Preliminary Stormwater Management Report

40 Wilson Avenue Subdivision – Romspen Investments

Belleville, ON

Revised

March 4, 2026

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Revision Summary

March 4, 2026

Preliminary Stormwater Management Report issued for Zoning By-Law Amendment and Draft Plan of Subdivision applications.

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1 Introduction and Background

Romspen Investments Corporation (the Owner) is proposing to develop a 13.03 ha site located at 40 Wilson Ave in Belleville, ON [Figure 1-1]. The proposed development will be a new low-density residential subdivision, and is planned to occur in 2 phases.

At this time, the Owner is seeking approval of Phase 1, which comprises 8.43 ha of land, and is progressing through applications for Zoning By-Law Amendment and Draft Plan of Subdivision. Phase 2 is on the horizon and an application for draft plan approval will be submitted at a later date.

This Preliminary Stormwater Management Report has considered both phases and provides an overall plan for successive implementation of each phase starting with Phase 1.

Figure 1-1: Development site location (Google, Maxar Tech 2020)

The development site is located in the southwestern area of Belleville, bounded by Moira St W, Bridge St W, Sidney St, and Palmer Rd. The development will have access to Wilson Ave, which will be extended to make connection to Palmer Road. The lands immediately adjacent to the site consist of residential dwellings to the west and north, and industrial developments to the east and south [Figure 1-2].

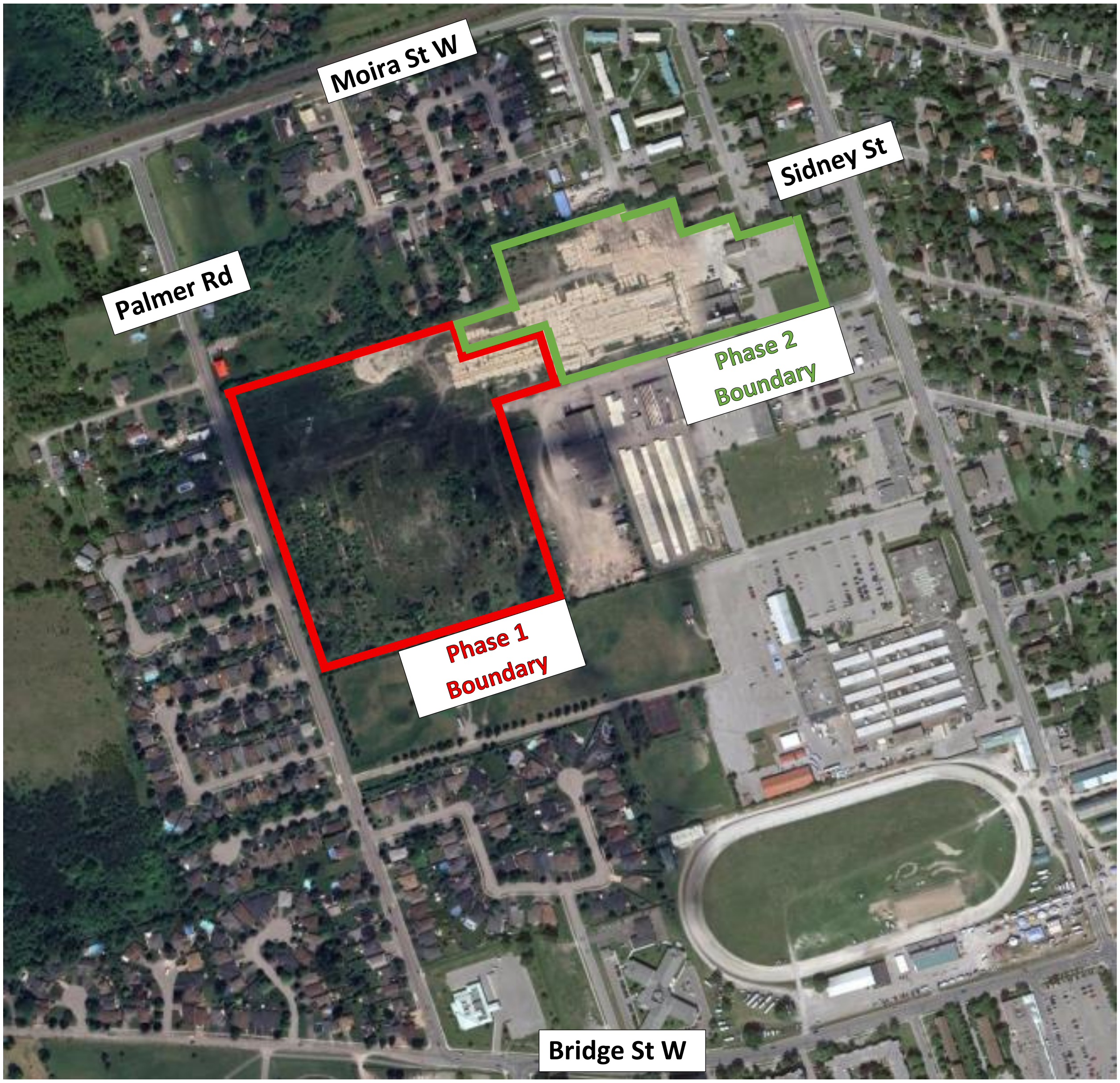


Figure 1-2: Proposed development site in relation to surrounding area (Google, Maxar Tech 2025)

2 Existing Conditions

The subject lands were once part of the Pre-Con facility that produced concrete products. The Phase 1 lands were previously disturbed by construction, but are currently vacant with sparse tree coverage. The Phase 2 lands are mostly developed with an industrial building currently located on them. The subject lands are located on a height of land which generally slopes towards the southwestern corner of the site at a shallow (~1-2%) slope [Figure 1-2] [Figure 2-1].

Figure 2-1: View of the site from Palmer Rd, facing southeast (Google, Maxar Tech 2025)

2.1 Soils

Soils were reviewed from the Soil Survey of Hastings County (Ontario Ministry of Agriculture and Food, 1974). The development lands mainly fall under hydrologic soil group (HSG) D, with small areas of HSG C [Figure 2-2] [Figure 2-3].

Soils found on the site include:

- Lindsay Clay
    - These soils have poor natural drainage, and the material is comprised primarily of silt (50-69%), with more sand than clay in the remainder. Lindsay Clay is classified as hydrologic soil group D.
- Sidney Clay
    - These soils have poor natural drainage, and the material is comprised mostly of silt (47-69%), with more sand than clay in the remainder. Sidney clay is classified as hydrologic soil group D.
- Solmesville Clay Loam
    - These soils have imperfect natural drainage, and the material is comprised mostly of sand (48-93%), with an approximately even amount of silt and clay in the remainder. Solmesville Clay Loam is classified as hydrologic soil group C.

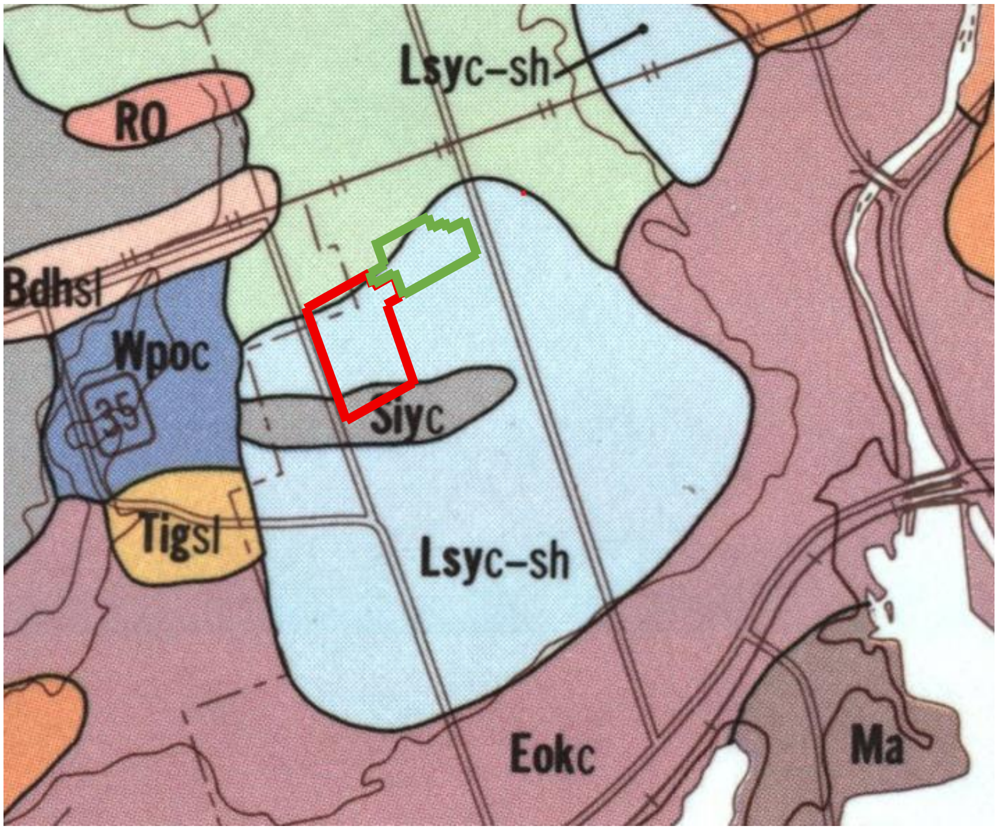


Figure 2-2: Proposed development site hydrologic soil group (Ontario Ministry of Agriculture, 1974)

Hydrologic Soil Group

The hydrologic soil group is used to classify soils into groups of various runoff potential.

The Soil Conservation Service (SCS) classifies bare thoroughly wet soils into four hydrologic soil groups (A, B, C and D). SCS descriptions of the four groups, modified slightly to suit Ontario conditions, are as follows: (Design Chart 1.09)

A: High infiltration and transmission rates when thoroughly wet, eg. deep, well drained to excessively-drained sands and gravels. These soils have a low runoff potential.

B: Moderate infiltration and transmission rates when thoroughly wet, such as moderately deep to deep open textured loam.

C: Slow infiltration and transmission rates when thoroughly wet, eg. fine to moderately fine-textured soils such as silty clay loam.

D: Very slow infiltration and transmission rates when thoroughly wet, eg. clay loams with a high swelling potential. These soils have the highest runoff potential.

In Ontario, soils have been found to lie between the main groups given above, and have therefore been interpolated as AB, BC, CD as appropriate, such as Guelph loam, which is classified as BC.

Figure 2-3: MTO Drainage Management Manual – Description of Hydrologic Soils Groups

A geotechnical study was commissioned to determine the Phase 1 local soil conditions. GEI Consultants advanced 8 boreholes (BH) to refusal, at depths between 1.5-4.6 m. An earth fill material was encountered in BH 6-11 and BH 13. The fill extended to depths between 0.8-1.5 m aside from in BH 9, where the fill extended to the refusal depth of 2.1 m. The fill material ranged from silty sand, sand and silt, sand and gravel, and sand and limestone fragments. Other materials including concrete, plastic, and bricks were also encountered in BH 9-11 and BH 13. A native soil consisting of sand and limestone fragments with trace to some silt and gravel was encountered at the surface in BH 12, and underlying the fill at BH 6-8, BH 11, and BH 13. This native soil extended to the inferred bedrock surface at depths ranging from 1.5-4.6 m. A native soil consisting of clayey and silty sand with trace gravel and trace to some limestone fragments was encountered beneath the fill in BH 10, and extended to inferred bedrock at 2.4 m depth.

To facilitate zoning change, a Phase One Environmental Site Assessment was commissioned from Greer Galloway Group Inc. for both Phase 1 and Phase 2 of the Owner’s lands. The Assessment found that several Potentially Contaminating Activities (PCAs) have occurred on the lands. These activities include concrete manufacturing, material recycling, aboveground and underground fuel storage, and hydrocarbon staining. Several additional PCAs have occurred off-site but within the study area (250 m from the site boundary). In total, seven Areas of Potential Environmental Concern were identified, warranting a Phase Two Environmental Site Assessment to investigate any contaminants within the soil and groundwater of the site.

Due to the potential existence of contaminated soil/groundwater, the site is not suitable for stormwater management technologies that employ infiltration.

2.2 Groundwater / Bedrock Constraints

The GEI geotechnical investigation encountered inferred weathered bedrock at depths ranging from 1.5 – 4.6 m across the Phase 1 site, with the highest elevation along the southern border of the site. Monitoring wells were installed in BH 7, BH 12, and BH 13 to measure stabilized groundwater levels. No groundwater was encountered in these monitoring wells, however, the highest groundwater level in an existing 8.5 m deep monitoring well adjacent to BH 13 was measured at a depth of 3.6 m (within the bedrock). Seasonal fluctuations of the groundwater were observed, with the lowest groundwater level measured at a depth of 5.56 m in October.

Most agencies require 1 m of separation between the bottom of infiltration technologies and the bedrock surface or water table (per Table 3.4.1 of the LID Design Manual, 2010).

Due to the high elevation of bedrock, the site is not suitable for infiltration.

2.3 Targets

The stormwater management plan focuses on three environmental objectives when considering the treatment and conveyance of stormwater runoff. The objectives are to mitigate flooding, quality, and erosion impacts to the receiving system. These objectives, such as preventing increase in flood risk and protecting water quality, comply with the environmental guidelines set out by the Quinte Conservation Authority Bay of Quinte Remedial Action Plan (2006), the City of Belleville Development Manual (2024), and the Ministry of Environment Stormwater Management Planning and Design Manual (2003).

The MTO Drainage Manual (1997) outlines potential negative impacts as a result of development, including increase in surface runoff, soil erosion, and higher downstream flow velocities.

Based on the guidance above, Jewell proposed a SWM methodology to achieve the following targets:

Quantity Control

- Ensure the development doesn't increase the risk of flooding compared to pre-development conditions

Quality Control

- Treat stormwater runoff to **Enhanced** quality control objectives

Erosion and Sediment Control

- Minimize the potential for erosion of soils
- Mitigate the release of sediment offsite

Measures to achieve design targets are discussed in the following sections.

3 Proposed Conditions

The current concept plan for the development is included in Appendix A.

The proposed development is a low-density residential subdivision comprising single-family, semi-detached, and townhouse unit types. The respective unit counts are 55, 36, and 71 for Phase 1, and 9, 22, and 78 for Phase 2. Tripp Ave and Elgin St will be extended to Wilson Ave, and Wilson Ave will be extended to Palmer Rd. Four new unnamed streets are also proposed.

Jewell has assumed a conservative development density and should unit counts be changed from those listed above, the conclusions in this preliminary report will be unchanged. Final design modifications can be made to the design during detailed design.

3.1 Stormwater Management Scheme

3.1.1 Conveyance

The site will follow a major-minor conveyance system, to be finalized in detailed design. The minor system will be designed to convey the 5-yr design event, and comprises a new storm sewer and design elements which direct runoff to it (catch basins, swales, etc.). The major system will be designed to convey the 100-yr design event, and comprises the site roadways. In practice, during the major event the minor system will still collect 5-yr flows, reducing major system overland flows.

Phase 1 drainage will be directed to a dry pond stormwater management facility to be located along Palmer Road.

Runoff generated by the Phase 2 lands will first be conveyed to an underground reservoir beneath the site park block. The discharge from this reservoir will also be conveyed to the dry pond facility. All site runoff will be discharged from the dry pond to the Palmer Rd storm sewer through a 675 mm outlet pipe, adhering to the City of Belleville's storm sewer design. An emergency spillway is incorporated in the dry pond design, and will discharge flows in a controlled manner should the standard outlet be inoperable.

3.1.2 Quality Control

Quality control will be provided for the 5-yr event via a combination of technologies approach, using OGS units and a dry pond in series. The OGS units will be the first in the series. One OGS unit will be located prior to the underground reservoir and provide treatment to Phase 2 runoff. A second OGS unit will be located prior to the dry pond, and will provide treatment to all site runoff. Final treatment will be provided via settlement and filtration from grassy contact within the dry pond. Some additional treatment will be provided to rear yards and rooftops, which will flow across grassed areas and be conveyed by grassed swales.

3.1.3 Quantity Control

Quantity control for the Phase 1 lands will be provided by the dry pond facility. The Phase 2 lands will be controlled by the underground reservoir and dry pond operating in conjunction, with primary control provided by the underground reservoir.

4 Hydrologic Modelling

An OTTHYMO model was prepared to review the hydrologic conditions of the existing lands and compare with the post development conditions to determine the mitigation measures needed.

OTTHYMO is a single event hydrologic model that allows a user to generate a runoff hydrograph from simulated catchments using limited input data. The program will add, route, divert, store and delay hydrographs generating several runoff data parameters such as peak flow, time to peak, volume and runoff coefficient.

The user may simulate a catchment by selecting from an urban (Standhyd) or a rural (Nashyd, Wilhyd or SCShyd) unit hydrograph depending on the degree of development measured as imperviousness. The modelling software allows users to simulate catchments using parameters such as:

- Catchment area
- Imperviousness, total and directly connected
- Runoff coefficient or curve number
- Length and slope of impervious area
- Length and slope of pervious area
- Time to peak of the catchment
- Manning's roughness coefficient
- Storage coefficient

Precipitation inputs may be provided using precipitation gauge statistics from Intensity Duration Frequency (IDF) curves, or it may be an historic storm read in from an external file. The hydrologic model estimates how much of the precipitation input is translated to output (runoff) using data supplied about the catchment. The volume of water, measured as depth of water in mm, is conserved throughout the model as per the equation below.

$$Rainfall\ depth = Runoff\ depth + Losses$$

Losses include those through interception depression storage (Initial Abstraction) and infiltration determined using one of three infiltration methods; SCS curve number (CN), proportional loss coefficient (C), or Horton's Infiltration equation. Diversions are another means of subtracting volume from the model output (a loss). These can be imposed by the user with the DUHYD or Divert HYD command. Evaporative losses are ignored.

Peak flows are generated in the Nash unit hydrograph method assuming the runoff is routed through a series of linear reservoirs (the number of which is selected by the user). In the Standard unit hydrograph method, the impervious areas are separated from the pervious and hydrographs are derived for each and added to develop a catchment-wide hydrograph.

Storage, lags or routing through channels do not subtract from the runoff volume, but result in delays of the times to peak and can lead to changes in the peak flow, typically by reducing the peaks.

4.1 Model Inputs

Pre-development catchments were developed for each of the phases, with Catchment 100 representing Phase 1 and Catchment 101 representing Phase 2. Catchment 100 was modelled using Nashyd due to its primarily undeveloped nature, while Catchment 101 was simulated using the Stanhyd subroutine due to the urban condition. In the post-development scenario, the entire development was simulated in 2 phases using Stanhyd subroutine, with Catchment 200 representing Phase 1 and 201 representing Phase 2. The catchment area drawing is included in Appendix B.

The inputs to the OTTHYMO model are summarized in Table 4-2 and Table 4-1. Detailed input calculations are provided in Appendix D.

Table 4-1: Nashyd catchment area hydrologic inputs

Catchment	Area (ha)	CN	T_P (hr)
100	8.43	86.7	0.34

Table 4-2: Stanhyd catchment area hydrologic inputs

Catchment	Area (ha)	CN	XIMP (%)	TIMP (%)	Length (m)	Slope (P/I) (%)
101	4.60	94.2	61	71	100	2 / 1
200	8.43	86	40	50	100	2 / 1
201	4.60	86	40	50	100	2 / 1

4.1.1 Precipitation

Precipitation records from Environment Canada were used for Belleville station 6150689. The most recent V3.3 IDF curves were released October 2022, and contain data from 1960-2016. These IDF curves are included in Appendix C.

Modelling was completed for the 5-yr and 100-yr (regional) storm events. A Chicago distribution was applied to rainfall data, and a 6 hr duration design storm was selected to align with the 100 year design storm used in the 2022 Wilson Avenue Subdivision Stormwater Management Report by WSP Canada Inc. (WSP).

4.1.1.1 Area
The development site has an area of 13.03 ha, 8.43 ha of which is Phase 1 and 4.6 ha of which is Phase 2. The areas of the site, each phase/catchment, and each land use/surface were calculated using the assistance of AutoCAD.

4.1.1.2 Imperviousness
Composite imperviousness was calculated for Catchment 101 by assigning an imperviousness of 100% to paved surfaces, 50% to gravel surfaces, and 0% to grassed surfaces. An imperviousness of 50%, standard for low-density residential subdivisions, was assumed for Catchments 200 and 201. Directly connected imperviousness was set as 10% lower than the total.

4.1.1.3 Curve Number
The SCS Curve Number method was used to calculate losses. A composite curve number was calculated for Catchments 100 and 101 based on the values prescribed by Design Chart 1.09 of the MTO Drainage Management Manual; 98 for paved areas and 86 for improved HSG D areas. The curve numbers of Catchments 200 and 201 were set as 86 to align with an improved HSG D area.

It should be noted that the small areas of HSG C were conservatively considered as HSG D.

4.1.1.4 Storage
A standard depression storage depth was assumed at 5 mm for pervious areas and 2 mm for impervious areas.

4.1.2 Manning's Number

For all catchment areas, the impervious Manning's Number was set as 0.013 for smooth textured asphalt pavement, and the pervious Manning's Number was set as 0.25 for sheet flow.

4.1.3 Length

The Stanhyd catchment pervious and impervious area lengths were set as 100 m, to align with typical distance between catchbasins.

4.1.4 Slope

The Stanhyd catchment pervious area slopes were set as 2% to align with typical lot grading, and impervious area slopes were set as 1% to align with typical road grading.

4.1.5 Time to Peak

To calculate the time to peak of Catchment 100, the slope was first calculated using the 85/10 Average Slope Method per Equation B2.2 of the MTO Drainage Management Manual, with the assistance of AutoCAD. This method is included as Equation 2.

Equation 2: 85/10 Average Slope Method

$$S_W = \frac{E_{85} - E_{10}}{0.75 * L} * 100$$

Where:

S_W = Watershed slope (%)
L = Watershed length (m)
E_{85} = Elevation at the 85% upstream point of the watershed (m)
E_{10} = Elevation at the 10% upstream point of the watershed (m)

The 5-year composite runoff coefficient was then calculated based on the values prescribed by Design Chart 1.07 of the MTO Drainage Management Manual; 0.55 for cultivated areas of flat clayey soil, 0.95 for pavement, and 0.60 for gravel. The 100-year coefficient was then calculated with the value for cultivated areas of flat clayey soil increased by 25%, as required.

Using these inputs, times of concentration were calculated using the Airport Method per Equation 8.16 of the MTO Drainage Management Manual. It should be noted that, though the composite runoff coefficients for Catchment 100 were greater than the 0.4 value recommended for use of this method, the Bransby-Williams method recommended for higher coefficients is based on highly channelized flow and typically used for urban areas. This would not accurately represent the pre-development conditions of Phase 1 and produce inaccurate results; the Airport Method was more suitable. The Airport Method is included as Equation 3.

Equation 3: Airport Method

$$T_C = \frac{3.26 * (1.1 - C) * L^{0.5}}{{S_W}^{0.33}}$$

Where:

T_C = Time of concentration (min)
L = Watershed length (m)
C = Runoff Coefficient
S_W = Watershed slope (%)

The 5-yr and 100-yr times to peak of Catchment 100 were then calculated using Equation 4.

Equation 4: Time to Peak Formula

$$T_P = \frac{2}{3} * \frac{T_c}{60}$$

Where:

T_P = Time to peak (hr)
T_C = Time of concentration (min)

5 Stormwater Management Controls

A previous Preliminary Stormwater Management Report was prepared for Phase 1 of the 40 Wilson Avenue Subdivision by WSP Canada Inc. in 2022. This plan included the dry pond that would control to pre-development peak flows and discharge to the Palmer Rd storm sewer. This would normally be an acceptable treatment target, but the receiving storm sewer on Palmer Rd was designed with a 498.5 L/s allotment to the subject lands. This is less than the planned discharge by WSP for the 100-yr release rate of 583.9 L/s. Additionally, the quality control design proposed infiltration technologies, which are not recommended while the potential presence of contaminated soil/groundwater on the site remains unconfirmed.

As such, Jewell developed a revised preliminary SWM design. Several alternative quantity control discharge schemes were investigated, including upsizing of the Palmer Rd storm sewer and downstream system, installation of a new storm sewer along Wilson Ave, and control via a central municipal facility. However, the only option that was determined to be feasible, both financially and for conveyance of flows, was restricting all quantity events to the allotted 498.5 L/s and discharging to the existing Palmer Rd storm sewer. An alternative quality control scheme was developed which does not utilize infiltration technologies.

It should also be noted that the Phase 1 post-development peak flows determined by Jewell's OTTHYMO model exceed those determined in the previous report. This can be attributed to the addition of 0.64 ha of land to Phase 1 (0.5 ha of which comprises a park block), and Jewell's conservative assumption of 50%imperviousness for the entire site area, while a lower imperviousness was offered in the previous report.

5.1 Quality Control

Quality control will be achieved via a combination of technologies approach, via:

- Manufactured treatment device (OGS unit); and
- A natural treatment facility (dry pond)

The treatment target of *Enhanced* protection level is achieved through the successive treatment scheme outlined below.

5.1.1 OGS Unit

OGS units are positioned first in the treatment train. An OGS unit will be installed prior to the entrance of each of the dry pond and the underground reservoirs. In this position, the OGS units will reduce the accumulation of sediment within the two reservoirs. As the underground reservoir flows into the dry pond, this would mean Phase 2 runoff receives treatment from both

OGS units. However, as the City of Belleville CLI-ECA precludes use of multiple manufactured treatment devices in series in the calculation of quality control effectiveness, only the OGS unit prior to the dry pond will be attributed sediment removal effectiveness.

The OGS unit was attributed a maximum of 60% sediment removal effectiveness, as municipalities and conservation authorities typically only credit effectiveness up to this value.

5.1.2 Dry Pond Facility

Per Table 3.2 of the MOE Stormwater Management Planning and Design Manual, a continuous flow dry pond would require 1,759 m^3 of storage to provide Basic treatment to a 50% imperviousness site. As the provided active storage is 1,922 m^3, the dry pond could achieve a TSS removal rate of 60%. However, as the OGS units were designed as the primary sediment removal mechanism, no forebays were incorporated in the design.

The dry pond sediment removal effectiveness will be discounted to 50% for conservatism.

5.1.3 Additional Treatment Technologies

Rear yards and other grassed areas will function similarly to vegetated filter strips, and rear yard grasses swales are incorporated in the design. These technologies will provide some additional treatment through filtration.

No sediment removal effectiveness was attributed to grassed areas/swales for conservatism.

5.1.4 Quality Control Effectiveness

A sediment removal effectiveness of 80% is achieved under the proposed stormwater management scheme, achieving the *Enhanced* quality control target.

Quality treatment effectiveness was calculated using the following formula:

Equation 5: Combined Technologies Method (NCDENR Stormwater BMP Manual, p3-20)

$$E = A + B - \left(\frac{A * B}{100}\right)$$

Where:

E = Total pollutant removal efficiency (%)

A = Removal Efficiency of Technology 1 (OGS Unit – 60%)

B = Removal Efficiency of Technology 2 (Dry Pond – 50%)

Calculation of the treatment effectiveness achieved is shown below:

$$E = 60\% + 50\% - \left(\frac{60\% * 50\%}{100}\right) = 80\%$$

As the quality control requirement is satisfied with the discounted effectiveness of the dry pond, without accounting for the OGS unit in Phase 2, and without accounting for sediment removal via grassed area filtration, the design is conservative.

Alterations to the preliminary quality control design may be made as development progresses. The quality control design will be finalized in the detailed design phase.

5.2 Quantity Control

Alterations to the preliminary quantity control design may be made as development progresses. The quantity control design will be finalized in the detailed design phase.

Typically, quantity control requires post-development peak flows to be restricted to pre-development rates. However, the City designed the Palmer Rd storm sewer system with a 498.5 L/s contribution from the site in the 5-yr storm. Overcontrol of the 100-yr storm to this rate would also avoid required upgrades to the downstream system or installation of alternate discharge routes, which are prohibitively costly.

The control target of both the 5-yr and 100-yr event is set as 498.5 L/s.

The pre- and post- development peak flows and control targets are summarized in Table 5-1.

Table 5-1: OTTHYMO modelling results of overall pre- and post- development peak flow rates

Event			5-Yr	100-Yr
Peak Flow Rate (m3/s)	Phase 1	Pre-Development	0.370	0.820
		Post-Development	1.035	1.958
		Control Target	0.4985	0.4985
	Phase 1 + Phase 2	Pre-Development	1.073	2.030
		Post-Development	1.600	3.026
		Control Target	0.4985	0.4985

The site stormwater management scheme implements two quantity control facilities:

- **A dry pond within the stormwater management block; and**
- **An underground reservoir beneath the park block**

The dry pond will fully control Phase 1 runoff, and operate in conjunction with the underground reservoir to control all site runoff once Phase 2 is complete.

Design calculations for the dry pond are included in Appendix E, and the underground reservoir was sized using the OTTHYMO model included in Appendix D.

5.2.1 Phase 1 Control

Phase 1 quantity control will be provided by the dry pond within the stormwater block at the southwestern corner of the site. The pond occupies 1,466 m^2 of surface area, while the remainder of the 2,200 m^2 SWM block is occupied by the access road, berm, and grading. 2,343 m^3 of total storage is provided, 1,922 m^3 of which is designed as active storage.

The design parameters of the dry pond are as follows:

- Bottom elevation: 97.4 m
- Bottom surface area: 621 m^2
- Side slope: 3:1
- Active storage depth: 2.0 m
- Freeboard: 0.3 m
- Outlet Orifice 1: 0.30 m circular orifice, 97.4 m invert
- Outlet Orifice 2: 0.30 m circular orifice, 97.4 m invert
- Emergency Spillway: 10.0 m broad crested weir, 99.45 m invert

The quantity control provided by the dry pond facility is summarized in Table 5-2.

Table 5-2: Summary table of quantity control provided to the development (Phase 1) via dry pond

Event	Peak Flow Rate (m^3/s)			Dry Pond Storage	
	Pre-Dev	Post-Dev	Controlled	Volume (m^3)	Elevation (m)
5-Year	0.370	1.035	0.328	700	98.31
100-Year	0.820	1.958	0.494	1,764	99.28

The 5-year event discharge of Phase 1 is controlled from 1.035 m^3/s to 0.328 m^3/s, occupying 700 m^3 of storage and rising to an elevation of 98.31 m.

The 100-year event discharge of Phase 1 is controlled from 1.958 m^3/s to 0.494 m^3/s, occupying 1,764 m^3 of storage and rising to an elevation of 99.28 m.

The emergency spillway has a capacity of 2.088 m^3/s, which is sufficient to convey the entirety of the 100-year event flows which enter the dry pond (1.958 m^3/s), preventing overtopping of the facility should the orifices become inoperable.

5.2.2 Phase 2 Control

As Phase 1 runoff is controlled to nearly the allotted rate using most of the dry pond active storage, and since Phase 2 runoff will also be routed through the dry pond, Phase 2 runoff must be controlled prior to entering the pond. This can be achieved using an underground reservoir beneath the park block bordering Phase 2. Through the OTTHYMO model, the allowable discharge from this reservoir was determined, and a storage requirement of 2,548 m^3

predicted. However, as the Compute Volume command used to estimate storage is known to underestimate slightly, this was increased for conservatism. The actual volume will be confirmed during detailed design.

The required parameters of the underground reservoir are:

- 0.011 m^3/s discharge
- 3,000 m^3 storage volume

The discharge requirement can be accomplished through use of orifices, vortex valves, and other controls. The storage volume can be satisfied through use of underground storage units, such as the NextStorm EZ Storm System. Sediment accumulation within the main storage can also be mitigated through the use of StormTech Isolator Row Units.

The quantity control provided by the underground reservoir and dry pond working in concert is summarized in Table 5-3.

Table 5-3: Summary table of quantity control provided to the development (Phase 1 & 2) via underground reservoir and dry pond

Event	Peak Flow Rate (m^3/s)				Dry Pond Storage	
	Pre-Dev	Post-Dev	Post-Reservoir	Controlled	Volume (m^3)	Elevation (m)
5-Year	1.073	1.600	1.045	0.335	731	98.35
100-Year	2.030	3.026	1.968	0.497	1,790	99.30

The 5-year event discharge of Phase 1 is controlled from 1.600 m^3/s to 0.335 m^3/s, occupying 731 m^3 of storage and rising to an elevation of 98.35 m in the dry pond.

The 100-year event discharge of Phase 1 is controlled from 1.958 m^3/s to 0.494 m^3/s, occupying 1,790 m^3 of storage and rising to an elevation of 99.30 m in the dry pond.

The emergency spillway has a capacity of 2.088 m^3/s, which is sufficient to convey the entirety of the 100-year event flows which enter the dry pond (1.968 m^3/s), preventing overtopping of the facility should the orifices become inoperable.

5.2.3 Stage-Storage-Discharge

Stage-storage and stage-discharge figures for the dry pond facility are provided below.

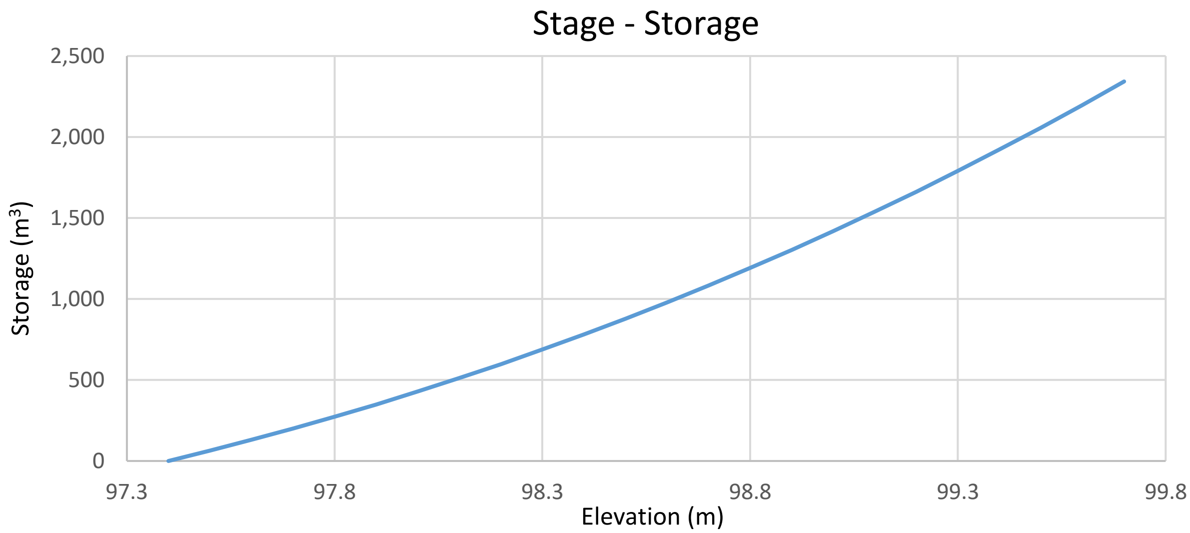


Figure 5-1: Dry pond facility stage - storage relationship

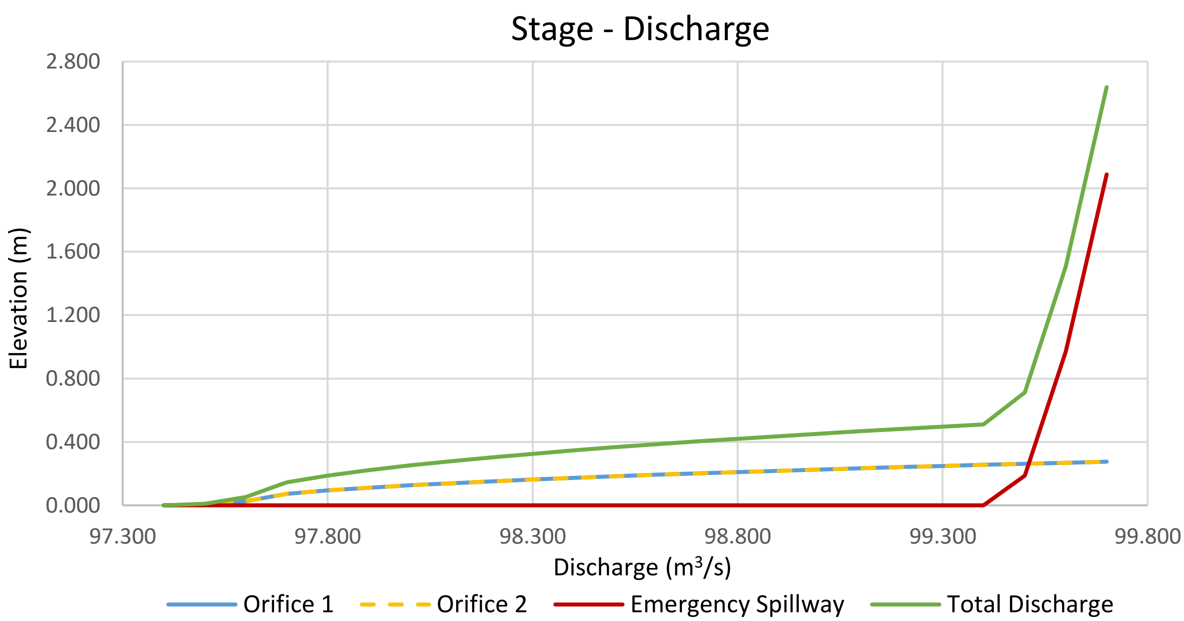


Figure 5-2: Dry pond facility stage - discharge relationship

6 LID

Low Impact Development is a requirement of the 2024 Provincial Planning Statement. This requires that all developments consider LID strategies to reduce the impact of development on the hydrologic regime.

The Low Impact Development Guidelines (Toronto and Region Conservation Authority, 2010) states that "increases in the quantity, rate, and frequency of runoff can be linked to two root causes:

- the conversion of undeveloped or agricultural land cover to urban uses, and
- the application of storm sewer systems."

The goal of LID site design strategies is to minimize these two sources of hydrologic impacts (Toronto and Region Conservation Authority, 2010, p. 3.3). Large urban areas are negatively impacted by flash flooding associated with extensive hardening. The LID design techniques seek to mitigate flooding and erosion associated with urbanization. While water quality improvements are associated with the recommended techniques, quantity control remains the focus of LID.

The guidelines provide some site design strategies for reducing the hydrologic impact postulating 4 major groupings or "themes":

1) Preserving important hydrologic features and functions;
2) siting and layout of development;
3) reducing impervious area; and
4) using natural drainage systems.

LID has been considered throughout the design to incorporate these themes where feasible. Further LID measures may be implemented as development progresses to detailed design. However, implementation of some strategies is limited due to municipal requirements for techniques such as setbacks, road design, parking, and drainage design. The LID guidelines provide a hierarchy of applying the LID techniques by first invoking the use of natural hydrologic areas and then development of green infrastructure.

Discussion of the LID practices used in the stormwater management design is provided below.

6.1 Theme 1 – Preserving Important Hydrologic Features

This theme focuses on preservation. Site design is adjusted to preserve natural features that benefit hydrology.

Preserve stream buffers, including along intermittent and ephemeral channels

- Preserve areas of undisturbed soil and vegetation cover
- Avoid development on permeable soils
- Preserve existing trees and, where possible, tree clusters

Important hydrologic features include:

- Highly permeable soils
- Pocket wetlands
- Significant small (headwater) drainage features
- Riparian buffers
- Floodplains
- Undisturbed natural vegetation
- Tree clusters

6.2 Theme 2 – Application of Siting and Layout Techniques

Siting and layout techniques aim to reduce the environmental impacts of the development by fitting the development within the framework of the natural heritage features.

- Fit the design to the terrain
- Use open space or clustered development
- Use innovative street network designs
- Reduce roadway setbacks and lot frontages

The development site generally follows existing grading. The existing grades at the site boundaries are maintained, and the SWM block is situated at the outlet point of existing drainage patterns. Loop and cul-de-sac street patterns are incorporated, and townhouse development is clustered in Phase 2 where the pre-development imperviousness is higher than in post-development.

6.3 Theme 3 – Reducing the Impervious Area

Imperviousness can be reduced by minimizing unnecessary surface hardening. Some strategies include:

- Reducing street width
- Reducing building footprints
- Reducing parking footprints
- Considering alternatives to cul-de-sacs
- Eliminating unnecessary sidewalks and driveways

The street network has been designed with the typical minimum right-of-way.

6.4 Theme 4 – Using Natural Drainage Systems

These strategies focus on the use of existing natural drainage systems where available “to take advantage of undisturbed vegetated areas and natural drainage patterns”.

- “Disconnect” impervious areas
- Preserve or create micro-topography
- Extend drainage flow paths

Rooftop areas will be disconnected from the street by discharging runoff to rear yard grassed swales. Where suitable, site grading will slow and lengthen slow paths, and flows will be encouraged to drain across grassed surfaces prior to collection.

6.5 LID Summary

The 40 Wilson Avenue Subdivision preliminary design follows the LID strategies provided in the Low Impact Development Guide. Where feasible, techniques to preserve hydrologic features, adjust the siting and layout, reduce impervious areas, and utilize natural drainage systems have been incorporated. Further LID measures may be implemented as development progresses.

7 Maintenance

The stormwater management technologies proposed in this report include:

1) Vegetated Filter Strips
2) Grassed Swales
3) OGS Units
4) Dry Pond Facility

Maintenance inspections should be conducted at least once per year for each technology. However, inspecting more frequently is recommended during the first few years of operation to gain experience with the technology performance at the site and develop required maintenance schedules. This is typically recommended to be after every significant storm within the first 2 years.

Preliminary maintenance requirements for the proposed technologies are detailed below, and will be further developed in the detailed design phase.

7.1 Vegetated Filter Strips

Grass cutting should be as limited as possible with respect to local requirements, with a minimum height of 75 mm recommended to improve filtration, and clippings removed from the flow path. Weed control should be performed with respect to local requirements, with any weeds removed by hand to prevent contamination. Accumulated sediment should be removed from the filter strip based on visual inspection, triggered by impact to its intended function (conveyance of sediment downstream, inducement of ponding, etc.) or desired aesthetics. Sediment removal may be completed by hand or with excavating equipment, and the filter strip should be restored to its original state following. Any accumulated trash and debris should be removed as required. Recommended care practices should be followed for any larger vegetation planted on the filter strip.

7.2 Grassed Swales

The grass of the swale is recommended to be maintained above a minimum 75 mm height, with grass cutting as limited as possible with respect to local requirements and clippings prevented from entering the swale. Weed control should be performed with respect to local requirements, with any weed removal completed by hand. Removal of accumulated sediment should be based on visual inspection, triggered by risk of overtopping due to loss of volume, conveyance of sediment to downstream facilities, inducement of ponding, and other impacts to its intended function. Sediment removal may be completed by hand or with excavating equipment, and the swale should be restored to its original state following. Any accumulated trash and debris should be removed as required.

7.3 OGS Units

OGS units will require routine sediment removal. It is a good standard of practice to remove sediment every year as part of routine maintenance. Sediment cleanout should be performed using a vacuum truck.

Per Table 6.3 of the MOE Stormwater Management Planning and Design Manual, annual sediment loading can conservatively be estimated as 1.58 m^3/ha for a 50% impervious site. As the OGS units have been specified to provide 60% TSS removal, the Phase 1 unit (prior to the dry pond) with 8.43 ha of contributing area can be expected to require 7.99 m^3 of sediment storage, and the Phase 2 unit (prior to the underground reservoir) can be expected to require 4.36 m^3 of sediment storage.

OGS unit manufacturers typically provide detailed Operations & Maintenance Manuals. If available, the relevant manual(s) will be included following OGS unit sizing in detailed design.

7.4 Dry Pond Facility

Grass cutting and weed control should be performed with respect to local requirements. Grass clippings should be prevented from entering the facility, and any weed removal should be performed by hand. Any accumulated trash and debris should be removed as required.

Of the 1.58 m^3/ha annual sediment accumulation estimated for the site per Table 6.3 of the MOE Stormwater Management Planning and Design Manual, 0.632 m^3/ha will not be removed by the OGS units. As the entire 13.03 ha site will contribute this volume to the dry pond, annual sediment accumulation can be conservatively estimated as 8.23 m^3.

As an additional 6.9% active storage was provided in the dry pond for the overall site quantity control design, 132 m^3 of sediment storage is available, corresponding to a 16 yr maintenance period. However, this corresponds to a sediment depth of ~0.2 m, while the orifice diameter is 0.3 m. As this may lead to impacts to the intended function of the pond (conveyance of sediment downstream, obstruction of inlet/outlet pipes, etc.), sediment may be required to be removed earlier (e.g. 0.15 m depth, ~12 yr maintenance period) if impacts are observed.

Sediment cleanout should be completed using excavation equipment and the facility should be restored to its original state following maintenance, as detailed in Section 5.2.1.

8 Erosion and Sediment Control

Erosion and sediment control is one of the three targets identified in Section 2.3. The following measures are proposed to prevent the negative erosion and sediment impacts of development.

Typical site development requires removal of some vegetated cover. While it is the intention to reduce vegetation removal, exposed soils from the work will be at risk of eroding into the receiving drainage system. Measures will need to be put in place to reduce erosion during construction, and for a period of up to one year after construction is completed. Typical erosion and sediment control measures include:

- Siltation fencing.
- Rip-rap check dams.
- Filter sock inserts in catch basins.

Controls are to be placed downstream of all active work areas and upstream of protected receivers. Controls should also be placed around stockpiles of topsoil and fill materials.

Typical OPSDs provide good instruction on the correct placement and construction of the controls. The controls provide some protection if they are properly maintained, but they should be considered last-resort measures. The most effective means of control are those which prevent or reduce erosion at the source. This would include diligent stabilization of exposed areas immediately after grading is completed. Stabilization measures include sod, erosion blankets, or rip-rap and filter cloth on steep slopes, as well as topsoil and hydroseed on gently sloped areas (with slope 10% or less).

A silt fence should be located along the upland perimeter of all sensitive features during the construction process, which should be maintained until the lands have stabilized or as directed by the municipality. There would be benefit in maintaining this silt fence for up to 2 growing seasons.

The 90% (27 mm 4-hr Chicago distribution) was used as a proxy for the quality event. This was modelled in OTTHYMO, and when passed through the dry pond facility, has a drawdown time of less than the 24 hrs recommended by the MOE Stormwater Management Planning and Design Manual. However, the purpose of providing a 24 hr drawdown time to the quality event is to mitigate risk of erosion in the downstream system due to the development. As all discharge will be directly to the municipal storm sewer system, there is little risk of downstream erosion regardless of drawdown time. There is also little risk of local erosion at the discharge point.

The site developer and contractor should actively maintain the new drainage works to remove accumulations of sediment.

9 Conclusions

Romspen Investments Corporation is proposing to develop a 13.03 ha site located at 40 Wilson Ave in Belleville, ON. The proposed development will be a low-density residential subdivision comprising single-family, semi-detached, and townhouse units, and will occur in 2 phases.

Quality Control

The design will achieve the Enhanced treatment target. Quality control is provided via a combination of technologies approach using OGS units and a dry pond facility.

Quantity Control

The design will overcontrol post-development peak flows for the 5-yr and 100-yr events relative to pre-development peak flows, to satisfy the capacity constraint of the receiving system. **Quantity control provided is summarized in Table 9-1 and Table 9-2.**

Table 9-1: Summary table of quantity control provided to the development (Phase 1) via dry pond

Event	Peak Flow Rate (m^3/s)			Dry Pond Storage	
	Pre-Dev	Post-Dev	Controlled	Volume (m^3)	Elevation (m)
5-Year	0.370	1.035	0.328	700	98.31
100-Year	0.820	1.958	0.494	1,764	99.28

Table 9-2: Summary table of quantity control provided to the development (Phase 1 & 2) via underground reservoir and dry pond

Event	Peak Flow Rate (m^3/s)				Dry Pond Storage	
	Pre-Dev	Post-Dev	Post-Reservoir	Controlled	Volume (m^3)	Elevation (m)
5-Year	1.073	1.600	1.045	0.335	731	98.35
100-Year	2.030	3.026	1.968	0.497	1,790	99.30

Outlet Controls

The dry pond controls within the outlet structure are as follows:

- **0.30 m circular orifice, 97.4 m invert**
- **0.30 m circular orifice, 97.4 m invert**
- **10.0 m broad crested weir emergency spillway, 99.45 m invert**

Conveyance

The site follows a major-minor conveyance system, which will be finalized in detailed design.

The quality and quantity targets are demonstrated to be achieved.

The preliminary stormwater management plan is sufficient to support the Zoning By-Law Amendment and Draft Plan of Subdivision applications of the 40 Wilson Avenue Subdivision Development.

Prepared by	Reviewed by
DSB	LICENSED PROFESSIONAL ENGINEER B. C. KEENE Mar. 4/26. PROVINCE OF ONTARIO
Duncan Burgess, BASc Jewell Engineering Inc.	Bryon Keene, P.Eng. Jewell Engineering Inc.

10 References

City of Belleville. (2024). *Development Manual.*

Government of Ontario. (2024*). National Soil Database.*

Ministry of the Environment. (2003). *Stormwater Management Planning and Design Manual.*

MTO. (2008). Highway Drainage Design Standards.

Ontario Ministry of Agriculture and Food. (1974). *Soil Survey of Hastings County.*

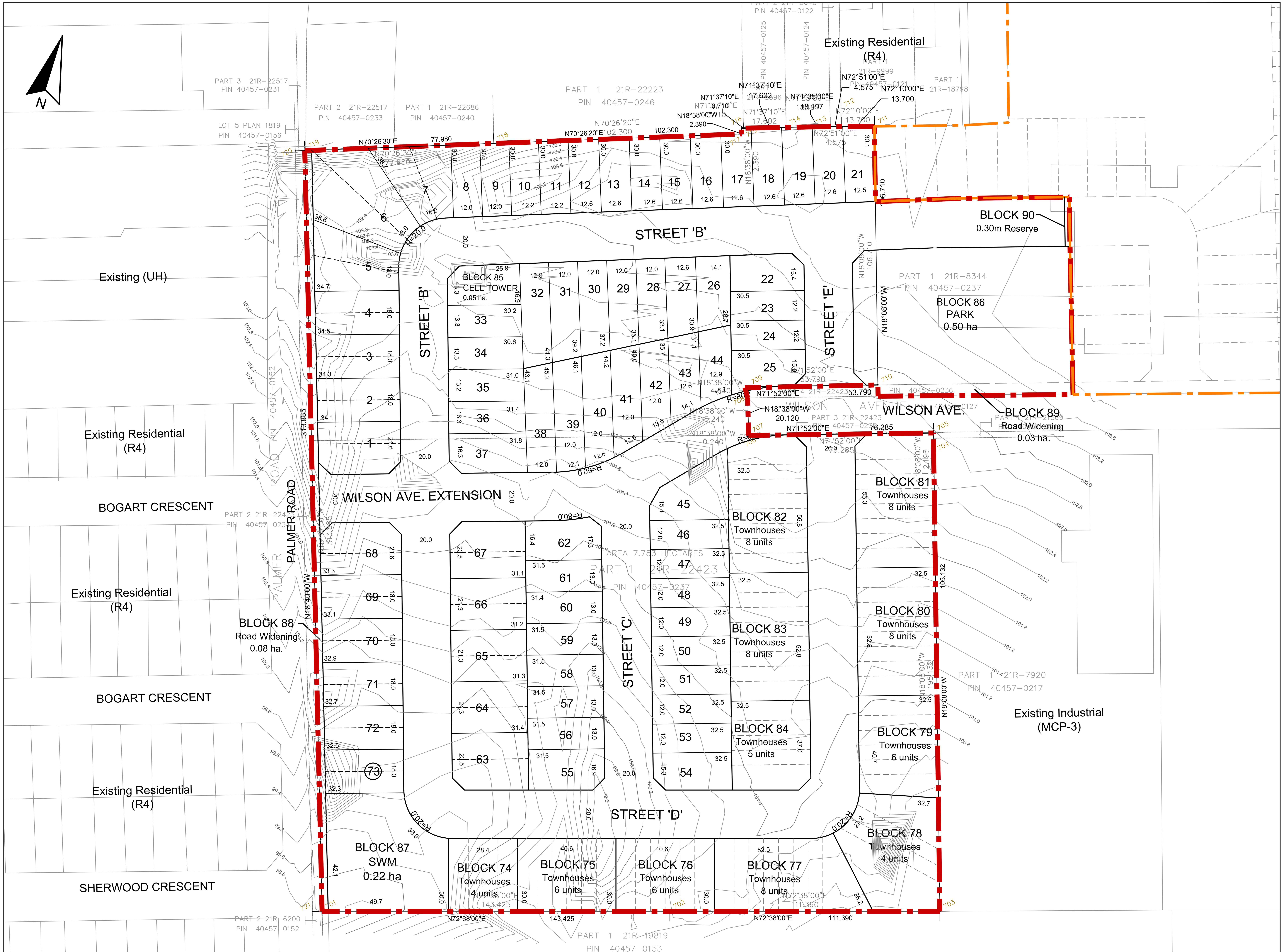
Ontario Ministry of Municipal Affairs and Housing. (2020). *Provincial Policy Statement.*

Quinte Conservation Authority. (2006). *Bay of Quinte Remedial Action Plan Stormwater Management Design Guidelines.*

Toronto and Region Conservation Authority. (2010). *Low Impact Development Stormwater Management Planning and Design Guide, Version 1.0.*

APPENDIX A

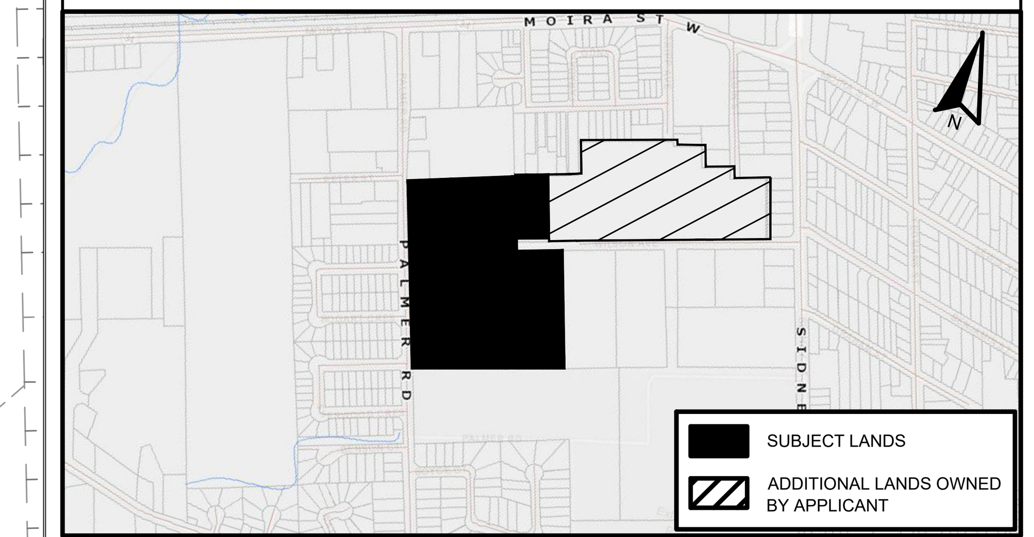
Development Concept Plan



METRIC NOTE:
DISTANCES SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048

KEY MAP

Scale: 1:10,000



DRAFT PLAN OF SUBDIVISION

Part of Lots 15, 16, 17, 26 & 27, Plan 135,
Part of Lots 6 & 7, Plan 1819
In the City of Belleville,
County of Hastings

Scale

0 15 30 45 60 75m

LEGEND

SUBJECT SITE (84,352.47m^2 / 8.43ha)

ADDITIONAL LANDS OWNED BY APPLICANT (46,031.70m^2 / 4.60ha)

OWNER'S CERTIFICATE

I HEREBY AUTHORIZE INNOVATIVE PLANNING SOLUTIONS TO PREPARE THIS DRAFT PLAN OF SUBDIVISION AND SUBMIT THIS DRAFT PLAN OF SUBDIVISION FOR APPROVAL.

DATE

RIC (MIDLAND LAND) INC.

SURVEYOR'S CERTIFICATE

I CERTIFY THAT THE BOUNDARIES OF THE LAND TO BE SUBDIVIDED AND THEIR RELATIONSHIP TO ADJACENT LANDS ARE ACCURATELY AND CORRECTLY SHOWN.

DATE

KEITH WATSON, ONTARIO LAND SURVEYOR
WATSON LAND SURVEYORS LTD.

ADDITIONAL INFORMATION REQUIRED UNDER SECTION 51(17) OF THE PLANNING ACT

A) SEE SURVEYORS CERTIFICATE
B) AS SHOWN ON PLAN
C) AS SHOWN ON KEY PLAN
D) SEE LOTTING SUMMARY
E) AS SHOWN OF PLAN
F) AS SHOWN OF PLAN
G) AS SHOWN ON PLAN
H) FULL MUNICIPAL SERVICE
I) AS SHOWN ON PLAN
J) AS SHOWN ON PLAN
K) FULL MUNICIPAL SERVICES
L) AS SHOWN ON PLAN

LAND USE STATISTICS

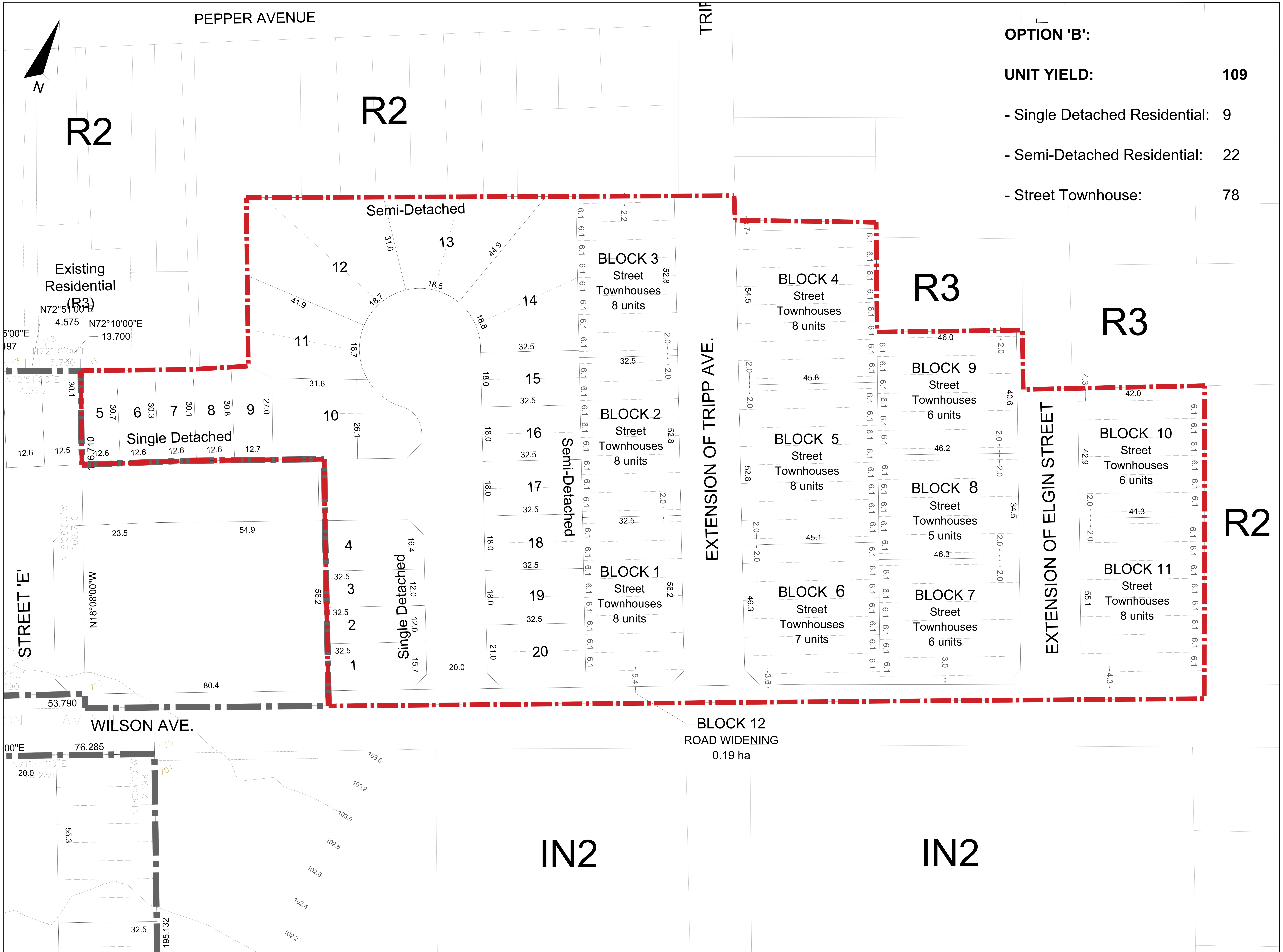
LAND USE	LOT / BLK. NO.	UNITS	AREA (ha)
Single Detached Lots (R4 - 12m / 370.9m^2)	1 - 7, 63 - 73	55	2.33
Semi - Detached Lots (R4 - 18m / 582.8m^2)	8 - 62	36	1.25
Street Townhouse Units (R5 - 6.1m)	74 - 84	71	1.63
Cell Tower	85		0.05
Park	86		0.50
SWM Facilities	87		0.22
Road Widening	88 - 89		0.11
0.3m Reserves	90		0.00
20.0m ROW			2.35
TOTAL		162	8.43

SCHEDULE OF REVISIONS

No.	Date	Description	By
1	June 1, 2022	Updated Legal description and OLS boundary	BH
2	Aug. 11, 2023	Expand site boundary; Revise lotting;	A.S.

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

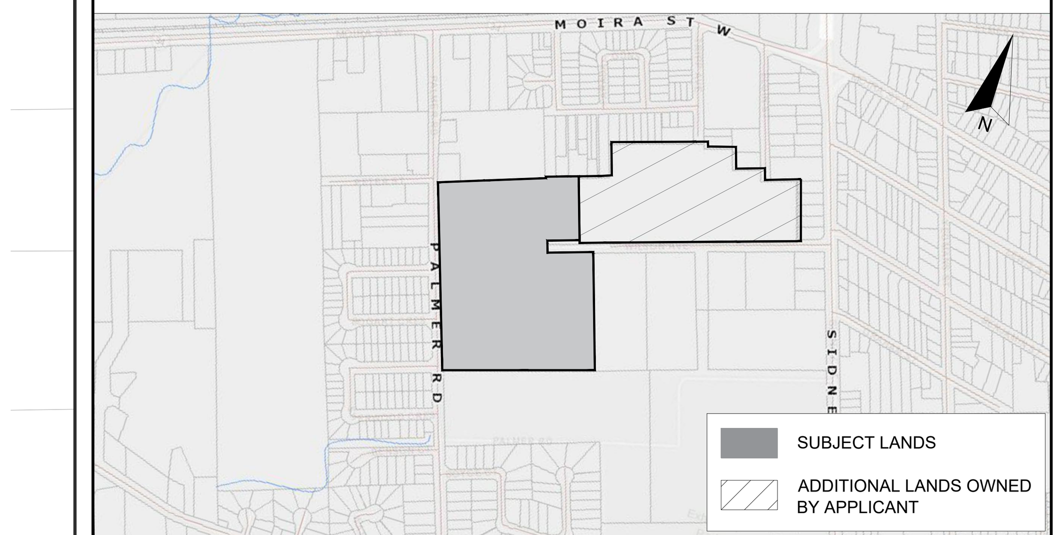
Date:	December 14, 2020	Drawn By:	BH
File:	20-908	Checked:	KT



METRIC NOTE:
DISTANCES SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048

KEY MAP

Scale: 1:10,000



DRAFT PLAN OF SUBDIVISION

Part of Lots 15, 16, 17, 26 & 27, Plan 135,
Part of Lots 6 & 7, Plan 1819
In the City of Belleville,
County of Hastings

Scale
0 15 30 45 60 75m

LEGEND

SUBJECT SITE (46,031.70m2/4.60ha)

OWNER'S CERTIFICATE

I HEREBY AUTHORIZE INNOVATIVE PLANNING SOLUTIONS TO PREPARE THIS DRAFT PLAN OF SUBDIVISION AND SUBMIT THIS DRAFT PLAN OF SUBDIVISION FOR APPROVAL.

DATE

NAME , POSITION
NAME OF FIRM

SURVEYOR'S CERTIFICATE

I CERTIFY THAT THE BOUNDARIES OF THE LAND TO BE SUBDIVIDED AND THEIR RELATIONSHIP TO ADJACENT LANDS ARE ACCURATELY AND CORRECTLY SHOWN.

DATE

KEITH WATSON, ONTARIO LAND SURVEYOR
WATSON LAND SURVEYORS LTD.

ADDITIONAL INFORMATION REQUIRED UNDER SECTION 51(17) OF THE PLANNING ACT

A) SEE SURVEYORS CERTIFICATE
B) AS SHOWN ON PLAN
C) AS SHOWN ON KEY PLAN
D) SEE LOTTING SUMMARY
E) AS SHOWN OF PLAN
F) AS SHOWN OF PLAN
G) AS SHOWN ON PLAN
H) FULL MUNICIPAL SERVICE
I) AS SHOWN ON PLAN
J) AS SHOWN ON PLAN
K) FULL MUNICIPAL SERVICES
L) AS SHOWN ON PLAN

LAND USE STATISTICS 2

LAND USE	LOT / BLK. NO.	UNITS	AREA (ha)
Single Detached Lots	1-9	9	0.37
Semi Detached Units	10-20	22	0.99
Street Townhouse Units	1-11	78	2.15
Road Widening	12		0.19
20.0m ROW			0.90
TOTAL		109	4.60

Street Length (Street B, Extension of Tripp Ave. & Elgin Street) = 444.2m

SCHEDULE OF REVISIONS

No.	Date	Description	By
1	May 25, 2022	Updated Legal description and OLS boundary	BH
2	Aug. 10, 2023	Expand site boundary; Revise lotting;	A.S.
3	Feb. 28, 2025	Update surrounding zoning and Statistic table	A.G.

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

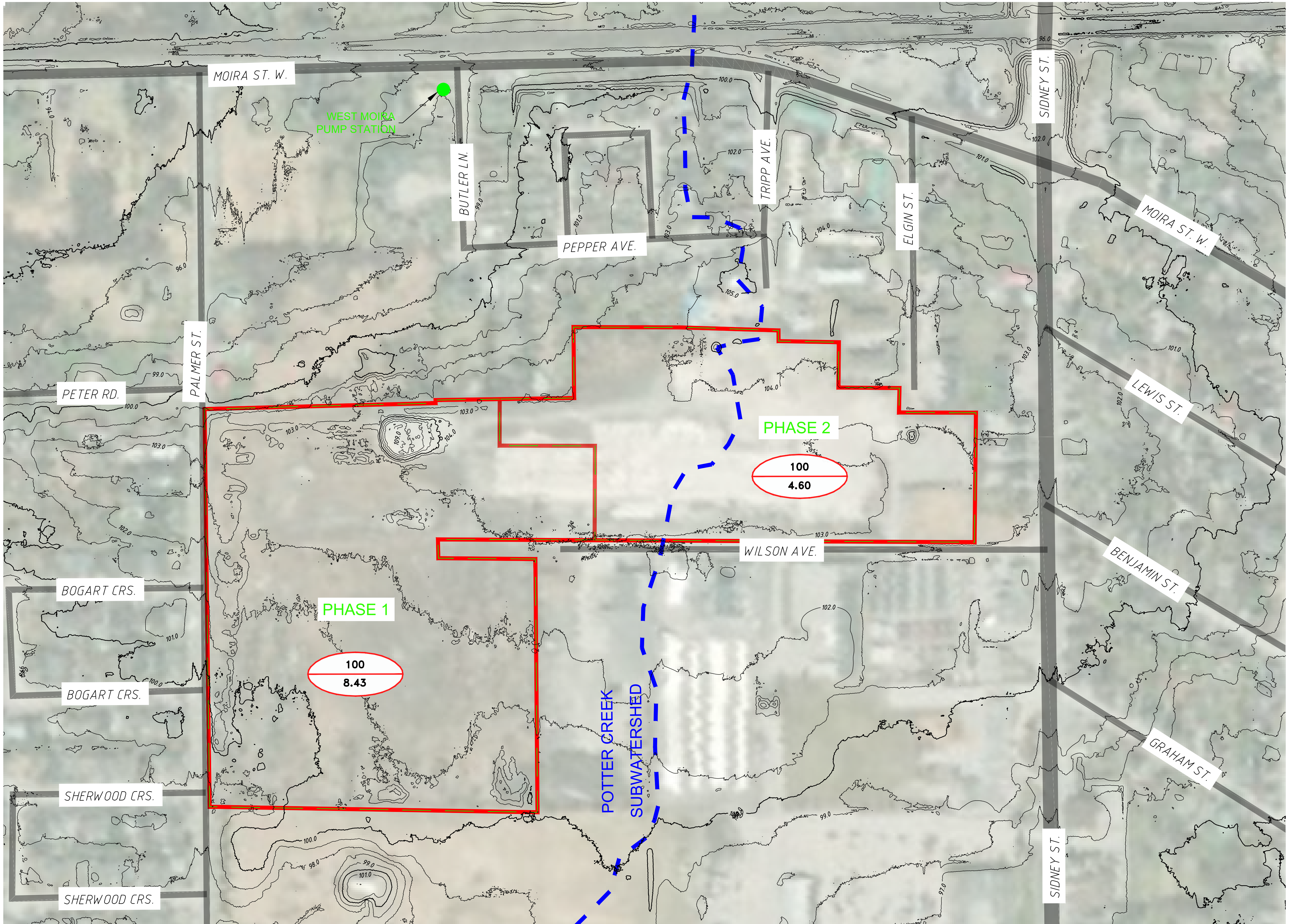
Date:	February 28, 2025	Drawn By:	BH/ A.G.
File:	20 - 908	Checked:	KT

APPENDIX B

Catchment Area Drawing

03/05/2026

F:\FTP\PROJECT FILES\1 CIVIL 3D PROJECT FILES\2505897 - ROMSPEN INV - 40 WILSON AVE\2 MODELS\2505897 - SWD CATCHMENTS



GENERAL NOTES:

- ALL INFORMATION TO BE VERIFIED ON SITE PRIOR TO COMMENCING ANY WORK. ANY DISCREPANCIES ARE TO BE REPORTED TO THE CONSULTANT IMMEDIATELY.
- ALL UTILITY LOCATIONS SHOWN ON THE DRAWINGS ARE APPROXIMATE. THE CONTRACTOR SHALL CONFIRM THE LOCATION ON SITE AND ASSUME ALL LIABILITY FOR DAMAGE TO ALL UTILITIES.
- EXCLUDING THE BENCHMARK AND DESCRIPTION PROVIDED FOR THIS PROJECT, NO OTHER ELEVATIONS ARE TO BE USED AS A REFERENCE ELEVATION FOR ANY PURPOSE.

METRIC NOTE:

- ALL DIMENSIONS SHOWN ARE IN METRES OR MILLIMETRES, UNLESS OTHERWISE NOTED.

GEOMETRIC NOTE:

- ALL SURVEY DATA SHOWN ON THIS DRAWING WAS RECORDED USING REAL-TIME KINETIC (RTK) GPS OBSERVATIONS IN REFERENCE TO UTM 18 NORTH COORDINATE SYSTEM.
- ALL ELEVATIONS ARE IN REFERENCE TO LOCAL DATUM NAD83 - GEODETIC MODEL HT2_0, UNLESS DESCRIBED OTHERWISE.

* * DRAWINGS ARE NOT TO BE SCALED * *

REVISIONS

NO.	DATE	DESCRIPTION	BY

100 CATCHMENTS AREA ID
46.6 DRAINAGE AREA (ha)
STORMWATER CATCHMENT BOUNDARY
MARSH CREEK CATCHMENT BOUNDARY
PROPERTY DEVELOPMENT PHASES

N W E S

JEWELL ENGINEERING

ROMSPEN INVESTMENT
40 WILSON AVE
BELLEVILLE, ONTARIO

STORMWATER SUBCATCHMENTS

DRAWN BY: ASG
PROJECT NO: 2505897
DESIGNED BY: ASG
DATE: March 2026
CHECKED BY: BK
SCALE: HORIZONTAL -1:3000 VERTICAL -NA
APPROVED BY: BK
CONTRACT NO: --- --- ---
DRAWING NO:

APPENDIX C

Environment Canada IDF Curves

Environment and Climate Change Canada
Environnement et Changement climatique Canada

Short Duration Rainfall Intensity-Duration-Frequency Data
Données sur l'intensité, la durée et la fréquence des chutes de pluie de courte durée

Gumbel - Method of moments/Méthode des moments

2022/10/31

===

BELLEVILLE (composite) ON 6150689
Latitude: 44 9'N Longitude: 77 23'W Elevation/Altitude: 76 m

Years/Années : 1960 - 2016 # Years/Années : 44

===

****

Table 1 : Annual Maximum (mm)/Maximum annuel (mm)

****

Year Année	5 min	10 min	15 min	30 min	1 h	2 h	6 h	12 h	24 h
1960	6.3	9.1	12.4	23.4	25.4	35.1	53.8	55.1	55.9
1961	6.1	7.9	8.9	12.2	18.0	18.8	23.9	34.0	36.3
1963	12.4	19.0	23.1	28.4	30.7	31.0	31.0	31.7	44.4
1964	4.3	5.6	7.4	12.2	12.4	20.6	45.2	45.7	45.7
1966	6.3	8.9	10.4	11.9	13.2	16.0	32.8	37.8	38.1
1967	7.4	9.9	10.4	10.4	11.9	13.2	26.4	42.4	58.7
1968	7.9	11.9	13.7	18.5	21.8	27.2	43.9	57.1	57.1
1969	5.8	9.7	13.0	17.5	24.4	31.0	37.8	43.2	62.2
1971	7.4	11.4	13.0	23.9	25.1	25.4	25.7	25.7	32.5
1972	9.4	10.7	11.7	12.4	14.7	20.6	28.2	33.5	50.5
1973	7.4	10.7	11.9	18.0	21.3	21.8	37.3	45.5	48.0
1974	10.9	15.2	17.8	25.4	25.4	25.4	34.3	42.7	42.7
1977	4.8	8.1	9.9	14.7	25.1	30.2	60.5	66.0	66.0
1980	13.2	16.9	19.0	20.5	20.5	34.6	46.9	47.6	59.6
1981	-99.9	-99.9	13.3	25.5	29.4	34.6	46.2	49.2	57.4
1982	4.6	8.5	10.1	14.2	18.3	24.7	39.8	45.0	45.0
1983	6.5	8.9	10.5	18.4	22.2	30.7	39.6	39.6	50.3
1984	5.1	8.1	10.1	11.3	19.7	23.7	33.4	51.4	55.1
1985	10.5	16.2	20.0	27.0	27.4	42.3	42.3	44.5	44.5
1986	9.1	14.4	16.4	23.2	25.2	35.0	59.2	68.8	78.9

1987	4.3	6.6	9.3	14.2	24.7	37.1	39.2	39.2	39.2
1988	3.7	6.2	7.4	8.6	9.2	10.6	20.8	22.2	28.2
1989	14.5	16.7	17.9	18.4	24.2	24.2	27.7	27.7	37.7
1990	6.9	8.3	10.0	12.3	13.6	20.8	29.7	34.8	38.7
1991	8.5	13.8	18.5	18.8	32.0	32.4	32.4	32.4	32.7
1992	6.3	7.6	8.4	13.2	18.8	21.9	38.2	48.3	50.1
1993	8.2	15.8	23.6	28.3	28.3	28.3	-99.9	-99.9	69.6
1994	8.8	10.2	14.5	18.3	23.6	25.5	38.2	49.2	52.8
1995	8.0	12.9	14.9	19.3	27.5	31.5	48.5	58.5	67.3
1996	6.9	10.4	13.4	19.2	25.1	41.3	41.5	53.8	53.8
1997	10.3	16.8	20.9	25.5	42.8	50.0	56.0	56.0	56.0
1998	9.5	12.1	15.1	22.1	25.0	32.6	38.6	38.6	50.2
1999	9.6	13.1	17.9	23.2	29.4	36.9	42.8	72.7	72.7
2000	10.4	13.4	14.7	16.8	29.0	39.8	52.0	52.4	53.0
2001	7.4	10.1	11.0	11.8	16.7	17.4	21.2	31.6	39.8
2002	7.1	9.4	14.0	21.0	22.4	26.0	39.4	44.2	49.8
2003	7.6	13.5	20.1	26.2	27.0	27.0	31.1	-99.9	56.2
2004	14.4	22.1	28.8	33.3	33.3	49.0	89.9	114.4	124.5
2006	9.0	14.7	18.8	19.5	19.5	19.5	37.3	42.7	59.8
2009	6.3	10.7	14.1	20.2	21.7	30.6	36.9	52.3	68.0
2011	12.7	20.3	25.8	31.1	39.7	44.3	49.1	49.1	51.2
2012	6.2	11.3	16.1	26.0	30.0	30.8	44.4	64.6	65.4
2013	7.4	11.6	15.7	19.3	21.5	23.2	29.0	32.8	33.9
2014	7.7	12.0	14.7	16.6	18.1	26.7	34.0	42.4	63.2
2015	5.3	8.5	11.4	17.0	29.0	48.2	56.4	60.6	73.7
2016	7.0	9.8	14.7	22.9	24.4	24.6	32.2	41.6	41.6
# Yrs. Années	45	45	46	46	46	46	45	44	46
Mean Moyenne	8.0	11.8	14.7	19.4	23.7	29.2	39.9	47.0	53.4
Std. Dev. Écart-type	2.6	3.8	4.9	5.9	6.8	9.2	12.5	15.5	16.1
Skew. Dissymétrie	0.80	0.78	0.86	0.26	0.30	0.43	1.54	1.96	1.88
Kurtosis	3.48	3.43	3.72	2.61	3.95	3.11	7.71	10.31	10.23

*-99.9 Indicates Missing Data/Données manquantes

Warning: annual maximum amount greater than 100-yr return period amount
Avertissement : la quantité maximale annuelle excède la quantité pour une période de retour de 100 ans

Year/Année	Duration/Durée	Data/Données	100-yr/ans
2004	6 h	89.9	78.9
2004	12 h	114.4	95.6
2004	24 h	124.5	104.0

****

Table 2a : Return Period Rainfall Amounts (mm)

Quantité de pluie (mm) par période de retour

****

Duration/Durée	2 yr/ans	5 yr/ans	10 yr/ans	25 yr/ans	50 yr/ans	100 yr/ans	#Years Années
5 min	7.6	9.9	11.4	13.3	14.8	16.2	45
10 min	11.1	14.5	16.7	19.5	21.5	23.6	45
15 min	13.9	18.2	21.0	24.6	27.3	29.9	46
30 min	18.4	23.6	27.1	31.4	34.7	37.9	46
1 h	22.6	28.5	32.5	37.5	41.3	45.0	46
2 h	27.7	35.8	41.1	47.9	52.9	57.9	46
6 h	37.8	48.8	56.1	65.3	72.2	78.9	45
12 h	44.5	58.1	67.2	78.6	87.1	95.6	44
24 h	50.8	65.0	74.5	86.4	95.2	104.0	46

****

Table 2b :

Return Period Rainfall Rates (mm/h) - 95% Confidence limits
Intensité de la pluie (mm/h) par période de retour - Limites de confiance de 95%

****

Duration/Durée	2 yr/ans	5 yr/ans	10 yr/ans	25 yr/ans	50 yr/ans	100 yr/ans	#Years Années
5 min	90.7	118.5	136.9	160.1	177.4	194.5	45
	+/- 8.4	+/- 14.2	+/- 19.2	+/- 25.9	+/- 31.0	+/- 36.1	45
10 min	66.8	86.8	100.0	116.7	129.1	141.4	45
	+/- 6.1	+/- 10.2	+/- 13.8	+/- 18.6	+/- 22.2	+/- 25.9	45
15 min	55.5	72.7	84.0	98.4	109.1	119.6	46
	+/- 5.2	+/- 8.7	+/- 11.7	+/- 15.8	+/- 18.9	+/- 22.0	46
30 min	36.9	47.3	54.2	62.9	69.3	75.8	46
	+/- 3.1	+/- 5.3	+/- 7.1	+/- 9.6	+/- 11.5	+/- 13.4	46
1 h	22.6	28.5	32.5	37.5	41.3	45.0	46
	+/- 1.8	+/- 3.0	+/- 4.1	+/- 5.5	+/- 6.6	+/- 7.7	46
2 h	13.8	17.9	20.6	24.0	26.5	29.0	46
	+/- 1.2	+/- 2.0	+/- 2.8	+/- 3.7	+/- 4.5	+/- 5.2	46
6 h	6.3	8.1	9.4	10.9	12.0	13.2	45
	+/- 0.6	+/- 0.9	+/- 1.3	+/- 1.7	+/- 2.0	+/- 2.4	45
12 h	3.7	4.8	5.6	6.6	7.3	8.0	44
	+/- 0.3	+/- 0.6	+/- 0.8	+/- 1.1	+/- 1.3	+/- 1.5	44
24 h	2.1	2.7	3.1	3.6	4.0	4.3	46
	+/- 0.2	+/- 0.3	+/- 0.4	+/- 0.5	+/- 0.7	+/- 0.8	46

****

Table 3 : Interpolation Equation / Équation d'interpolation: R = A*T^B

R = Interpolated Rainfall rate (mm/h)/Intensité interpolée de la pluie (mm/h)

RR = Rainfall rate (mm/h) / Intensité de la pluie (mm/h)
T = Rainfall duration (h) / Durée de la pluie (h)

****

Statistics/Statistiques	2 yr/ans	5 yr/ans	10 yr/ans	25 yr/ans	50 yr/ans	100 yr/ans
Mean of RR/Moyenne de RR	33.1	43.0	49.6	57.9	64.0	70.1
Std. Dev. /Écart-type (RR)	31.6	41.3	47.7	55.8	61.9	67.8
Std. Error/Erreur-type	7.6	9.6	10.9	12.6	13.9	15.1
Coefficient (A)	20.5	26.5	30.5	35.5	39.3	43.0
Exponent/Exposant (B)	-0.676	-0.677	-0.678	-0.679	-0.679	-0.679
Mean % Error/% erreur moyenne	8.5	8.1	8.0	7.8	7.7	7.7

APPENDIX D

OTTHYMO Model

OTTHYMO Model Inputs (Pre-Development)

Project: 40 Wilson Avenue Subdivision

Designer: Duncan Burgess, BASc

Date: January 28, 2026

Catchment Area Land Use		
Catchment 100 (Phase 1)		
A Total (*HSG D)=	8.43	ha
A Improved (Flat, Clay)=	7.4	ha
A Roof/Pavement =	0.46	ha
A Gravel =	0.57	ha
Catchment 101 (Phase 2)		
A Total (*HSG D)=	4.60	ha
A Lawn/Grassed	1.18	ha
A Roof/Pavement =	3.14	ha
A Gravel=	0.28	ha

Composite Curve Number		
$CN = \frac{\sum HSG\ Land\ Use\ CN * Area}{A_{total}}$		
Impervious	CN=	98
Improved (HSG D)	CN=	86
Catchment 100	CN=	86.7
Catchment 101	CN=	94.2

Composite Runoff Coefficient (Catchment 100)		
$C = \frac{\sum HSG\ Land\ Use\ C * Area}{A_{total}}$		
Roof / Pavement	C=	0.95
Gravel	C=	0.6
Cultivated (Flat, Clays)	C=	0.55
Composite Runoff Coefficient (5Yr) =		0.58
Composite Runoff Coefficient (100Yr) =		0.59

Composite Imperviousness (Catchment 101)	
$C = \frac{\sum Land\ Use\ Imperviousness * Area}{A_{total}}$	
Paved Imperviousness =	1
Gravel Imperviousness =	0.5
Grassed Imperviousness =	0
Composite Imperviousness =	0.71

85/10 Slope Method (Catchment 100)		
$S_w = \frac{E_{85} - E_{10}}{0.75L}(100)$		
Watershed Length (m)	L =	365
10% Elevation (m)	E_{10} =	99.50
85% Elevation (m)	E_{85} =	102.75
Watershed slope (%)	S_w =	1.2

Airport Method (Catchment 100)	
Time of Concentration (min)	
Time of Concentration (5yr) =	30.9
Time of Concentration (100yr) =	30.2
Time to Peak (hr)	
T_p= (2/3)T_c / 60	
Time to peak (5yr) =	0.34
Time to peak (100yr) =	0.34

```
================================================================================

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    I N T E R H Y M O
       O   O    T      T    H   H   Y Y   MM MM  O   O   * * * 1989a * * *
       O   O    T      T    HHHHH    Y    M M M  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO              01636

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  Input   filename: 40WSWMPR.DAT
  Output  filename: 40WSWMPR.OUT
  Summary filename: 40WSWMPR.SUM




DATE: 02-25-2026                      TIME: 14:07:16


COMMENTS: ____________________________________________________________


--------------------------------------------------------------------------------
*
  ****************************
  ** SIMULATION NUMBER:   1 **
  ****************************

*
*                   40 Wilson Ave Subdivision, College St. E. Belleville
*                   Romspen Investments
*
*                   Using the 1960-2016 Belleville IDF V3.3
*                   Station 6150689 from Environment Canada
*
*                   Original Model Prepared January 28th, 2026
*                   Date of Last Revision February 25th, 2026

*                   Duncan Burgess, BASc
*
*                   Constrain all discharge to 498.5 L/s
*                   City allottment to site for Palmer Rd storm sewer
*
*                   Calculation of pre and post dev. peak flows (5, 100 yr)
*                   Check sizing and quantity control of reservoirs
*                   *Note that Phase 2 pre-dev imp. > post - conveyance only

*                   Check 90% event control - for quality drawdown
```

```
*
*                   Use 6-hr Chicago: Align with WSP SWM Report 100-yr storm
*
*                   Pond Sizing + SSD completed using Excel spreadsheet
*
*                   Common assumptions

*                   LGI, LGP set as 100 m (Typ. distance between catchbasins)
*                   Assume 2% slope pervious, 1% impervious (typ. grading)
*                   Assume lands HSG D (conservative - small areas of HSG C)

*
*                   Assume 50% post-dev imperviousness (typ. low-density)
*
*****************************************************************************
*                   5-Yr Pre-Development Peak Flows
*****************************************************************************
--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 687.413
| Ptotal= 48.21 mm |                          B=   5.274
--------------------                          C=    .754
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  =  6.00 hrs
                        Storm time step    =  5.00 min
                        Time to peak ratio =   .33

                    The CORRELATION coefficient is =  .9998

                     TIME       INPUT INT.          TAB. INT.
                    (min)        (mm/hr)             (mm/hr)
                       5.        118.50              118.68
                      10.         86.80               88.01
                      15.         72.70               71.09
                      30.         47.30               46.82
                      60.         28.50               29.44
                     120.         17.90               18.01
                     360.          8.10                8.04


                 TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                  .08    2.15 |  1.58    7.68 |  3.08    5.89 |  4.58    2.91
                  .17    2.22 |  1.67    9.42 |  3.17    5.54 |  4.67    2.83
                  .25    2.31 |  1.75   12.37 |  3.25    5.23 |  4.75    2.77
                  .33    2.40 |  1.83   18.58 |  3.33    4.96 |  4.83    2.70
                  .42    2.50 |  1.92   40.69 |  3.42    4.72 |  4.92    2.64
                  .50    2.61 |  2.00  118.68 |  3.50    4.50 |  5.00    2.58
                  .58    2.73 |  2.08   51.73 |  3.58    4.31 |  5.08    2.53
                  .67    2.87 |  2.17   29.71 |  3.67    4.13 |  5.17    2.47
```

```
                    .75    3.02 |  2.25   20.93 |  3.75    3.97 |  5.25    2.42
                    .83    3.20 |  2.33   16.26 |  3.83    3.83 |  5.33    2.38
                    .92    3.39 |  2.42   13.37 |  3.92    3.69 |  5.42    2.33
                   1.00    3.63 |  2.50   11.40 |  4.00    3.57 |  5.50    2.29
                   1.08    3.90 |  2.58    9.97 |  4.08    3.45 |  5.58    2.24
                   1.17    4.22 |  2.67    8.89 |  4.17    3.35 |  5.67    2.20
                   1.25    4.61 |  2.75    8.03 |  4.25    3.25 |  5.75    2.17
                   1.33    5.09 |  2.83    7.35 |  4.33    3.15 |  5.83    2.13
                   1.42    5.71 |  2.92    6.78 |  4.42    3.07 |  5.92    2.09
                   1.50    6.53 |  3.00    6.30 |  4.50    2.98 |  6.00    2.06


--------------------------------------------------------------------------------
*                    Catchment 100 (Phase 1)
--------------------
| CALIB              |
| NASHYD    (0001) |   Area    (ha)=   8.43   Curve Number   (CN)= 86.7
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .34

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.

     Unit Hyd Qpeak  (cms)=    .95

     PEAK FLOW       (cms)=    .37 (i)
     TIME TO PEAK    (hrs)=   2.42
     RUNOFF VOLUME    (mm)=  22.58
     TOTAL RAINFALL   (mm)=  48.21
     RUNOFF COEFFICIENT   =    .47

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=   8.43
| ID= 1   PCYC= 86 |   QPEAK     (cms)=    .37 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   2.42
--------------------   VOLUME     (mm)=  22.58
  Filename: 5YRP1PRE.HYD
  Comments:

     (i)  PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
*                    Catchment 101 (Phase 2)
--------------------
| CALIB              |
| STANDHYD  (0001) |   Area    (ha)=   4.60
|ID= 2 DT= 5.0 min |   Total Imp(%)=  71.00   Dir. Conn.(%)=  61.00
--------------------
```

```
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       3.27         1.33
     Dep. Storage     (mm)=       2.00         5.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     100.00       100.00
     Mannings n           =       .013         .250

     Max.eff.Inten.(mm/hr)=      85.20        92.90
                over (min)       10.00        10.00
     Storage Coeff.  (min)=       2.72 (ii)   12.41 (ii)
     Unit Hyd. Tpeak (min)=       5.00        15.00
     Unit Hyd. peak  (cms)=        .29          .08
                                                           *TOTALS*
     PEAK FLOW       (cms)=        .82          .19            .90 (iii)
     TIME TO PEAK    (hrs)=       2.08         2.25           2.08
     RUNOFF VOLUME    (mm)=      46.04        35.11          41.76
     TOTAL RAINFALL   (mm)=      48.21        48.21          48.21
     RUNOFF COEFFICIENT   =        .95          .73            .87

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR RAINFALL LOSSES:
            CN*  =  94.2    Ia = Dep. Storage  (Above)
      (ii) COMPUTATIONAL TIME STEP SHOULD BE SMALL OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=   4.60
| ID= 2   PCYC= 80 |   QPEAK     (cms)=    .90 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   2.08
--------------------   VOLUME     (mm)=  41.76
  Filename: 5YRP2PRE.HYD
  Comments:

     (i)  PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------


--------------------
| ADD HYD   (0001) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0001):     8.43      .37     2.42    22.58
        + ID2= 2 (0001):     4.60      .90     2.08    41.76
          ===============================================
          ID = 3 (0001):    13.03     1.07     2.08    29.35

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
```

```
--------------------------------------------------------------------------------
*                    5-yr pre-development peak flow total-P1+P2
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  13.03
| ID= 3   PCYC= 86 |   QPEAK     (cms)=   1.07 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   2.08
--------------------   VOLUME     (mm)=  29.35
  Filename: 5YRPREDT.HYD
  Comments:

     (i)  PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
******************************************************************************
*                    100-Yr Pre-Development Peak Flows
******************************************************************************
--------------------
| CHICAGO STORM    |    IDF curve parameters: A=1050.238
| Ptotal= 78.25 mm |                          B=   4.562
--------------------                          C=    .744
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  =  6.00 hrs
                        Storm time step    =  5.00 min
                        Time to peak ratio =   .33

                    The CORRELATION coefficient is =  .9996

                     TIME       INPUT INT.          TAB. INT.
                    (min)        (mm/hr)             (mm/hr)
                       5.         194.50              195.78
                      10.         141.40              143.17
                      15.         119.60              114.94
                      30.          75.80               75.26
                      60.          45.00               47.28
                     120.          29.00               28.99
                     360.          13.20               13.04


                 TIME     RAIN |  TIME     RAIN |  TIME     RAIN |  TIME     RAIN
                  hrs    mm/hr |   hrs    mm/hr |   hrs    mm/hr |   hrs    mm/hr
                  .08     3.59 |  1.58    12.46 |  3.08     9.63 |  4.58     4.84
                  .17     3.72 |  1.67    15.19 |  3.17     9.07 |  4.67     4.72
                  .25     3.86 |  1.75    19.79 |  3.25     8.58 |  4.75     4.61
                  .33     4.01 |  1.83    29.41 |  3.33     8.15 |  4.83     4.50
                  .42     4.17 |  1.92    64.10 |  3.42     7.76 |  4.92     4.40
                  .50     4.35 |  2.00   195.78 |  3.50     7.42 |  5.00     4.31
                  .58     4.55 |  2.08    81.58 |  3.58     7.11 |  5.08     4.22
                  .67     4.77 |  2.17    46.69 |  3.67     6.82 |  5.17     4.13
```

```
                    .75    5.02 |  2.25   33.06 |  3.75    6.56 |  5.25    4.05
                    .83    5.31 |  2.33   25.83 |  3.83    6.33 |  5.33    3.97
                    .92    5.63 |  2.42   21.34 |  3.92    6.11 |  5.42    3.90
                   1.00    6.00 |  2.50   18.28 |  4.00    5.91 |  5.50    3.83
                   1.08    6.44 |  2.58   16.05 |  4.08    5.72 |  5.58    3.76
                   1.17    6.96 |  2.67   14.36 |  4.17    5.55 |  5.67    3.69
                   1.25    7.58 |  2.75   13.02 |  4.25    5.39 |  5.75    3.63
                   1.33    8.36 |  2.83   11.93 |  4.33    5.24 |  5.83    3.57
                   1.42    9.34 |  2.92   11.04 |  4.42    5.10 |  5.92    3.51
                   1.50   10.65 |  3.00   10.28 |  4.50    4.96 |  6.00    3.45

-------------------------------------------------------------------------------
*                   Catchment 100 (Phase 1)
--------------------
| CALIB             |
| NASHYD    (0001) |   Area    (ha)=   8.43   Curve Number   (CN)= 86.7
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .34

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.

     Unit Hyd Qpeak  (cms)=    .95

     PEAK FLOW       (cms)=    .82 (i)
     TIME TO PEAK    (hrs)=   2.33
     RUNOFF VOLUME    (mm)=  47.54
     TOTAL RAINFALL   (mm)=  78.25
     RUNOFF COEFFICIENT   =    .61

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=   8.43
| ID= 1   PCYC= 87 |   QPEAK     (cms)=    .82 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   2.33
--------------------   VOLUME     (mm)=  47.54
  Filename: 100P1PRE.HYD
  Comments:

     (i)  PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
*                   Catchment 101 (Phase 2)
--------------------
| CALIB             |
| STANDHYD  (0001) |   Area    (ha)=   4.60
|ID= 2 DT= 5.0 min |   Total Imp(%)=  71.00   Dir. Conn.(%)=  61.00
--------------------
```

```
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       3.27         1.33
     Dep. Storage     (mm)=       2.00         5.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     100.00       100.00
     Mannings n          =       .013         .250

     Max.eff.Inten.(mm/hr)=     138.68       169.21
                over (min)       10.00        10.00
     Storage Coeff.  (min)=       2.24 (ii)   10.21 (ii)
     Unit Hyd. Tpeak (min)=       5.00        15.00
     Unit Hyd. peak  (cms)=        .30          .09
                                                           *TOTALS*
     PEAK FLOW       (cms)=       1.41          .40           1.59 (iii)
     TIME TO PEAK    (hrs)=       2.08         2.25           2.08
     RUNOFF VOLUME    (mm)=      75.96        64.19          71.36
     TOTAL RAINFALL   (mm)=      78.25        78.25          78.25
     RUNOFF COEFFICIENT   =        .97          .82            .91

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR RAINFALL LOSSES:
            CN*  =  94.2    Ia = Dep. Storage  (Above)
      (ii) COMPUTATIONAL TIME STEP SHOULD BE SMALL OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA      (ha)=   4.60
| ID= 2   PCYC= 80 |   QPEAK     (cms)=   1.59 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   2.08
--------------------   VOLUME     (mm)=  71.36
  Filename: 100P2PRE.HYD
  Comments:

     (i)  PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------


--------------------
| ADD HYD   (0001) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0001):     8.43      .82     2.33    47.54
        + ID2= 2 (0001):     4.60     1.59     2.08    71.36
          ==================================================
          ID = 3 (0001):    13.03     2.03     2.08    55.95

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
```

```
--------------------------------------------------------------------------------
*                    100-yr pre-development peak flow total-P1+P2
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  13.03
| ID= 3   PCYC= 87 |   QPEAK     (cms)=   2.03 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   2.08
--------------------   VOLUME     (mm)=  55.95
  Filename: 100PREDT.HYD
  Comments:

     (i)  PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
*******************************************************************************
*                    5-Yr Post-Development Peak Flows
*******************************************************************************
--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 687.413
| Ptotal= 48.21 mm |                          B=   5.274
--------------------                          C=    .754
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  =  6.00 hrs
                        Storm time step    =  5.00 min
                        Time to peak ratio =   .33

                    The CORRELATION coefficient is =  .9998

                     TIME       INPUT INT.          TAB. INT.
                    (min)        (mm/hr)             (mm/hr)
                       5.         118.50              118.68
                      10.          86.80               88.01
                      15.          72.70               71.09
                      30.          47.30               46.82
                      60.          28.50               29.44
                     120.          17.90               18.01
                     360.           8.10                8.04


                 TIME     RAIN |  TIME     RAIN |  TIME     RAIN |  TIME     RAIN
                  hrs    mm/hr |   hrs    mm/hr |   hrs    mm/hr |   hrs    mm/hr
                  .08     2.15 |  1.58     7.68 |  3.08     5.89 |  4.58     2.91
                  .17     2.22 |  1.67     9.42 |  3.17     5.54 |  4.67     2.83
                  .25     2.31 |  1.75    12.37 |  3.25     5.23 |  4.75     2.77
                  .33     2.40 |  1.83    18.58 |  3.33     4.96 |  4.83     2.70
                  .42     2.50 |  1.92    40.69 |  3.42     4.72 |  4.92     2.64
                  .50     2.61 |  2.00   118.68 |  3.50     4.50 |  5.00     2.58
                  .58     2.73 |  2.08    51.73 |  3.58     4.31 |  5.08     2.53
                  .67     2.87 |  2.17    29.71 |  3.67     4.13 |  5.17     2.47
```

```
                   .75     3.02 |  2.25   20.93 |  3.75    3.97 |  5.25    2.42
                   .83     3.20 |  2.33   16.26 |  3.83    3.83 |  5.33    2.38
                   .92     3.39 |  2.42   13.37 |  3.92    3.69 |  5.42    2.33
                  1.00     3.63 |  2.50   11.40 |  4.00    3.57 |  5.50    2.29
                  1.08     3.90 |  2.58    9.97 |  4.08    3.45 |  5.58    2.24
                  1.17     4.22 |  2.67    8.89 |  4.17    3.35 |  5.67    2.20
                  1.25     4.61 |  2.75    8.03 |  4.25    3.25 |  5.75    2.17
                  1.33     5.09 |  2.83    7.35 |  4.33    3.15 |  5.83    2.13
                  1.42     5.71 |  2.92    6.78 |  4.42    3.07 |  5.92    2.09
                  1.50     6.53 |  3.00    6.30 |  4.50    2.98 |  6.00    2.06


--------------------------------------------------------------------------------
*                   Catchment 200 (Post-dev Phase 1)
--------------------
| CALIB              |
| STANDHYD  (0001) |   Area    (ha)=   8.43
|ID= 1 DT= 5.0 min |   Total Imp(%)=  50.00   Dir. Conn.(%)=  40.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       4.22          4.21
     Dep. Storage     (mm)=       2.00          5.00
     Average Slope     (%)=       1.00          2.00
     Length            (m)=     100.00        100.00
     Mannings n           =       .013          .250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.

                              IMPERVIOUS    PERVIOUS (i)
     Max.eff.Inten.(mm/hr)=      85.20         36.43
                over (min)       10.00         20.00
     Storage Coeff.  (min)=       2.72 (ii)    21.04 (ii)
     Unit Hyd. Tpeak (min)=       5.00         25.00
     Unit Hyd. peak  (cms)=        .29           .05
                                                               *TOTALS*
     PEAK FLOW       (cms)=        .99           .24              1.04 (iii)
     TIME TO PEAK    (hrs)=       2.08          2.50              2.08
     RUNOFF VOLUME    (mm)=      46.04         24.57             33.15
     TOTAL RAINFALL   (mm)=      48.21         48.21             48.21
     RUNOFF COEFFICIENT   =        .95           .51               .69

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR RAINFALL LOSSES:
            CN*  =  86.0    Ia = Dep. Storage  (Above)
      (ii) COMPUTATIONAL TIME STEP SHOULD BE SMALL OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
```

```
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=   8.43
| ID= 1   PCYC= 89 |   QPEAK     (cms)=   1.04 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   2.08
--------------------   VOLUME     (mm)=  33.15
  Filename: 5YRP1PST.HYD
  Comments:

     (i)  PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
*                   Catchment 201 (Post-dev Phase 2)
--------------------
| CALIB            |
| STANDHYD  (0001) |   Area    (ha)=   4.60
|ID= 2 DT= 5.0 min |   Total Imp(%)=  50.00   Dir. Conn.(%)=  40.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       2.30         2.30
     Dep. Storage     (mm)=       2.00         5.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     100.00       100.00
     Mannings n          =        .013         .250

     Max.eff.Inten.(mm/hr)=      85.20        36.43
                over (min)      10.00        20.00
     Storage Coeff.  (min)=       2.72 (ii)   21.04 (ii)
     Unit Hyd. Tpeak (min)=       5.00        25.00
     Unit Hyd. peak  (cms)=        .29          .05
                                                             *TOTALS*
     PEAK FLOW       (cms)=        .54          .13              .56 (iii)
     TIME TO PEAK    (hrs)=       2.08         2.50             2.08
     RUNOFF VOLUME    (mm)=      46.04        24.57            33.13
     TOTAL RAINFALL   (mm)=      48.21        48.21            48.21
     RUNOFF COEFFICIENT   =        .95          .51              .69

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR RAINFALL LOSSES:
            CN*  =  86.0    Ia = Dep. Storage  (Above)
      (ii) COMPUTATIONAL TIME STEP SHOULD BE SMALL OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=   4.60
| ID= 2   PCYC= 86 |   QPEAK     (cms)=    .56 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   2.08
--------------------   VOLUME     (mm)=  33.13
```

```
  Filename: 5YRP2PST.HYD
  Comments:

     (i)  PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------

--------------------
| ADD HYD   (0001) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0001):     8.43     1.04     2.08    33.15
        + ID2= 2 (0001):     4.60      .56     2.08    33.13
          ==================================================
          ID = 3 (0001):    13.03     1.60     2.08    33.14

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
*                   5-yr post-development peak flow total-P1+P2
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  13.03
| ID= 3   PCYC= 89 |   QPEAK     (cms)=   1.60 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   2.08
--------------------   VOLUME     (mm)=  33.14
  Filename: 5YRPSTDT.HYD
  Comments:

     (i)  PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
*****************************************************************************
*                   100-Yr Post-Development Peak Flows
*****************************************************************************
--------------------
| CHICAGO STORM    |    IDF curve parameters: A=1050.238
| Ptotal= 78.25 mm |                          B=   4.562
--------------------                          C=    .744
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  =  6.00 hrs
                        Storm time step    =  5.00 min
                        Time to peak ratio =   .33

                    The CORRELATION coefficient is =  .9996

                     TIME       INPUT INT.          TAB. INT.
                    (min)        (mm/hr)             (mm/hr)
                      5.          194.50              195.78
                     10.          141.40              143.17
```

```
                    15.         119.60             114.94
                    30.          75.80              75.26
                    60.          45.00              47.28
                   120.          29.00              28.99
                   360.          13.20              13.04

              TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
               hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
               .08    3.59 |  1.58   12.46 |  3.08    9.63 |  4.58    4.84
               .17    3.72 |  1.67   15.19 |  3.17    9.07 |  4.67    4.72
               .25    3.86 |  1.75   19.79 |  3.25    8.58 |  4.75    4.61
               .33    4.01 |  1.83   29.41 |  3.33    8.15 |  4.83    4.50
               .42    4.17 |  1.92   64.10 |  3.42    7.76 |  4.92    4.40
               .50    4.35 |  2.00  195.78 |  3.50    7.42 |  5.00    4.31
               .58    4.55 |  2.08   81.58 |  3.58    7.11 |  5.08    4.22
               .67    4.77 |  2.17   46.69 |  3.67    6.82 |  5.17    4.13
               .75    5.02 |  2.25   33.06 |  3.75    6.56 |  5.25    4.05
               .83    5.31 |  2.33   25.83 |  3.83    6.33 |  5.33    3.97
               .92    5.63 |  2.42   21.34 |  3.92    6.11 |  5.42    3.90
              1.00    6.00 |  2.50   18.28 |  4.00    5.91 |  5.50    3.83
              1.08    6.44 |  2.58   16.05 |  4.08    5.72 |  5.58    3.76
              1.17    6.96 |  2.67   14.36 |  4.17    5.55 |  5.67    3.69
              1.25    7.58 |  2.75   13.02 |  4.25    5.39 |  5.75    3.63
              1.33    8.36 |  2.83   11.93 |  4.33    5.24 |  5.83    3.57
              1.42    9.34 |  2.92   11.04 |  4.42    5.10 |  5.92    3.51
              1.50   10.65 |  3.00   10.28 |  4.50    4.96 |  6.00    3.45

--------------------------------------------------------------------------------
*                   Catchment 200 (Post-dev Phase 1)
--------------------
| CALIB              |
| STANDHYD  (0001) |   Area    (ha)=   8.43
|ID= 1 DT= 5.0 min |   Total Imp(%)=  50.00   Dir. Conn.(%)=  40.00
--------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       4.22          4.21
     Dep. Storage     (mm)=       2.00          5.00
     Average Slope     (%)=       1.00          2.00
     Length            (m)=     100.00        100.00
     Mannings n          =        .013          .250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.

                               IMPERVIOUS    PERVIOUS (i)
     Max.eff.Inten.(mm/hr)=     138.68         90.59
                over (min)      10.00         15.00
     Storage Coeff.  (min)=       2.24 (ii)   14.96 (ii)
     Unit Hyd. Tpeak (min)=       5.00         15.00
```

```
     Unit Hyd. peak  (cms)=        .30          .08
                                                          *TOTALS*
     PEAK FLOW       (cms)=       1.70          .66          1.96 (iii)
     TIME TO PEAK    (hrs)=       2.08         2.25          2.08
     RUNOFF VOLUME    (mm)=      75.96        50.30         60.55
     TOTAL RAINFALL   (mm)=      78.25        78.25         78.25
     RUNOFF COEFFICIENT   =        .97          .64           .77

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR RAINFALL LOSSES:
            CN*  =  86.0    Ia = Dep. Storage  (Above)
      (ii) COMPUTATIONAL TIME STEP SHOULD BE SMALL OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=   8.43
| ID= 1   PCYC= 85 |   QPEAK     (cms)=   1.96 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   2.08
--------------------   VOLUME     (mm)=  60.55
  Filename: 100P1PST.HYD
  Comments:

     (i)  PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
*                    Catchment 201 (Post-dev Phase 2)
--------------------
| CALIB            |
| STANDHYD  (0001) |   Area    (ha)=   4.60
|ID= 2 DT= 5.0 min |   Total Imp(%)=  50.00   Dir. Conn.(%)=  40.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       2.30         2.30
     Dep. Storage     (mm)=       2.00         5.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     100.00       100.00
     Mannings n           =       .013         .250

     Max.eff.Inten.(mm/hr)=     138.68        90.59
                over (min)       10.00        15.00
     Storage Coeff.  (min)=       2.24 (ii)   14.96 (ii)
     Unit Hyd. Tpeak (min)=       5.00        15.00
     Unit Hyd. peak  (cms)=        .30          .08
                                                          *TOTALS*
     PEAK FLOW       (cms)=        .93          .36          1.07 (iii)
     TIME TO PEAK    (hrs)=       2.08         2.25          2.08
     RUNOFF VOLUME    (mm)=      75.96        50.30         60.54
```

```
     TOTAL RAINFALL   (mm)=      78.25        78.25          78.25
     RUNOFF COEFFICIENT   =        .97          .64            .77

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR RAINFALL LOSSES:
            CN*  =  86.0    Ia = Dep. Storage  (Above)
      (ii) COMPUTATIONAL TIME STEP SHOULD BE SMALL OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=   4.60
| ID= 2   PCYC= 83 |   QPEAK     (cms)=   1.07 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   2.08
--------------------   VOLUME     (mm)=  60.54
  Filename: 100P2PST.HYD
  Comments:

     (i)  PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------


--------------------
| ADD HYD   (0001) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0001):     8.43     1.96     2.08    60.55
        + ID2= 2 (0001):     4.60     1.07     2.08    60.54
          ==================================================
          ID = 3 (0001):    13.03     3.03     2.08    60.55

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
*                   100-yr post-development peak flow total-P1+P2
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  13.03
| ID= 3   PCYC= 85 |   QPEAK     (cms)=   3.03 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   2.08
--------------------   VOLUME     (mm)=  60.55
  Filename: 100PSTDT.HYD
  Comments:

     (i)  PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
******************************************************************************
*                  90% (27mm 4-hr Chicago) Event
```

```
*****************************************************************************

 --------------------
 |    READ STORM    |     Filename: 27Chcago.stm
 | Ptotal= 27.00 mm |     Comments: 4 Hr Chicago 27mm
 --------------------
                  TIME     RAIN |  TIME     RAIN |  TIME     RAIN |  TIME     RAIN
                   hrs    mm/hr |   hrs    mm/hr |   hrs    mm/hr |   hrs    mm/hr
                   .08     1.87 |  1.08     7.67 |  2.08     4.98 |  3.08     2.46
                   .17     1.98 |  1.17    11.55 |  2.17     4.55 |  3.17     2.37
                   .25     2.10 |  1.25    25.39 |  2.25     4.19 |  3.25     2.29
                   .33     2.24 |  1.33    74.37 |  2.33     3.90 |  3.33     2.20
                   .42     2.41 |  1.42    32.29 |  2.42     3.65 |  3.42     2.13
                   .50     2.60 |  1.50    18.50 |  2.50     3.43 |  3.50     2.06
                   .58     2.85 |  1.58    13.01 |  2.58     3.24 |  3.58     2.01
                   .67     3.15 |  1.67    10.10 |  2.67     3.07 |  3.67     1.94
                   .75     3.54 |  1.75     8.29 |  2.75     2.92 |  3.75     1.89
                   .83     4.04 |  1.83     7.07 |  2.83     2.79 |  3.83     1.84
                   .92     4.76 |  1.92     6.19 |  2.92     2.67 |  3.92     1.79
                  1.00     5.84 |  2.00     5.51 |  3.00     2.56 |  4.00     1.75

-------------------------------------------------------------------------------

*                   Catchment 200 (Post-dev Phase 1)
 --------------------
 | CALIB            |
 | STANDHYD  (0001) |    Area    (ha)=   8.43
 |ID= 1 DT= 5.0 min |    Total Imp(%)=  50.00   Dir. Conn.(%)=  40.00
 --------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       4.22          4.21
     Dep. Storage     (mm)=       2.00          5.00
     Average Slope     (%)=       1.00          2.00
     Length            (m)=     100.00        100.00
     Mannings n          =        .013          .250

     Max.eff.Inten.(mm/hr)=      53.33         11.35
                over (min)      10.00         30.00
     Storage Coeff.  (min)=       3.29 (ii)    32.49 (ii)
     Unit Hyd. Tpeak (min)=       5.00         35.00
     Unit Hyd. peak  (cms)=        .27           .03
                                                             *TOTALS*
     PEAK FLOW       (cms)=        .59           .07             .59 (iii)
     TIME TO PEAK    (hrs)=       1.50          2.17            1.50
     RUNOFF VOLUME    (mm)=      25.00          9.10           15.44
     TOTAL RAINFALL   (mm)=      27.00         27.00           27.00
     RUNOFF COEFFICIENT   =        .93           .34             .57

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!
```

```
      (i) CN PROCEDURE SELECTED FOR RAINFALL LOSSES:
           CN*  =  86.0    Ia = Dep. Storage  (Above)
     (ii) COMPUTATIONAL TIME STEP SHOULD BE SMALL OR EQUAL
          THAN THE STORAGE COEFFICIENT.
    (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
*                   27mm 4hr Chicago (quality) storm - Phase 1
*                   Uses 2 300 mm orifices, inverts 97.4 m

--------------------
| RESERVOIR (0001) |
| IN= 1---> OUT= 2 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                            .000       .000   |      .420       .119
                            .009       .006   |      .452       .142
                            .053       .013   |      .483       .166
                            .188       .027   |      .511       .192
                            .252       .043   |      .711       .206
                            .303       .060   |     1.508       .220
                            .346       .078   |     2.638       .234
                            .385       .098   |      .000       .000

                                AREA     QPEAK      TPEAK        R.V.
                                (ha)     (cms)      (hrs)        (mm)
     INFLOW : ID= 1 (0001)      8.43       .59       1.50       15.44
     OUTFLOW: ID= 2 (0001)      8.43       .21       1.67       15.42

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 35.47
                   TIME SHIFT OF PEAK FLOW         (min)= 10.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=   .03

-------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=   8.43
| ID= 2   PCYC=120 |   QPEAK     (cms)=    .21 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   1.67
--------------------   VOLUME     (mm)=  15.42
  Filename: 40WP1QPR.HYD
  Comments:

     (i)  PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
*                   Catchment 201 (Post-dev Phase 2)
--------------------
| CALIB            |
| STANDHYD  (0001) |   Area    (ha)=   4.60
|ID= 3 DT= 5.0 min |   Total Imp(%)=  50.00   Dir. Conn.(%)=  40.00
```

```
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       2.30         2.30
     Dep. Storage     (mm)=       2.00         5.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     100.00       100.00
     Mannings n           =       .013         .250

     Max.eff.Inten.(mm/hr)=      53.33        11.35
                over (min)       10.00        30.00
     Storage Coeff.  (min)=       3.29 (ii)   32.49 (ii)
     Unit Hyd. Tpeak (min)=       5.00        35.00
     Unit Hyd. peak  (cms)=        .27          .03
                                                           *TOTALS*
     PEAK FLOW       (cms)=        .32          .04            .32 (iii)
     TIME TO PEAK    (hrs)=       1.50         2.17           1.50
     RUNOFF VOLUME    (mm)=      25.00         9.10          15.42
     TOTAL RAINFALL   (mm)=      27.00        27.00          27.00
     RUNOFF COEFFICIENT   =        .93          .34            .57

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR RAINFALL LOSSES:
            CN*  =  86.0    Ia = Dep. Storage  (Above)
      (ii) COMPUTATIONAL TIME STEP SHOULD BE SMALL OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
*                   Split off 11 L/s to pond (allowable reservoir outflow)

--------------------
| DUHYD     (0001) |
| Inlet Cap.= .011 |
| #of Inlets=    1 |
| Total(cms)=   .0 |      AREA     QPEAK     TPEAK    R.V.
--------------------      (ha)     (cms)     (hrs)    (mm)
     TOTAL HYD.(ID= 3):   4.60       .32      1.50   15.42
     ===================================================
     MAJOR SYS.(ID= 4):   3.58       .31      1.50   15.42
     MINOR SYS.(ID= 5):   1.03       .01      1.00   15.42

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
*                   Determine required reservoir storage for remaining runoff

--------------------
| COMPUTE VOLUME   |
| ID= 4   (0001)   |             DISCHARGE      TIME
```

```
--------------------                (cms)       (hrs)
           START CONTROLLING AT      .00         .92
           INFLOW HYD. PEAKS AT      .31        1.50
           STOP  CONTROLLING AT      .00        4.42

           REQUIRED STORAGE VOLUME (ha.m.)=    .0552
           TOTAL HYDROGRAPH VOLUME (ha.m.)=    .0552
           % OF HYDROGRAPH TO STORE       =  99.9996

           NOTE:  Storage was computed to reduce the Inflow

--------------------------------------------------------------------------------
*                   27 mm Phase 1 uncontrolled + Phase 2 reservoir outflow


--------------------
| ADD HYD   (0001) |
|   1 +  5 =  6    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0001):     8.43      .59     1.50    15.44
        + ID2= 5 (0001):     1.03      .01     1.00    15.42
          ==================================================
          ID = 6 (0001):     9.46      .61     1.50    15.44

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
*                   27mm 4hr Chicago (quality) storm - Phase 1 + 2
*                   Uses 2 300 mm orifices, inverts 97.4 m

--------------------
| RESERVOIR (0001) |
| IN= 6---> OUT= 7 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                            .000        .000  |      .420        .119
                            .009        .006  |      .452        .142
                            .053        .013  |      .483        .166
                            .188        .027  |      .511        .192
                            .252        .043  |      .711        .206
                            .303        .060  |     1.508        .220
                            .346        .078  |     2.638        .234
                            .385        .098  |      .000        .000

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 6 (0001)      9.46       .61      1.50      15.44
     OUTFLOW: ID= 7 (0001)      9.46       .22      1.67      15.42

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 35.87
```

```
                  TIME SHIFT OF PEAK FLOW        (min)= 10.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=   .03

-------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=   9.46
| ID= 7   PCYC=122 |   QPEAK     (cms)=    .22 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   1.67
--------------------   VOLUME     (mm)=  15.42
  Filename: 40WP2QPR.HYD
  Comments:

     (i)  PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
*****************************************************************************
*                   Phase 1 Post-Pre Control Only
*****************************************************************************
*                   Read in hyd. of 5-yr Phase 1 peak flows
--------------------
| READ HYD  (0001) |   AREA       (ha)=   8.43
| ID= 1   PCYC=  1 |   QPEAK     (cms)=   1.03
| DT= 5.0 min      |   TPEAK     (hrs)=   2.08
--------------------   VOLUME     (mm)=  33.12
  Filename: 5YRP1PST.HYD
  Comments:
```

TIME hrs	FLOW cms	TIME hrs	FLOW cms	TIME hrs	FLOW cms	TIME hrs	FLOW cms	TIME hrs	FLOW cms
.00	.00	1.17	.04	2.33	.41	3.50	.13	4.67	.07
.08	.00	1.25	.04	2.42	.40	3.58	.12	4.75	.06
.17	.00	1.33	.04	2.50	.38	3.67	.11	4.83	.06
.25	.00	1.42	.05	2.58	.34	3.75	.11	4.92	.06
.33	.00	1.50	.05	2.67	.31	3.83	.10	5.00	.06
.42	.00	1.58	.06	2.75	.28	3.92	.09	5.08	.06
.50	.00	1.67	.07	2.83	.25	4.00	.09	5.17	.06
.58	.00	1.75	.09	2.92	.23	4.08	.09	5.25	.05
.67	.00	1.83	.11	3.00	.21	4.17	.08	5.33	.05
.75	.00	1.92	.17	3.08	.19	4.25	.08	5.42	.05
.83	.00	2.00	.36	3.17	.17	4.33	.08	5.50	.05
.92	.02	2.08	1.03	3.25	.16	4.42	.07	5.58	.05
1.00	.03	2.17	.65	3.33	.15	4.50	.07		
1.08	.03	2.25	.46	3.42	.14	4.58	.07		

```
-------------------------------------------------------------------------------
*                   Route 5 yr Phase 1 through SWM Pond

*                   Uses 2 300 mm orifices, inverts 97.4 m

--------------------
| RESERVOIR (0001) |
```

```
| IN= 1---> OUT= 2 |
| DT=  5.0 min     |      OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------       (cms)     (ha.m.)   |   (cms)     (ha.m.)
                             .000       .000   |      .420       .119
                             .009       .006   |      .452       .142
                             .053       .013   |      .483       .166
                             .188       .027   |      .511       .192
                             .252       .043   |      .711       .206
                             .303       .060   |     1.508       .220
                             .346       .078   |     2.638       .234
                             .385       .098   |      .000       .000

                                 AREA     QPEAK     TPEAK       R.V.
                                 (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 1 (0001)       8.43      1.03      2.08      33.12
     OUTFLOW: ID= 2 (0001)       8.43       .33      2.58      33.10

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 31.75
                   TIME SHIFT OF PEAK FLOW         (min)= 30.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=   .07

--------------------------------------------------------------------------------
*                   Controlled 5 yr Phase 1 flows
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=   8.43
| ID= 2   PCYC=139 |   QPEAK     (cms)=    .33 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   2.58
--------------------   VOLUME     (mm)=  33.10
  Filename: 5YRP1CON.HYD
  Comments:

     (i)  PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
*                   Read in hyd. of 100-yr Phase 1 peak flows
--------------------
| READ HYD  (0001) |   AREA       (ha)=   8.43
| ID= 3   PCYC=  1 |   QPEAK     (cms)=   1.96
| DT= 5.0 min      |   TPEAK     (hrs)=   2.08
--------------------   VOLUME     (mm)=  60.50
  Filename: 100P1PST.HYD
  Comments:

  TIME     FLOW |  TIME     FLOW |  TIME     FLOW |  TIME     FLOW |  TIME     FLOW
   hrs      cms |   hrs      cms |   hrs      cms |   hrs      cms |   hrs      cms
   .00      .00 |  1.50      .09 |  3.00      .32 |  4.50      .12 |  6.00      .08
   .08      .00 |  1.58      .11 |  3.08      .29 |  4.58      .12 |  6.08      .05
   .17      .00 |  1.67      .13 |  3.17      .27 |  4.67      .11 |  6.17      .04
   .25      .00 |  1.75      .16 |  3.25      .24 |  4.75      .11 |  6.25      .03
   .33      .00 |  1.83      .21 |  3.33      .23 |  4.83      .11 |  6.33      .02
```

```
    .42      .00 |  1.92      .32 |  3.42      .21 |  4.92      .10 |  6.42      .01
    .50      .00 |  2.00      .66 |  3.50      .20 |  5.00      .10 |  6.50      .01
    .58      .00 |  2.08     1.96 |  3.58      .19 |  5.08      .10 |  6.58      .01
    .67      .03 |  2.17     1.33 |  3.67      .18 |  5.17      .10 |  6.67      .00
    .75      .04 |  2.25     1.15 |  3.75      .17 |  5.25      .09 |  6.75      .00
    .83      .05 |  2.33      .98 |  3.83      .16 |  5.33      .09 |  6.83      .00
    .92      .05 |  2.42      .84 |  3.92      .15 |  5.42      .09 |  6.92      .00
   1.00      .05 |  2.50      .71 |  4.00      .15 |  5.50      .09 |  7.00      .00
   1.08      .06 |  2.58      .61 |  4.08      .14 |  5.58      .09 |   .00    -1.00
   1.17      .06 |  2.67      .53 |  4.17      .14 |  5.67      .09 |
   1.25      .07 |  2.75      .46 |  4.25      .13 |  5.75      .08 |
   1.33      .07 |  2.83      .41 |  4.33      .13 |  5.83      .08 |
   1.42      .08 |  2.92      .36 |  4.42      .12 |  5.92      .08 |
------------------------------------------------------------------------------
*                   Route 100 yr Phase 1 through SWM Pond

*                   Uses 2 300 mm orifices, inverts 97.4 m

--------------------
| RESERVOIR (0001) |
| IN= 3---> OUT= 4 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                           .000        .000   |     .420       .119
                           .009        .006   |     .452       .142
                           .053        .013   |     .483       .166
                           .188        .027   |     .511       .192
                           .252        .043   |     .711       .206
                           .303        .060   |    1.508       .220
                           .346        .078   |    2.638       .234
                           .385        .098   |     .000       .000

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 3 (0001)     8.43      1.96      2.08      60.50
     OUTFLOW: ID= 4 (0001)     8.43       .49      2.75      60.48

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 25.24
                  TIME SHIFT OF PEAK FLOW        (min)= 40.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=   .18

------------------------------------------------------------------------------
*                   Controlled 100 yr Phase 1 flows

--------------------
| SAVE HYD  (0001) |   AREA       (ha)=   8.43
| ID= 4   PCYC=139 |   QPEAK     (cms)=    .49 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   2.75
--------------------   VOLUME     (mm)=  60.48
  Filename: 100P1CON.HYD
```

```
  Comments:

     (i)  PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
*****************************************************************************
*                   5-Yr Phase 1 Control Plus Phase 2 Conveyance
*****************************************************************************
*                   Read in hyd. of 5-yr Phase 2 peak flows
--------------------
| READ HYD  (0001) |   AREA       (ha)=   4.60
| ID= 5   PCYC=  1 |   QPEAK     (cms)=    .56
| DT= 5.0 min      |   TPEAK     (hrs)=   2.08
--------------------   VOLUME     (mm)=  33.10
  Filename: 5YRP2PST.HYD
  Comments:

  TIME    FLOW |  TIME    FLOW |  TIME    FLOW |  TIME    FLOW |  TIME    FLOW
   hrs     cms |   hrs     cms |   hrs     cms |   hrs     cms |   hrs     cms
   .00     .00 |  1.50     .03 |  3.00     .11 |  4.50     .04 |  6.00     .02
   .08     .00 |  1.58     .03 |  3.08     .10 |  4.58     .04 |  6.08     .02
   .17     .00 |  1.67     .04 |  3.17     .09 |  4.67     .04 |  6.17     .01
   .25     .00 |  1.75     .05 |  3.25     .09 |  4.75     .03 |  6.25     .01
   .33     .00 |  1.83     .06 |  3.33     .08 |  4.83     .03 |  6.33     .01
   .42     .00 |  1.92     .09 |  3.42     .07 |  4.92     .03 |  6.42     .01
   .50     .00 |  2.00     .20 |  3.50     .07 |  5.00     .03 |  6.50     .01
   .58     .00 |  2.08     .56 |  3.58     .06 |  5.08     .03 |  6.58     .00
   .67     .00 |  2.17     .36 |  3.67     .06 |  5.17     .03 |  6.67     .00
   .75     .00 |  2.25     .25 |  3.75     .06 |  5.25     .03 |  6.75     .00
   .83     .00 |  2.33     .22 |  3.83     .05 |  5.33     .03 |  6.83     .00
   .92     .01 |  2.42     .22 |  3.92     .05 |  5.42     .03 |  6.92     .00
  1.00     .02 |  2.50     .20 |  4.00     .05 |  5.50     .03 |  7.00     .00
  1.08     .02 |  2.58     .19 |  4.08     .05 |  5.58     .03 |  7.08     .00
  1.17     .02 |  2.67     .17 |  4.17     .04 |  5.67     .03 |
  1.25     .02 |  2.75     .15 |  4.25     .04 |  5.75     .03 |
  1.33     .02 |  2.83     .14 |  4.33     .04 |  5.83     .03 |
  1.42     .03 |  2.92     .12 |  4.42     .04 |  5.92     .03 |
--------------------------------------------------------------------------------
*                   Split off 11 L/s to pond (allowable reservoir outflow)

--------------------
| DUHYD     (0001) |
| Inlet Cap.= .011 |
| #of Inlets=    1 |
| Total(cms)=   .0 |      AREA     QPEAK     TPEAK    R.V.
--------------------      (ha)     (cms)     (hrs)    (mm)
     TOTAL HYD.(ID= 5):   4.60       .56      2.08   33.10
     =====================================================
     MAJOR SYS.(ID= 6):   3.92       .55      2.08   33.10
     MINOR SYS.(ID= 7):    .68       .01      1.00   33.10
```

```
     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
*                    Determine required reservoir storage for remaining runoff

--------------------
| COMPUTE VOLUME   |
| ID= 6   (0001)   |             DISCHARGE      TIME
--------------------               (cms)       (hrs)
           START CONTROLLING AT      .00         .92
           INFLOW HYD. PEAKS AT      .55        2.08
           STOP  CONTROLLING AT      .00        6.25

           REQUIRED STORAGE VOLUME (ha.m.)=    .1296
           TOTAL HYDROGRAPH VOLUME (ha.m.)=    .1296
           % OF HYDROGRAPH TO STORE       =  99.9997

           NOTE:  Storage was computed to reduce the Inflow

--------------------------------------------------------------------------------
*                    5-yr Phase 1 uncontrolled + Phase 2 reservoir outflow


--------------------
| ADD HYD   (0001) |
|   1 +  7 =  8    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0001):     8.43     1.03     2.08    33.12
        + ID2= 7 (0001):      .68      .01     1.00    33.10
          ==================================================
          ID = 8 (0001):     9.11     1.05     2.08    33.12

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=   9.11
| ID= 8   PCYC= 89 |   QPEAK     (cms)=   1.05 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   2.08
--------------------   VOLUME     (mm)=  33.12
  Filename: 5YRCOMBU.HYD
  Comments:

     (i)  PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
*                    Route combination flow through SWM Pond

*                    Uses 2 300 mm orifices, inverts 97.4 m
```

```
--------------------
| RESERVOIR (0001) |
| IN= 8---> OUT= 9 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                            .000       .000   |     .420       .119
                            .009       .006   |     .452       .142
                            .053       .013   |     .483       .166
                            .188       .027   |     .511       .192
                            .252       .043   |     .711       .206
                            .303       .060   |    1.508       .220
                            .346       .078   |    2.638       .234
                            .385       .098   |     .000       .000

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 8 (0001)      9.11      1.05      2.08      33.12
     OUTFLOW: ID= 9 (0001)      9.11       .33      2.67      33.10

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 32.00
                   TIME SHIFT OF PEAK FLOW         (min)= 35.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=   .07

--------------------------------------------------------------------------------
*                   Controlled 5-yr site peak flows

--------------------
| SAVE HYD  (0001) |   AREA       (ha)=   9.11
| ID= 9   PCYC=140 |   QPEAK     (cms)=    .33 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   2.67
--------------------   VOLUME     (mm)=  33.10
  Filename: 5YRCOMBC.HYD
  Comments:

     (i)  PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
******************************************************************************
*                   100-Yr Phase 1 Control Plus Phase 2 Conveyance
******************************************************************************
*                   Read in hyd. of 100-yr Phase 2 peak flows
--------------------
| READ HYD  (0001) |   AREA       (ha)=   4.60
| ID= 5   PCYC=  1 |   QPEAK     (cms)=   1.07
| DT= 5.0 min      |   TPEAK     (hrs)=   2.08
--------------------   VOLUME     (mm)=  60.48
  Filename: 100P2PST.HYD
  Comments:
```

TIME	FLOW	TIME	FLOW	TIME	FLOW	TIME	FLOW	TIME	FLOW
hrs	cms	hrs	cms	hrs	cms	hrs	cms	hrs	cms
.00	.00	1.50	.05	3.00	.18	4.50	.06	6.00	.04
.08	.00	1.58	.06	3.08	.16	4.58	.06	6.08	.03
.17	.00	1.67	.07	3.17	.14	4.67	.06	6.17	.02
.25	.00	1.75	.09	3.25	.13	4.75	.06	6.25	.01
.33	.00	1.83	.12	3.33	.12	4.83	.06	6.33	.01
.42	.00	1.92	.17	3.42	.11	4.92	.06	6.42	.01
.50	.00	2.00	.36	3.50	.11	5.00	.05	6.50	.00
.58	.00	2.08	1.07	3.58	.10	5.08	.05	6.58	.00
.67	.02	2.17	.73	3.67	.10	5.17	.05	6.67	.00
.75	.02	2.25	.63	3.75	.09	5.25	.05	6.75	.00
.83	.02	2.33	.54	3.83	.09	5.33	.05	6.83	.00
.92	.03	2.42	.46	3.92	.08	5.42	.05	.00	-1.00
1.00	.03	2.50	.39	4.00	.08	5.50	.05	.00	.00
1.08	.03	2.58	.33	4.08	.08	5.58	.05	.00	.00
1.17	.03	2.67	.29	4.17	.07	5.67	.05	.00	-1.00
1.25	.04	2.75	.25	4.25	.07	5.75	.05	.00	.00
1.33	.04	2.83	.22	4.33	.07	5.83	.04		
1.42	.04	2.92	.20	4.42	.07	5.92	.04		

```
-----------------------------------------------------------------------------
*                   Split off 11 L/s to pond (allowable reservoir outflow)

--------------------
| DUHYD     (0001) |
| Inlet Cap.= .011 |
| #of Inlets=    1 |
| Total(cms)=   .0 |      AREA     QPEAK     TPEAK    R.V.
--------------------      (ha)     (cms)     (hrs)    (mm)
     TOTAL HYD.(ID= 5):   4.60      1.07      2.08   60.48
     =====================================================
     MAJOR SYS.(ID= 6):   4.21      1.06      2.08   60.48
     MINOR SYS.(ID= 7):    .39       .01       .67   60.48

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-----------------------------------------------------------------------------
*                   Determine required reservoir storage for remaining runoff

--------------------
| COMPUTE VOLUME   |
| ID= 6   (0001)   |             DISCHARGE      TIME
--------------------               (cms)       (hrs)
           START CONTROLLING AT      .00         .58
           INFLOW HYD. PEAKS AT     1.06        2.08
           STOP  CONTROLLING AT      .00        6.33

           REQUIRED STORAGE VOLUME (ha.m.)=    .2548
           TOTAL HYDROGRAPH VOLUME (ha.m.)=    .2548
           % OF HYDROGRAPH TO STORE       =  99.9997
```

```
          NOTE:  Storage was computed to reduce the Inflow

 --------------------------------------------------------------------------------
 *                   100-yr Phase 1 uncontrolled + Phase 2 reservoir outflow


 --------------------
 | ADD HYD   (0001) |
 |   3 +  7 =  8    |         AREA    QPEAK    TPEAK     R.V.
 --------------------         (ha)    (cms)    (hrs)     (mm)
           ID1= 3 (0001):     8.43     1.96     2.08    60.50
         + ID2= 7 (0001):      .39      .01      .67    60.48
           ==================================================
           ID = 8 (0001):     8.82     1.97     2.08    60.50

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 --------------------------------------------------------------------------------
 --------------------
 | SAVE HYD  (0001) |   AREA       (ha)=   8.82
 | ID= 8   PCYC= 85 |   QPEAK     (cms)=   1.97 (i)
 | DT= 5.0 min      |   TPEAK     (hrs)=   2.08
 --------------------   VOLUME     (mm)=  60.50
   Filename: 100COMBU.HYD
   Comments:

      (i)  PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 --------------------------------------------------------------------------------
 *                   Route combination flow through SWM Pond

 *                   Uses 2 300 mm orifices, inverts 97.4 m

 --------------------
 | RESERVOIR (0001) |
 | IN= 8---> OUT= 9 |
 | DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
 --------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                             .000       .000   |     .420       .119
                             .009       .006   |     .452       .142
                             .053       .013   |     .483       .166
                             .188       .027   |     .511       .192
                             .252       .043   |     .711       .206
                             .303       .060   |    1.508       .220
                             .346       .078   |    2.638       .234
                             .385       .098   |     .000       .000

                                    AREA     QPEAK     TPEAK       R.V.
                                    (ha)     (cms)     (hrs)       (mm)
```

```
     INFLOW : ID= 8 (0001)      8.82      1.97      2.08      60.50
     OUTFLOW: ID= 9 (0001)      8.82       .50      2.75      60.48

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 25.28
                  TIME SHIFT OF PEAK FLOW        (min)= 40.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=   .18

--------------------------------------------------------------------------------
*                   Controlled 100 yr Phase 1 + conveyance of post-reservoir Phase 2

--------------------
| SAVE HYD  (0001) |   AREA       (ha)=   8.82
| ID= 9   PCYC=140 |   QPEAK     (cms)=    .50 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   2.75
--------------------   VOLUME     (mm)=  60.48
  Filename: 100COMBC.HYD
  Comments:

     (i)  PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------

 FINISH
================================================================================
```

APPENDIX E

Dry Pond Facility Sizing

Dry Pond Sizing: Stage - Storage - Discharge Relationship

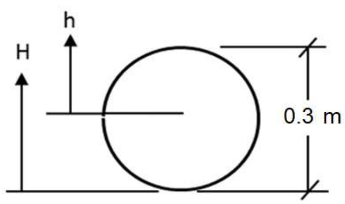
Project: **40 Wilson Avenue Subdivision**
Designer: Duncan Burgess, BASc
Date: February 25, 2026

Active Storage Calculations

Full Storage Elevation (m)	**99.4**	
Depth of Active Storage (m)	**2**	
Bottom of Active Storage (m)	**97.4**	
Active Volume (cu.m)	**1,922**	*(approx)*

Select Storage Value Method **User Defined**

Select Stage Increment (m) **0.1**
(not less than 0.01 m)



Outlet 1	Outlet 2	Outlet 3
Use Outlet 1 ? **Yes**	**Use Outlet 2 ?** **Yes**	**Use Outlet 3 ?** **Yes**
Orifice	**Orifice**	**Broad Crested Weir**
Formula: $Q = CA_o(2gh)^{0.5}$	Formula: $Q = CA_o(2gh)^{0.5}$	Formula: Q = 1.67LH13/2
Invert = 97.40 m	**Invert =** 97.40 m	**Invert =** 99.45 m
Coeff = 0.60	**Coeff =** 0.60	**Length** 10.0 m
Orifice Dia = 0.30 m	**Orifice Dia =** 0.30 m	*(No End Contractions)*
Circular? Yes	**Circular?** Yes	
Area = 0.071 m^2	Area = 0.071 m^2	
Obvert = 97.70 m	Obvert = 97.70 m	

				Low Flow Outlet (Orifice)			Orifice			Emergency Spillway		Total
Elevation	**Area**	**Incr Vol**	**Cum vol**	**Weir (H)**	**Head (h)**	**Flow (Q)**	**Head (H)**	**Head (h)**	**Flow (Q)**	**Head (H)**	**Flow (Q)**	**Discharge**
m	**m^2**	**m3**	**m3**	**m**	**m**	**cms**	**m**	**m**	**cms**	**m**	**cms**	**cms**
97.4	**620.8**	0	0	0.000	-0.150	0.000	0.000	-0.150	0.000	0.000	0.000	0.0000
97.5	**651.3**	64	64	0.100	-0.050	0.004	0.100	-0.050	0.004	0.000	0.000	0.0087
97.6	**682.4**	67	130	0.200	0.050	0.026	0.200	0.050	0.026	0.000	0.000	0.0527
97.7	**714.1**	70	200	0.300	0.150	0.073	0.300	0.150	0.073	0.000	0.000	0.1455
97.8	**746.3**	73	273	0.400	0.250	0.094	0.400	0.250	0.094	0.000	0.000	0.1879
97.9	**779.2**	76	349	0.500	0.350	0.111	0.500	0.350	0.111	0.000	0.000	0.2223
98	**812.5**	80	429	0.600	0.450	0.126	0.600	0.450	0.126	0.000	0.000	0.2520
98.1	**846.5**	83	512	0.700	0.550	0.139	0.700	0.550	0.139	0.000	0.000	0.2786
98.2	**881.0**	86	598	0.800	0.650	0.151	0.800	0.650	0.151	0.000	0.000	0.3029
98.3	**916.0**	90	688	0.900	0.750	0.163	0.900	0.750	0.163	0.000	0.000	0.3254
98.4	**951.7**	93	782	1.000	0.850	0.173	1.000	0.850	0.173	0.000	0.000	0.3464
98.5	**987.9**	97	879	1.100	0.950	0.183	1.100	0.950	0.183	0.000	0.000	0.3662
98.6	**1024.6**	101	979	1.200	1.050	0.192	1.200	1.050	0.192	0.000	0.000	0.3850
98.7	**1062.0**	104	1,083	1.300	1.150	0.201	1.300	1.150	0.201	0.000	0.000	0.4029
98.8	**1099.9**	108	1,192	1.400	1.250	0.210	1.400	1.250	0.210	0.000	0.000	0.4201
98.9	**1138.3**	112	1,303	1.500	1.350	0.218	1.500	1.350	0.218	0.000	0.000	0.4365
99	**1177.4**	116	1,419	1.600	1.450	0.226	1.600	1.450	0.226	0.000	0.000	0.4524
99.1	**1217.0**	120	1,539	1.700	1.550	0.234	1.700	1.550	0.234	0.000	0.000	0.4678
99.2	**1257.1**	124	1,663	1.800	1.650	0.241	1.800	1.650	0.241	0.000	0.000	0.4826
99.3	**1297.8**	128	1,790	1.900	1.750	0.249	1.900	1.750	0.249	0.000	0.000	0.4970
99.4	**1339.1**	132	1,922	2.000	1.850	0.256	2.000	1.850	0.256	0.000	0.000	0.5110
99.5	**1381.0**	136	2,058	2.100	1.950	0.262	2.100	1.950	0.262	0.050	0.187	0.7114
99.6	**1423.4**	140	2,199	2.200	2.050	0.269	2.200	2.050	0.269	0.150	0.970	1.5081
99.7	**1466.4**	144	2,343	2.300	2.150	0.275	2.300	2.150	0.275	0.250	2.088	2.6384