = Ground Elev. + Pressure Head

Date: 05-Jun-24
Project No: 24-836
Prepared by: JR

Description	Pipe Design Coefficient C	Forcemain Flow (L/s)	Forcemain Diameter (mm)	Forcemain Velocity (m/s)	Forcemain Unit Friction Head Loss (m/100m)	Forcemain Distance (m)	Forcemain Friction Head Loss (m)	Sum of Minor Loss Coeff. ∑K=	Minor Head Loss (m)	Total Head Loss (m)	Total Pressure Loss (psi)	Pressure @ Pt. A (psi)	Pressure Head @ Pt. A (m)	Ground Elev. @ Pt. A (m)	Total HGL @ Pt. A (m)	Ground Elev. @ Pt. B (m)	Total HGL @ Pt. B (m)	Pressure Head @ Pt. B (m)	Pressure @ Pt. B (psi)
Internal Watermain	**110**	**156.12**	**200**	4.97	14.38	**26.00**	3.74	**2.00**	2.52	6.26	8.90	**50**	35.16	**264.50**	299.66	**265.00**	293.41	28.41	**40.39**

NOTES:

- Minor losses are estimated to be equal to a sum of 2.0.

-Pressure @ point A = residual watermain pressure under a dual port flow scenario as identified from the hydrant flow test.
-Inputted flow is MDD+ Fire flow. See Total Daily Domestic Water Supply Flow Calculation sheet for domestic flow. Fire Flow = 150L/s.

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Watermain Headloss Calculations
Internal Loop

[ ] <<< **Elements Requiring Input Information**

Velocity, $V = \frac{Q}{A}$ (m/s)

where, Q = Flow (m^3/s)
A = Cross-Sectional Area (m^2)

Minor Head Loss, $H_L = (K_1+K_2+K_3\ldots) \times V^2/2g$

where, $\sum K = (K_1+K_2+K_3\ldots)$
V = mean velocity (m/s)
g = 9.81 (acceleration due to gravity, m/s^2)

Hazen -Williams Equation (re-arranged for Friction Slope)
(Friction Head Loss Calculation)

Friction Slope, $S = \frac{(V)^{1/0.54}}{(0.85CR^{0.63})^{1/0.54}} \times 100$ (m/100m)

where, V = mean velocity (m/s)
k = 0.85 for SI units
C = Roughness Coefficient
R = hydraulic radius (m)

Total Head Loss = Friction Head Loss + Minor Head Loss

Pressure (psi) = Pressure Head (m) x 1.422

Total HGL = Ground Elev. + Pressure Head

Date: **05-Jun-24**
Project No: **24-836**
Prepared by: **JR**

Description	Pipe Design Coefficient C	Forcemain Flow (L/s)	Forcemain Diameter (mm)	Forcemain Velocity (m/s)	Forcemain Unit Friction Head Loss (m/100m)	Forcemain Distance (m)	Forcemain Friction Head Loss (m)	Sum of Minor Loss Coeff. ∑K=	Minor Head Loss (m)	Total Head Loss (m)	Total Pressure Loss (psi)	Pressure @ Pt. A (psi)	Pressure Head @ Pt. A (m)	Ground Elev. @ Pt. A (m)	Total HGL @ Pt. A (m)	Ground Elev. @ Pt. B (m)	Total HGL @ Pt. B (m)	Pressure Head @ Pt. B (m)	Pressure @ Pt. B (psi)
Internal Watermain	**100**	**1.69**	**50**	0.86	3.36	**105.00**	3.53	**2.00**	0.08	3.61	5.13	**58**	40.79	**264.50**	305.29	**268.50**	301.68	33.18	**47.18**

NOTES: **- Minor losses are estimated to be equal to a sum of 2.0.**

-Pressure @ point A = static watermain pressure as identified from the hydrant flow test.
-Inputted flow is PHD. See Total Daily Domestic Water Supply Flow Calculation sheet for domestic flow. Fire Flow = 150L/s.

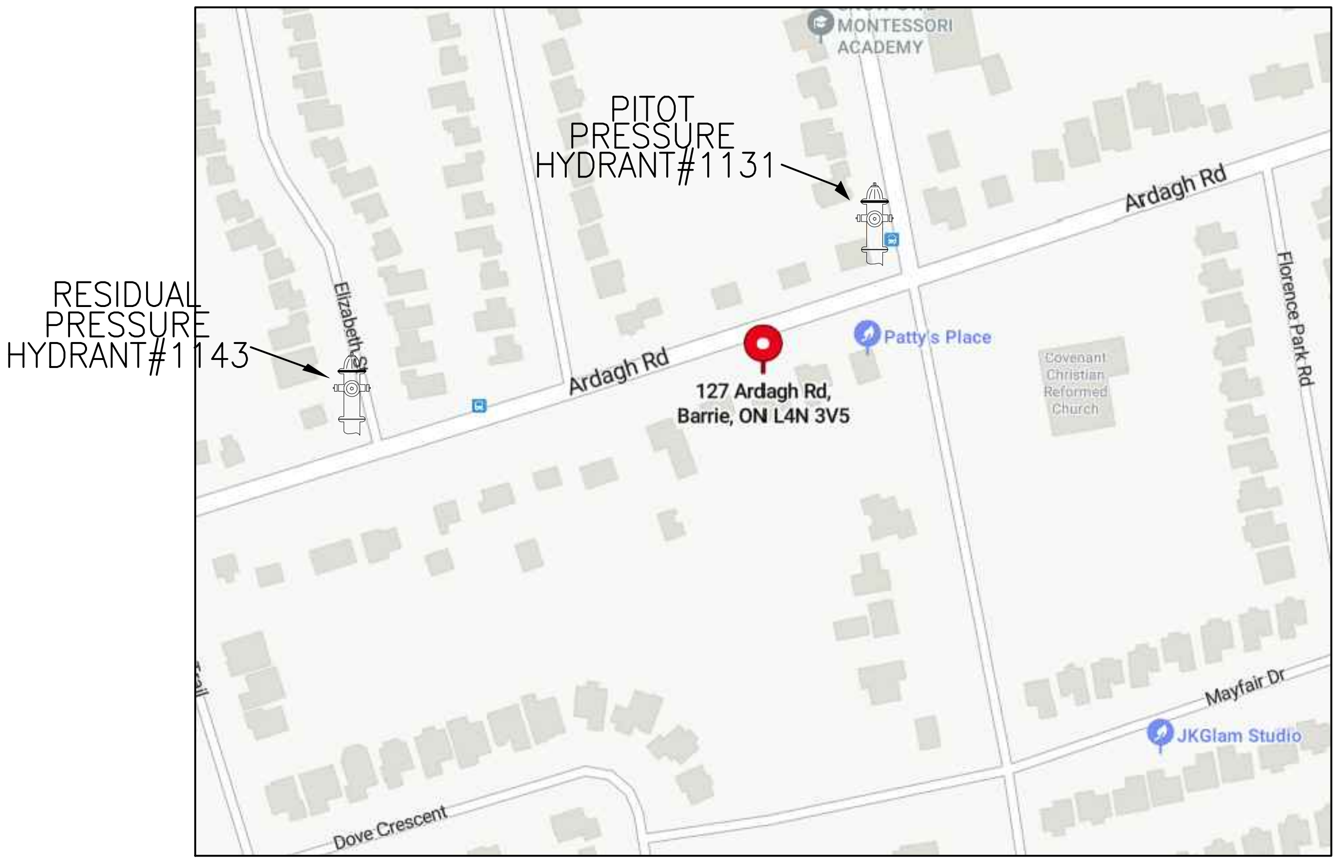
FLOW TEST RESULTS

FIRST FOR FIRE, LIFE SAFETY & SECURITY
VIPOND INC
est. 1945

DATE : APR-26-2024

LOCATION : 127 ARDAGH ROAD
BARRIE
ONTARIO

TEST BY : LEN. K



STATIC PRESSURE : 58 PSI

TEST NO.	NO. OF NOZZLES	NOZZLE DIAMETER (INCHES)	DISCHARGE CO-EFFICIENT	RESIDUAL PRESSURE (PSI)	PITOT PRESSURE (PSI)	DISCHARGE (U.S.GPM)
1	1	1-1/8	0.97	56	50	264
2	1	1-3/4	0.90	56	27	463
3	1	2-1/2	0.90	52	22	791
4	2	2-1/2	0.90	50	18	1432

FIRST FOR FIRE, LIFE SAFETY & SECURITY
VIPOND INC
est. 1945

127 ARDAGH ROAD	BY : LEN K.
BARRIE	OFFICE : BARRIE
ONTARIO	TEST BY : VIPOND & PUC
	DATE : APR-26-2024

STATIC: 58 PSI

	RESIDUAL:		FLOW:
TEST#1	56 PSI	@	264 GPM
TEST#2	56 PSI	@	463 GPM
TEST#3	52 PSI	@	791 GPM
TEST#3	50 PSI	@	1432 GPM