FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT

IN SUPPORT OF REZONING APPLICATION

45 Bishop Street

Residential Development

Township of Selwyn, Ontario

8395 Jane Street, Suite 100
Vaughan, Ontario L4K 5Y2
Tel: (905) 326-1404

File Number: 20013

Prepared For:

Veranda Properties

1	Issued For 1st Submission	Feb 26, 2021
No.	**Revision**	**Date**

EXECUTIVE SUMMARY

This Functional Servicing Report has been prepared on behalf of Veranda Properties the registered owner of the subject land. The application proposes a residential development located at 45 Bishop Street in the Township of Selwyn, Ontario in Peterborough County.

The servicing strategy for the proposed development is summarized as follows:

Water Servicing:

There is an existing 150mm watermain on the south side of Bishop Street and an existing hydrant east of the proposed entrance. The existing watermain alignment in Bishop Street is to be confirmed during detailed design.

The proposed development will be serviced through a 150mm connection to the existing 150mm watermain on the south side of Bishop Street. The development demand requirement is governed by the maximum day demand plus fire flow of 12,140 L/min while maintaining a minimum pressure of 140 kPa. Through discussions with the Township of Selwyn's peer review engineer, it is understood that the water demand shall be reviewed with the existing overall model for Lakefield during the review of this report.

Sanitary Servicing:

There is currently an existing 200mm sanitary sewer on Bishop Street, draining west. The proposed development will be serviced with a proposed manhole and 200mm sanitary sewer extension from Bishop Street into the proposed cul-de-sac. Individual sanitary service connections will be provided at each of the residential units.

In the proposed dry weather conditions, the addition of the proposed development will result in a total flow of **1.34 L/s.** The proposed sanitary sewer servicing the site shall be 200mm running at a minimum slope of 0.50%. The generated flow from the proposed development is only 6% of the full flow capacity and as a result, the system will operate in a non-surcharged condition. Based on discussions with the Township's peer review engineer, we understand there are no

known capacity constraints in the area and that an overall survey and evaluation of the sanitary sewer is underway and can be used to confirm capacity for the development once complete.

Stormwater Servicing:

The existing site is 1.01 ha and primarily drains south with a central area draining north to Bishop Street. There are no existing storm sewers on Bishop Street. Stormwater is conveyed overland via ditches on the north and south sides of Bishop Street and through existing culverts under driveways, flowing west.

The site shall be serviced by a proposed storm sewer system that will collect all paved drainage and a portion of the roof drainage from the site. The majority of the post development drainage collected from the cul-de-sac, and front half of lot drainage will drain along the proposed gutterline of the cul-de-sac and into proposed bioretention swales within the ROW approaching Bishop Street. Flows from the piped system will be controlled using an orifice plate in a control manhole which will attenuate discharge to a headwall at the south end of the site via a storm easement between lots 6 and 7. Discharge from the storm sewer outfall and the rear yard and roof drainage will be directed to a proposed rain garden surface LID feature at the south boundary. Site runoff in excess of the LID capacity will be discharged overland to the south of the site through a level spreader.

The majority of the roof drainage and runoff from the backyards are directed to swales on the east and west property boundaries where flow is conveyed overland to the proposed LID at the south property boundary.

Storage will be provided through a combination of the storage available in the LID features, pipe storage and storage in manholes and catchbasins.

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1.0 INTRODUCTION

1.1 Background

This Functional Servicing and Stormwater Management Report has been prepared on behalf of Veranda Properties in support of the rezoning application for the proposed 1.01 ha Residential Development.

This application proposes to construct a new residential development on the existing vacant land on 45 Bishop Street. The purpose of this report is to demonstrate that the existing infrastructure within the vicinity on Bishop Street, as well as the natural lands south of the site can accommodate the proposed development.

The subject site lies within the Township of Selwyn, Ontario in Lakefield. It is located on the south side of Bishop Street and is bounded by residential dwellings along Bishop Street to the north and existing vacant/forested areas to the east, south and west. **Figure 1 – Site Location** illustrates the subject site within the context of its surroundings. The proposed Residential Development consists of 8 townhouse units, 8 semi-detached units, and a proposed municipal road access from Bishop Street that leads to a cul-de-sac within the development. The proposed development layout is shown on **Figure 2 – General Plan.**

The existing site is currently a vacant site with open land, shrubs and vegetation.

1.2 Study Parameters

This servicing assessment is based on:

- Topographic Survey, prepared by IBW Surveyors
- Conceptual Architectural Plans, prepared by Zelinka Priamo Ltd.
- Engineering Design Standards, Infrastructure Management Division, April 2019, City of Peterborough
- Fire Underwriters Survey, 1999,

- Correspondence with the Region/Town

2.0 WATER SUPPLY

2.1 Existing Water Supply

There is an existing 150mm watermain on the south side of Bishop Street and an existing hydrant east of the proposed entrance. The existing watermain alignment in Bishop Street is to be confirmed during detailed design. The proposed site is currently not serviced with a connection to the existing system.

2.2 Proposed Water Supply

The proposed development will be serviced through a 150mm connection to the existing 150mm watermain on the south side of Bishop Street. Each of the residential unit will be serviced with a 25mm water service.

Refer to **Figure 3 – Water Servicing Plan** for the existing and proposed watermain layout.

The City of Peterborough's design criteria does not dictate specific water demand criteria, therefore, the MECP standards were used to dictate the water demand. The MECP standards states that governing flows shall be the greater of a) maximum day demand plus fire flow, or b) maximum hour demand. Based on MECP guidelines, it was assumed that the average day demand is equal to the average daily flow for residential development for sanitary being 450 L/cap/day. Therefore, an average day demand of 450 L/cap/day was used to calculate the residential maximum day and maximum hour water demand (domestic demand). The calculated daily demands for the proposed development are shown in ***Table 1*** below.

In addition to the domestic demand generated from the development, the fire flow demand has been calculated in accordance with The Fire Underwriter's Survey (FUS) guidelines. Both the townhouse and semi-detached dwellings are assumed to be wood frame construction, have combustible contents and have no sprinkler system installed. The resulting critical fire flow was

12,000 L/min. Therefore, the resulting maximum day plus fire flow demand for the proposed residential site is **12,140 L/min** (12,000 + 140).

Table 1: Proposed Water Demand Summary

	Population	Average Daily Usage (L/min)	Maximum Hour (L/min)	Maximum Day (L/min)	Fire Flow Required (L/min)	Water Demand (L/min)
Residential	47	15	211	140	12,000	12,140
Totals	**47**	**15**	**211**	**140**	**12,000**	**12,140**

Flow tests of nearby fire hydrants will need to be completed to confirm that residual system pressures are adequate at the governing flow rate. These shall be provided at detailed design. The MECP design criteria was used to dictate the following system pressure requirements:

- Maximum pressure during the minimum hourly demand = 700 kPa
- Minimum pressure during maximum hour demand = 275 kPa
- Minimum Fire Flow pressure during simultaneous maximum day demand plus fire flow = 140 kPa.

Refer to **Appendix B** for the supporting calculations of the proposed water supply system.

The development demand requirement is governed by the maximum day demand plus fire flow of 12,140 L/min while maintaining a minimum pressure of 140 kPa. Through discussions with the Township of Selwyn's peer review engineer, it is understood that the water demand shall be reviewed with the existing overall model for Lakefield during the review of this report.

3.0 SANITARY SERVICING

3.1 Existing Sanitary Servicing

There is currently an existing 200mm sanitary sewer on Bishop Street, draining west. There are no existing sanitary connections/stubs along the frontage of the site.

3.2 Proposed Sanitary Servicing

The proposed development will be serviced with a proposed manhole and 200mm sanitary sewer extension from Bishop Street into the proposed cul-de-sac. A new sanitary manhole will need to be installed into the existing sanitary sewer on Bishop Street. Individual sanitary service connections will be provided at each of the residential units.

The proposed sanitary demand is calculated as per the City of Peterborough Engineering Design Standards (2019) which state the following parameters:

- Domestic Flow: Q = 450 L/p/d
- Domestic Peaking Factor: As per Harmon's Formula
- Infiltration: 0.28 L/s/ha

In the proposed dry weather conditions, the addition of the proposed development will result in a total flow of **1.34 L/s.** The proposed sanitary sewer servicing the site shall be 200mm running at a minimum slope of 0.50%. Therefore, the capacity in the proposed sanitary sewer is 23.57 L/s. The generated flow from the proposed development is only 6% of the full flow capacity and as a result, the system will operate in a non-surcharged condition. Based on discussions with the Township's peer review engineer, we understand there are no known capacity constraints in the area and that an overall survey and evaluation of the sanitary sewer is underway and can be used to confirm capacity for the development once complete.

Refer to **Figure 4 – Sanitary Servicing Plan** for the existing and proposed sanitary network.

Refer to **Appendix C** for sanitary design flow calculations.

4.0 STORMWATER SERVICING

4.1 Existing Stormwater Drainage

The existing site is 1.01 ha and primarily drains south with a central area draining north to Bishop Street. It is currently comprised of open land and vegetation and is generally comprised of two drainage areas. There are no existing storm sewers on Bishop Street. Stormwater is conveyed overland via ditches on the north and south sides of Bishop Street and through existing culverts under driveways, flowing west. Refer to **Figure 6 – Pre-Development Drainage Plan**. The existing drainage areas are summarized in ***Table 2*** below.

Based on City of Peterborough's standards, the pre-development site characteristics are as follows:

Table 2 – Pre-Development Drainage Areas

Area ID	Area (ha)	Runoff Coefficient	Outlet
101	0.26	0.20	Bishop Street Ditch
102	0.75	0.20	Overland to South

4.2 Allowable Release Rate

As per the City of Peterborough's design criteria, the site shall control peak runoff flows from the 2-year to the 100-year storm event under post-development conditions to the corresponding pre-development release rate or less.

The allowable discharge from the subject site is calculated as follows: $\mathbf{Q_A = C \times A \times I\ (L/s)}$

Table 3: Allowable Release Rates

Area ID	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Area 101 Allowable Release Rate (L/s)	10	13	15	20	24	27
Area 102 Allowable Release Rate (L/s)	29	38	44	56	68	77

Refer to **Appendix D** for allowable release rate calculations.

4.3 Proposed Stormwater Servicing

The site shall be serviced by a proposed storm sewer system that will collect all paved drainage and a portion of the roof drainage from the site. The majority of the post development drainage collected from the cul-de-sac, and front half of lot drainage will drain along the proposed gutterline of the cul-de-sac and into proposed bioretention swales within the ROW approaching Bishop Street. Two LIDs within the proposed ROW immediately south of Bishop Street will outlet to a raised catch basin in each cell once filled to design capacity. Flows from the piped system will be controlled using an orifice plate in a control manhole which will attenuate discharge to a headwall at the south end of the site via a storm easement between lots 6 and 7. Discharge from the storm sewer outfall and the rear yard and roof drainage will be directed to a proposed rain garden surface LID feature at the south boundary. Site runoff in excess of the LID capacity will be discharged overland to the south of the site through a level spreader. A series of weirs can be explored during detailed design along the LID to control discharge overland to the south at the allowable release rate. A weir is proposed within the LID discharging to Bishop Street to allow some control of the runoff toward the Bishop Street ditch in larger storm events. Details of the weir can be explored during detailed design. Storage will be provided through a combination of the storage available in the LID features, pipe storage and storage in manholes and catchbasins. There is potential for some surface storage at the low point in the cul-de-sac if required during larger storm events, however, this can be evaluated during detailed design.

The majority of the roof drainage and runoff from the backyards are directed to swales on the east and west property boundaries where flow is conveyed overland to the proposed LID at the south property boundary.

Refer to **Figure 5 – Storm Servicing Plan** for the existing and proposed storm sewer layout.

4.4 Proposed Stormwater Management

4.4.1 Quantity Control

The 1.01 ha of developable site will be divided into two post development drainage boundaries.

Refer to **Figure 7 – Post-Development Drainage Plan**.

Area 201 (0.44 ha), represents the paved areas and a portion of the roof area drainage. Drainage from this area will be directed to the LIDs on the west and east side of the proposed right of way immediately south of Bishop Street. A run-off coefficient of 0.65 was determined for Area 201.

Area 202 (0.57 ha) represents most of the landscaped areas (backyards) and roof area drainage. Most of the drainage from Area 202 will be directed to the proposed rear lot drainage swales on the west and east property boundaries and into a LID at the south property boundary. A run-off coefficient of 0.40 was determined for Area 202.

Drainage from the cul-de-sac is directed along the proposed curb and gutters to LIDs on the west and east sides of the road entrance. Drainage from the road entrance also flows to these LIDs.

It was determined that controlling the 2-year to the 100-year post-development release rates down to the corresponding pre-development release rates for Area 201 will require storage that

is not feasible solely within the two proposed LID features adjacent to the entrance given the available boulevard dimensions. Therefore, a combination of LID storage and oversized pipe storage will be required to attenuate post-development runoff. The proposed stormwater management strategy for the site will utilize both the minor and major systems.

Quantity control will be provided by the following ways:

Minor System:

A catchbasin will be installed in the east LID adjacent to the road entrance in Area 201 and a catchbasin manhole will be installed in the west LID. As the LID storage volume is filled up in the west LID, it will eventually flow into the catchbasin manhole where discharge is conveyed south through the proposed storm system to a control manhole (MH-4) where it will be attenuated via an orifice plate. During a 100-year storm event, a total of 32 m^3 of storage and a 125mm orifice plate located within the downstream control manhole (MH-4) are required to provide adequate quantity control. The required storage is provided within the proposed storm sewers, manholes and catchbasins, which includes the use of an oversized 825mm ø storm pipe to provide adequate storage. In the 2-year storm event, an 85 mm ø orifice plate is required in the control manhole to provide adequate quantity control. Details of the outlet control structure can be explored during detailed design to ensure allowable release rates are achieved for all storm events.

Major System:

In the event the volume of the west LID is exceeded, drainage from Area 201 will be conveyed through a weir at the north end of the LID that will control discharge to the allowable release rate towards the existing ditch on Bishop Street. The weir will be set above the catchbasin manhole grate and sized to permit the allowable release rate of 27 L/s to be directed to Bishop Street. Details of the weir can be explored during detailed design. The remaining runoff will be captured by the overflow catchbasin and catchbasin manhole within the bioretention swales in the right of way.

Drainage from Area 202 primarily drains to the swales at the east and west property boundaries and to the LID feature at the south property boundary. During a 100-year storm event, a total of 59 m^3 of storage to attenuate the balance of runoff from Area 201 along with Area 202 would be required which is provided by the LID along the south boundary. A series of weirs along the LID can be explored during detailed design to control discharge to the allowable release rate. ***Table 4*** provides a summary of the peak flows and storages for Areas 201 and 202 during a 100-year storm event.

Table 4– Peak Flow and Storage Summary - 100-Year Storm Event

Area ID	Area (ha)	Runoff Coefficient	t_c (min)	Storage Required (m^3)	Storage Provided (m^3)	Release Rate to Bishop Street (L/s)	Release Rate to South Outlet (L/s)*	Orifice Size (mm)
201	0.44	0.70	10	32	32.3	27	46	125
202	0.57	0.45	10	59	62.0	N/A	31	N/A

* The total release rate to the south outlet is equal to the pre-development release rate for Area 102 (77L/s).

4.4.2 Quality Control

An enhanced level of quality control is required for the site, which will be provided by the proposed surface LID features that shall promote infiltration of the stormwater on-site. As mentioned previously, three LID features are proposed – two of which collect drainage from Area 201 and discharge runoff towards the north to Bishop Street, and one along the south boundary that collects drainage from Area 202 that discharges runoff towards the natural lands to the south. The two north LIDs provide a total storage of 22m^3, and the south LID provides 62m^3 of storage. This results in a total LID volume of **84m^3**.

Based on the MOE 2003 SWM Manual, infiltration is one of the contemplated strategies to provide quality control for storm water run-off. When infiltration is used alone to provide enhanced water quality, about 27 m^3/ha must be provided on-site (based on interpolation from MOE Table 3.2) for a site with an impervious percentage of 41%, which is the calculated imperviousness for the entire site. The site has a total area of 1.01 ha. Therefore, the infiltration capacity requirement to provide enhanced quality control through infiltration alone would be 27

m^3/ha x 1.01ha = 27.3m^3. Therefore, the 84m^3 of capacity provided in the surface LID features provides more infiltration capacity than required to achieve 80% TSS for the contributing drainage area.

It is notable that the site consists of a large amount of landscape area, which contributes to improved quality of the stormwater runoff. Also, majority of the runoff draining from impervious areas consist of roof runoff, which is generally considered clean. In addition, some of the roof drainage and road drainage will be draining overland across the landscaped portions of the site prior to entering the LID features, which provides an additional level of treatment and promotes further quality control.

The cul-de-sac on the subject site is also expected to be a low traffic area, therefore, there is minimal concerns for hazardous pollutants and sediment caused by vehicular traffic on the site.

4.4.3 Water Balance

As per the criteria provided by the peer review engineer, water balance would be required if soil conditions permit and no water balance target was provided. A hydrogeological report for the site has not yet been prepared and water balance will need to be confirmed during detailed design. Water balance will be provided by the proposed surface LID features, which will promote infiltration, retention and evapotranspiration of the incoming runoff. For this functional servicing report, an equivalent rainfall depth provided for water balance was determined based on the capacity of the LID features. The total volume provided by the LIDs is approximately 84 m^3 and the total impervious area on-site is 4163 m^2. This volume has the capacity to capture a rainfall depth of **20mm** for all impervious areas.

5.0 SITE GRADING

The site will be graded in accordance with the City of Peterborough design standards, requirements under the Accessibility for Ontarians with Disabilities Act (AODA) and building design. The grading design will respect the existing overland drainage patterns in order to

minimize disturbance to the existing site and surrounding land. Refer to **Figure 8** – Conceptual Grading Plan.

6.0 CONCLUSIONS

Based on the assessment provided above, the existing adjacent infrastructure can accommodate the proposed change in land use as follows:

WATER SERVICING:

There is an existing 150mm watermain on the south side of Bishop Street and an existing hydrant east of the proposed entrance. The existing watermain alignment in Bishop Street is to be confirmed during detailed design.

The proposed development will be serviced through a 150mm connection to the existing 150mm watermain on the south side of Bishop Street. The development demand requirement is governed by the maximum day demand plus fire flow of 12,140 L/min while maintaining a minimum pressure of 140 kPa. Through discussions with the Township of Selwyn's peer review engineer, it is understood that the water demand shall be reviewed with the existing overall model for Lakefield during the review of this report.

SANITARY SERVICING:

There is currently an existing 200mm sanitary sewer on Bishop Street, draining west.
The proposed development will be serviced with a proposed manhole and 200mm sanitary sewer extension from Bishop Street into the proposed cul-de-sac. Individual sanitary service connections will be provided at each of the residential units.

In the proposed dry weather conditions, the addition of the proposed development will result in a total flow of **1.34 L/s.** The proposed sanitary sewer servicing the site shall be 200mm running at a minimum slope of 0.50%. The generated flow from the proposed development is only 6%

of the full flow capacity and as a result, the system will operate in a non-surcharged condition. Based on discussions with the Township's peer review engineer, we understand there are no known capacity constraints in the area and that an overall survey and evaluation of the sanitary sewer is underway and can be used to confirm capacity for the development once complete.

STORMWATER SERVICING:

The existing site is 1.01 ha and primarily drains south with a central area draining north to Bishop Street. There are no existing storm sewers on Bishop Street. Stormwater is conveyed overland via ditches on the north and south sides of Bishop Street and through existing culverts under driveways, flowing west.

The site shall be serviced by a proposed storm sewer system that will collect all paved drainage and a portion of the roof drainage from the site. The majority of the post development drainage collected from the cul-de-sac, and front half of lot drainage will drain along the proposed gutterline of the cul-de-sac and into proposed bioretention swales within the ROW approaching Bishop Street. Flows from the piped system will be controlled using an orifice plate in a control manhole which will attenuate discharge to a headwall at the south end of the site via a storm easement between lots 6 and 7. Discharge from the storm sewer outfall and the rear yard and roof drainage will be directed to a proposed rain garden surface LID feature at the south boundary. Site runoff in excess of the LID capacity will be discharged overland to the south of the site through a level spreader.

The majority of the roof drainage and runoff from the backyards are directed to swales on the east and west property boundaries where flow is conveyed overland to the proposed LID at the south property boundary.

Storage will be provided through a combination of the storage available in the LID features, pipe storage and storage in manholes and catchbasins.

We trust the information provided in the report meets with your requirements. Should there be any questions or comments, please feel free to contact the undersigned.

Sincerely,

Counterpoint Engineering Inc.

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Karl Repka P.Eng
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Appendix A
Figures

BISHOP STREET

ASPHALT EDGE

POU

ASPHALT DRIVEWAY

#43
2 STOREY BRICK
DWELLING

#49
1 STOREY FRAME
DWELLING

BOARD FENCE

RAIL FENCE

BRICK SIDEWALK

GATE

BOARD FENCE

BIRD FEEDER

BOARD FENCE

LOT 1

LOT 2

LOT 3

LOT 4

BLOCK 1
TOWNHOUSES

LOT 16

LOT 15

LOT 14

LOT 13

BLOCK 3
TOWNHOUSES

LOT 5

LOT 6

LOT 7

LOT 8

LOT 9

LOT 10

LOT 11

LOT 12

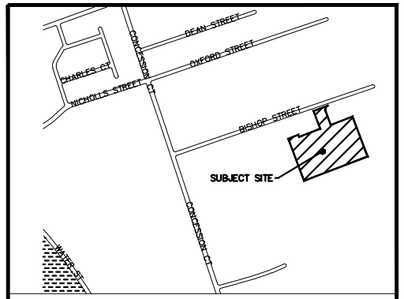
BLOCK 2
SEMI-DETACHED

POST & WIRE FENCE

POST & WIRE FENCE

POST & WIRE FENCE

POST & WIRE FENCE



KEY PLAN

LEGEND

PROPERTY LINE

counterpoint ENGINEERING

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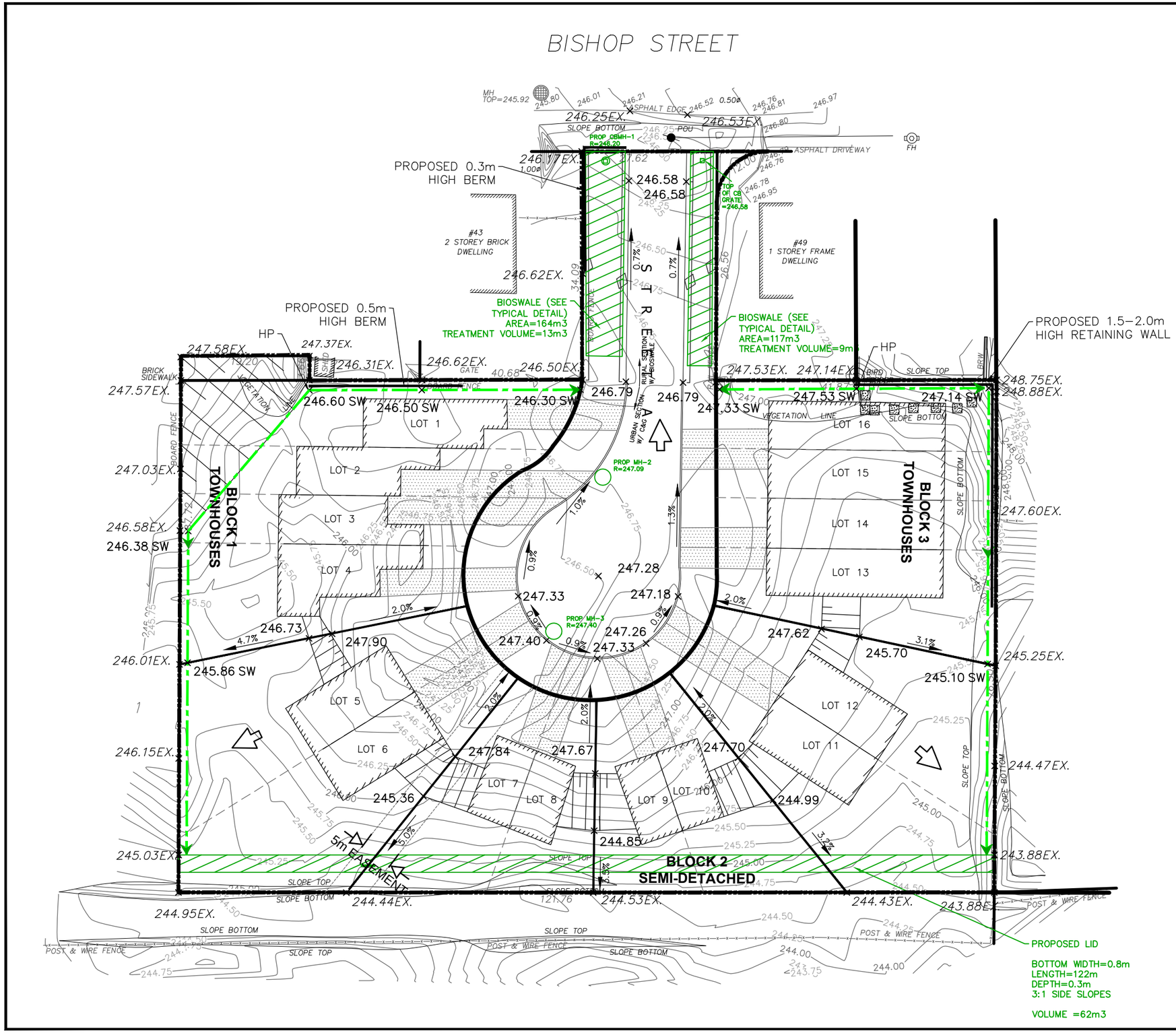
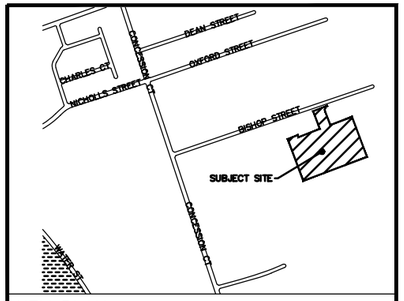
45 BISHOP STREET
RESIDENTIAL DEVELOPMENT
LAKEFIELD, ONTARIO

GENERAL PLAN

DESIGNED BY: JP	DATE: NOV 2020
CHECKED BY: KR	PROJECT No. 20013
DRAWING BY: JP	
CHECKED BY: KR	FIGURE No. 2
SCALE: 1:600	





KEY PLAN

LEGEND

- PROPERTY LINE
- ×246.58EX. EXISTING ELEVATION
- 246.58 EXISTING CONTOUR
- ×246.58 PROPOSED ELEVATION
- EMERGENCY OVERLAND FLOW
- PROPOSED STORM CATCHBASIN MANHOLE
- PROPOSED STORM CATCHBASIN
- PROPOSED SURFACE STORAGE/LID FEATURE
- PROPOSED SWALE
- PROPOSED STORM SEWER
- 2.0% PROPOSED SLOPE

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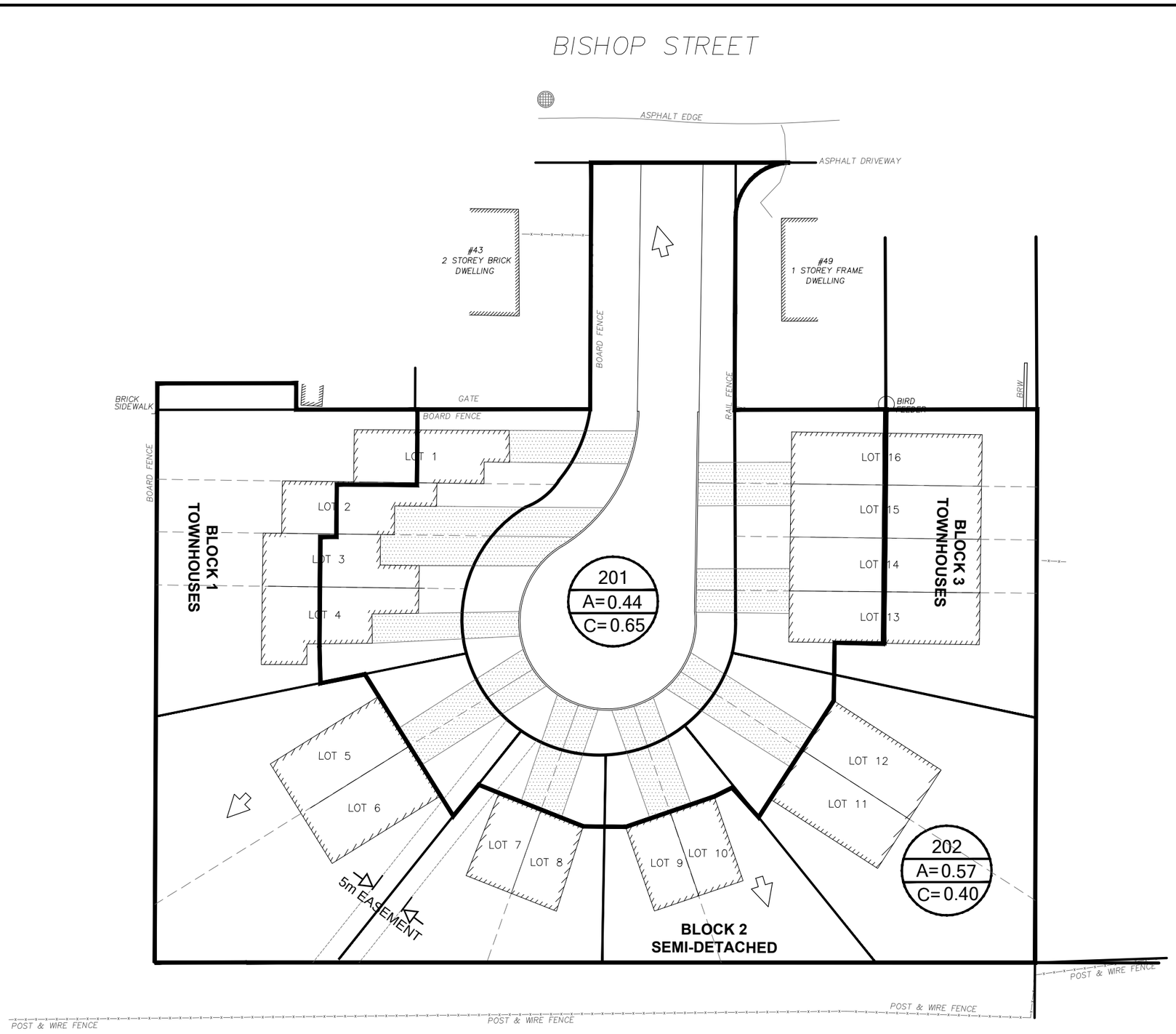
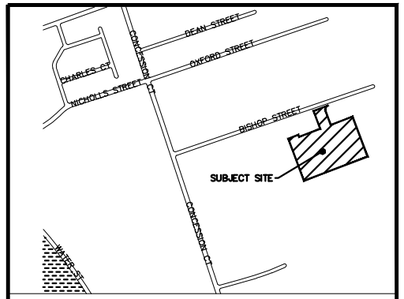
45 BISHOP STREET
RESIDENTIAL DEVELOPMENT
LAKEFIELD, ONTARIO

CONCEPTUAL GRADING PLAN

DESIGNED BY:	JP	DATE:	NOV 2020
CHECKED BY:	KR	PROJECT No.	20013
DRAWING BY:	JP		
CHECKED BY:	KR	FIGURE No.	8
SCALE:	1:600		





KEY PLAN

LEGEND

101
A=0.26
C=0.25

- AREA ID
- DRAINAGE AREA (HA)
- RUNOFF COEFFICIENT
- DRAINAGE BOUNDARY
- OVERLAND FLOW PATH

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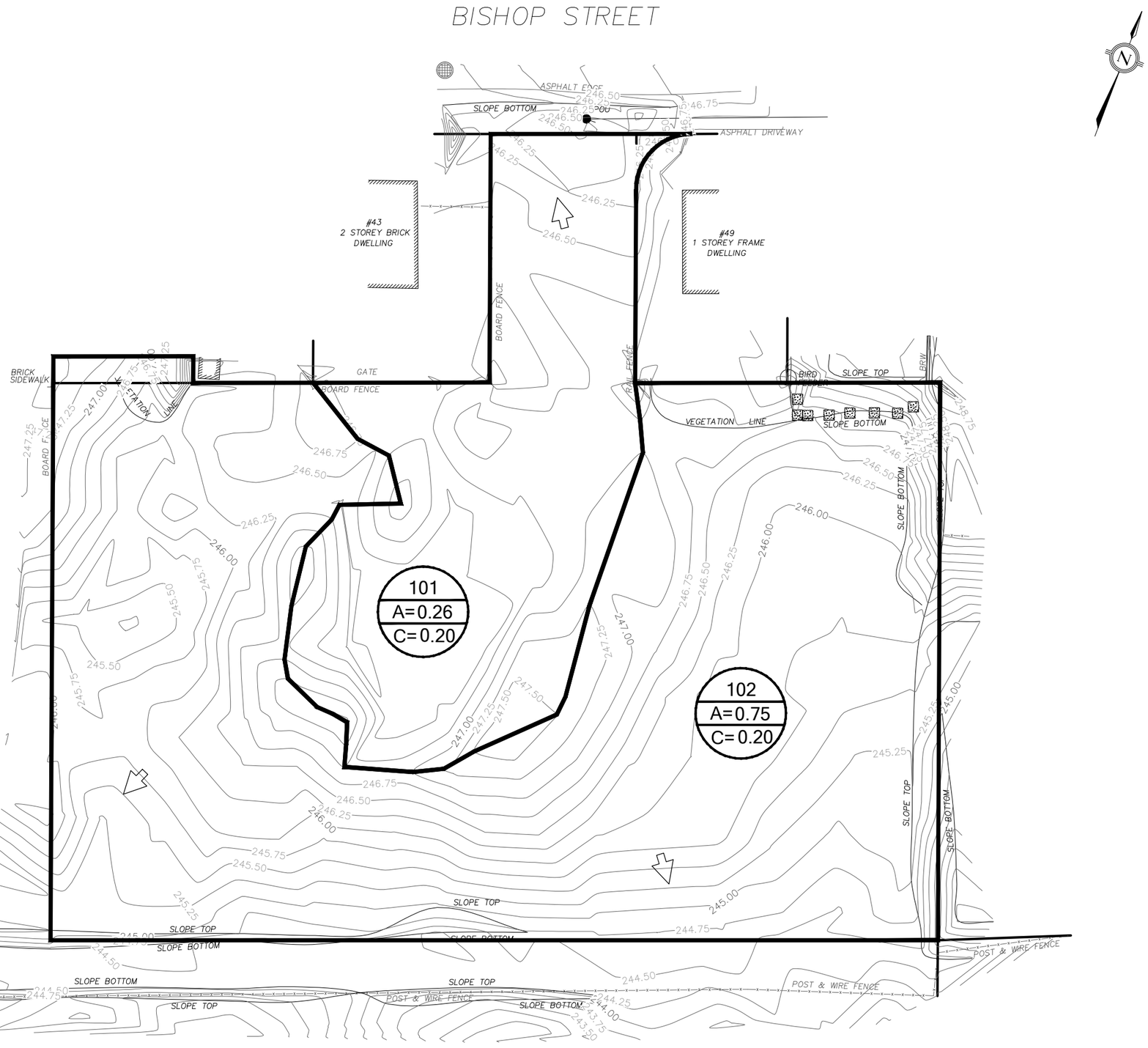
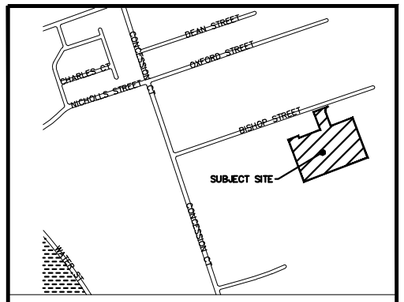
RESIDENTIAL DEVELOPMENT
LAKEFIELD, ONTARIO

POST-DEVELOPMENT DRAINAGE PLAN

DESIGNED BY: JP	DATE: NOV 2020
CHECKED BY: KR	PROJECT No. 20013
DRAWING BY: JP	
CHECKED BY: KR	FIGURE No. 7
SCALE: 1:600	





KEY PLAN

LEGEND

101 — AREA ID
A=0.26 — DRAINAGE AREA (HA)
C=0.25 — RUNOFF COEFFICIENT

DRAINAGE BOUNDARY

OVERLAND FLOW PATH

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45 BISHOP STREET
RESIDENTIAL DEVELOPMENT
LAKEFIELD, ONTARIO

PRE-DEVELOPMENT DRAINAGE PLAN

DESIGNED BY: JP	DATE: NOV 2020
CHECKED BY: KR	PROJECT No. 20013
DRAWING BY: JP	
CHECKED BY: KR	FIGURE No. 6
SCALE: 1:600	

BISHOP STREET

EX 200ø SAN

EX MH
242.95

EX 200ø SAN
243.08

243.71

PROP MH–1
R=245.51

243.71

EX 200ø SAN

243.80

244.67

EX MH

BREAK INTO EX SAN AND INSTALL PROPOSED MANHOLE.

ASPHALT TOOL

SLOPE BOTTOM

POU

CROSSING

ASPHALT DRIVEWAY

#43
2 STOREY BRICK DWELLING

#49
1 STOREY FRAME DWELLING

BOARD FENCE

PROP 200mm SAN
S=0.50% L=59.96m

STREET A

RAIL FENCE

BRICK SIDEWALK

VEGETATION LINE

GATE

BOARD FENCE

BIRD FEEDER

SLOPE TOP

BRW

VEGETATION LINE

SLOPE BOTTOM

LOT 1

LOT 2

LOT 3

LOT 4

LOT 16

LOT 15

LOT 14

LOT 13

BLOCK 1
TOWNHOUSES

BLOCK 3
TOWNHOUSES

SLOPE BOTTOM

PROP MH–2
R=247.07

244.10

PROP 200mm SAN
S=1.00% L=15.14m

244.16

244.31

PROP MH–3
R=247.28

LOT 5

LOT 6

LOT 7

LOT 8

LOT 9

LOT 10

LOT 11

LOT 12

SLOPE TOP

SLOPE BOTTOM

BLOCK 2
SEMI-DETACHED

SLOPE TOP

SLOPE BOTTOM

SLOPE TOP

SLOPE BOTTOM

POST & WIRE FENCE

SLOPE BOTTOM

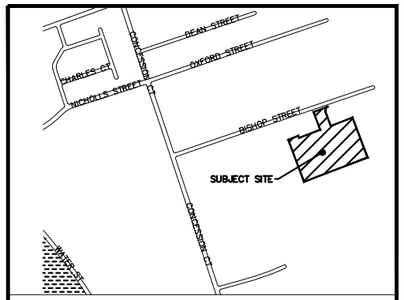
SLOPE TOP

POST & WIRE FENCE

SLOPE TOP

SLOPE BOTTOM

POST & WIRE FENCE



KEY PLAN

LEGEND

PROPERTY LINE

EXISTING SANITARY SEWER

EXISTING SANITARY MANHOLE

PROPOSED SANITARY SEWER

PROPOSED SANITARY MANHOLE

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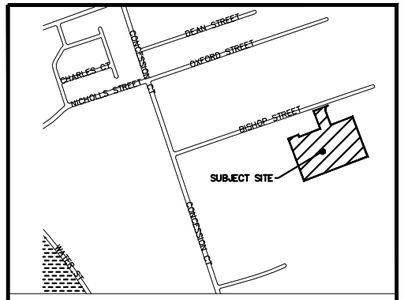
45 BISHOP STREET
RESIDENTIAL DEVELOPMENT
LAKEFIELD, ONTARIO

SANITARY SERVICING PLAN

DESIGNED BY: JP	DATE: NOV 2020
CHECKED BY: KR	PROJECT No. 20013
DRAWING BY: JP	
CHECKED BY: KR	FIGURE No. 4
SCALE: 1:600	



KEY PLAN

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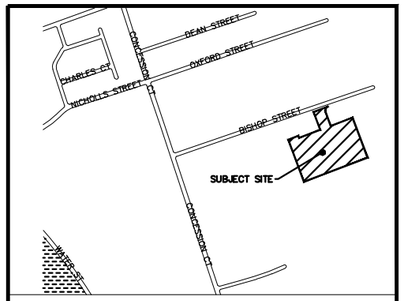
45 BISHOP STREET
RESIDENTIAL DEVELOPMENT
LAKEFIELD, ONTARIO

SITE LOCATION PLAN

DESIGNED BY: JP	DATE: NOV 2020
CHECKED BY: KR	PROJECT No. 20013
DRAWING BY: JP	
CHECKED BY: KR	FIGURE No. 1
SCALE: N.T.S	

BISHOP STREET

ASPHALT EDGE
SLOPE BOTTOM
POU
ASPHALT DRIVEWAY
PROP CBMH-1
R=246.20
245.39
245.48
245.58
PROP
250mm
@0.70%
TOP
OF
CB
GRATE
=246.58
#43
2 STOREY BRICK
DWELLING
PROP
250mm
STM
@1.30%
PROPOSED LID
PROPOSED LID
#49
1 STOREY FRAME
DWELLING
BOARD FENCE
RAIL FENCE
BRICK
SIDEWALK
VEGETATION LINE
GATE
BOARD FENCE
BIRD
FEEDER
SLOPE TOP
BRW
VEGETATION LINE
SLOPE BOTTOM
LOT 16
LOT 1
LOT 2
LOT 3
LOT 4
LOT 15
LOT 14
LOT 13
BLOCK 1
TOWNHOUSES
BLOCK 3
TOWNHOUSES
PROP MH-2
R=247.09
245.25
245.19
245.14
PROP 825mm
STM @0.20%
125mm ORIFACE
PLATE
PROP MH-3
R=247.40
45.08
5m EASEMENT
PROPOSED
SWALE
PROPOSED
SWALE
LOT 5
LOT 6
LOT 7
LOT 8
LOT 9
LOT 10
LOT 11
LOT 12
PROP 250mm
STM @1.10%
HEADWALL
244.59
SLOPE TOP
SLOPE BOTTOM
BLOCK 2
SEMI-DETACHED
PROPOSED LID
POST & WIRE FENCE
SLOPE BOTTOM
SLOPE TOP
POST & WIRE FENCE
SLOPE TOP
POST & WIRE FENCE
SLOPE BOTTOM
BOTTOM WIDTH=0.8m
LENGTH=122m
DEPTH=0.3m
3:1 SIDE SLOPES
VOLUME =62m3



KEY PLAN

LEGEND

- PROPERTY LINE
- PROPOSED STORM CATCHBASIN MANHOLE
- PROPOSED STORM CATCHBASIN
- PROPOSED SURFACE STORAGE/LID FEATURE
- PROPOSED SWALE
- PROPOSED STORM SEWER

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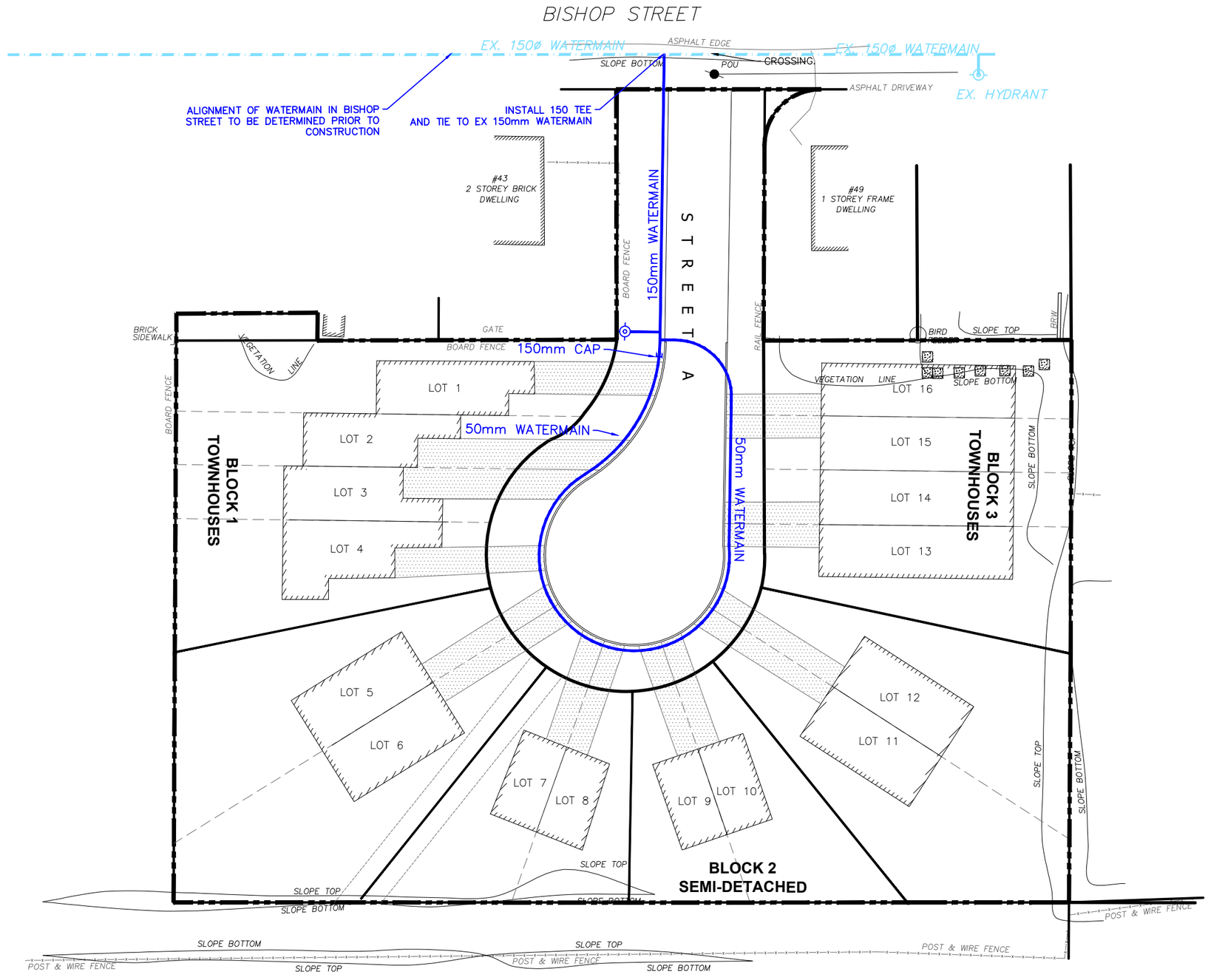
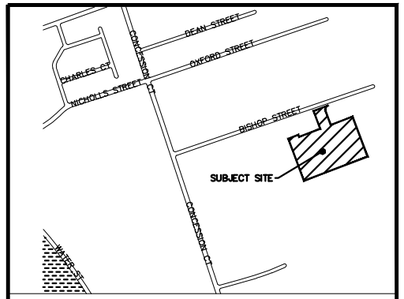
45 BISHOP STREET
RESIDENTIAL DEVELOPMENT
LAKEFIELD, ONTARIO

STORM SERVICING PLAN

DESIGNED BY: JP	DATE: NOV 2020
CHECKED BY: KR	PROJECT No. 20013
DRAWING BY: JP	
CHECKED BY: KR	FIGURE No. 5
SCALE: 1:600	





KEY PLAN

LEGEND

- PROPERTY LINE
- EXISTING WATERMAIN
- EXISTING HYDRANT
- PROPOSED WATERMAIN
- PROPOSED HYDRANT

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45 BISHOP STREET
RESIDENTIAL DEVELOPMENT
LAKEFIELD, ONTARIO

WATER SERVICING PLAN

DESIGNED BY: JP	DATE: NOV 2020
CHECKED BY: KR	PROJECT No. 20013
DRAWING BY: JP	
CHECKED BY: KR	FIGURE No. 3
SCALE: 1:600	

Appendix B

Water Demand Calculations

Counterpoint Engineering Inc.

Water Demand Design Calculations

Project:	**45 Bishop Street**
Project No:	**20013**
Location:	**Lakefield, Ontario**
Site Area:	1.01 ha

Equivalent Population per Land Use (as per City of Peterborough)

Single Family	3.5	ppu
Semi-Detached, 3+ BD Townhouse	3.5	ppu
2 BD Townhouse	2.4	ppu
2-3 BD Apartment	2.0	ppu
1 BD Apartment	1.6	ppu

	Townhouse	Semi-detached	Commercial (m^2)	Residential Population
Proposed Development	8	8	-	47
TOTAL UNITS / AREA (m^2)	8	8	-	**47**

	Residential Population	TOTAL POPULATION
Residential	47	47
Commercial	-	0
Total Equivalent Population		**47**

City of Peterborough Watermain Guidelines

Per Capita Demand

Average Daily Demand	450	(L/capita/day)

Commercial Demand	1.15	L/s/ha

Peaking Factors

Land Use	Minimum Hour	Maximum Day	Maximum Hour	
Residential	0.10	9.50	14.30	(MECP factors for equivalent population of 30)

Proposed Site

Water Demand based on Equivalent Population

	Population	Average Daily Usage (L/min)	Maximum Hour (L/min)	Maximum Day (L/min)	Fire Flow Required (L/min)	Water Demand (L/min)
Residential	47	15	211	140	12,000	12,140
Commercial	0	0	0	0	0	0
Totals	**47**	**15**	**211**	**140**	**12,000**	**12,140**

Counterpoint Engineering Inc.

REQUIRED FIRE FLOW WORKSHEET - PROPOSED DEVELOPMENT TOWNHOUSE BLOCK 1

Fire Underwriters Survey

Project : **45 Bishop Street**
Project No: **20013**

Guide for Determination of Required Flow Copyright I.S.O

$$F = 220C\sqrt{A}$$ where

F = the required fire flow in litres per minute.
C = coefficient related to the type of construction.
= 1.5 for wood frame construction (structure essentially all combustible).
= 1.0 for ordinary construction (brick or other masonry walls, combustible floor and interior).
= 0.8 for non-combustible construction (unprotected metal structural components, masonry or metal walls).
= 0.6 for fire-resistive construction (fully protected frame, floors, roof).

A = The total floor area in square metres (including all storeys, but excluding basements at least 50 percent below grade) in the building being considered.

Type of Construction		Class Factor
WF	Wood Frame	1.5
OC	Ordinary Construction	1.0
NC	Non-Combustible	0.8
FC	Fire-Resistive	0.6

Contents		% Reduction
NC	Non-Combustible	25
LC	Limited Combustible	15
C	Combustible	0
FB	Free Burning	15
RB	Rapid Burning	25

Area Notes for Fire Resistive Buildings (from FUS manual, 1999):

If Vertical Openings are inadequately protected (less than 1-hour fire rating): Area is the total of the two largest adjoining floors (above ground level) plus 50% of the area of each of the next 8 adjoining floors above that.

If Vertical Openings are adequately protected (at least 1-hour fire rating): Area is the total of the largest floor (above ground level) plus 25% of the area of each of the next 2 immediately adjoining floors above that.

1) Fire Flow

Type of Construction: WF
C= 1.5
A*= 594 m^2
F= 8,000 **L/min** (rounded to nearest 1,000 L/min)

Assuming fire walls are installed as per building code.

2) Occupancy Reduction/Surcharge

Contents Factor: C
Reduction/Surcharge of 0% = 0 L/min
F= 8000L/min + 0 L/min = 8,000 **L/min**

3) System Type Reduction

NFPA 13 Sprinkler:	NO	0%
Standard Water Supply:	NO	0%
Fully Supervised:	NO	0%
Total		0%

Reduction of 0% L/min = 0 L/min
F= 8000L/min - 0 L/min = 8,000 **L/min**

4) Separation Charge

Building Face	Dist(m)	Charge	
North	25	10%	(fire wall between adjacent units-10% charge)
East	52	0%	
South	8	20%	
West	20	15%	
Total		45%	**of** 8000 **L/min** = 3,600 **L/min**

(max exposure charge can be 75%)

Separation	Charge	Separation	Charge
0 to 3m	25%	20.1 to 30 m	10%
3.1 to 10m	20%	30.1 to 45m	5%
10.1 to 20m	15%		

F= 8000L/min + 3600L/min = 11,600 **L/min** (2,000L/min<F<45,000L/min)

F=	12,000	**L/min**
F=	200	**L/s**
F=	3,170	**gpm**

(round to the nearest 1,000L/min)

Appendix C

Sanitary Design Flow Calculations

Counterpoint Engineering Inc.

Project: 45 Bishop Street
Project No: 20013
Location: Lakefield, Ontario
Site Area: 1.01 ha

Proposed Sanitary Flow Calculations

As per Engineering Design Standards, City of Peterborough, 2019

Design flow = (Population in Thousands x Average Daily Flow x Peaking Factor)/86.4 + (Infiltration Rate x Area)

Persons Per Unit and per Land Use

Single Family	3.5	ppu
Semi-Detached, 3+ BD Townhouse	3.5	ppu
2 BD Townhouse	2.4	ppu
2-3 BD Apartment	2.0	ppu
1 BD Apartment	1.6	ppu
Commercial / Retail	1.15	l/s/ha

	Residential Units			Retail
	Townhouse	**Semi-detached**	**Total Units**	**Area (m^2)**
TOTAL UNITS / AREA (m^2)	**8**	**8**	**16**	**-**

	Population	TOTAL POPULATION
Residential	47	47
Commercial	-	n/a
Total Equivalent Population		**47**

Peak Flow Design Parameters

Residential Average flow	450	litres/person/day
Commercial Average flow	1.15	l/s/ha
Infiltration	0.28	litres/second/ha

Harmon Peaking Factor

PF = 1 + (14/(4+(P/1000)$^{1/2}$))

Residential Population	Harmon Peak Factor
47	**4.32**

Residential Flow	1.06	**l/s**
Commercial Flow	-	**l/s**
Infiltration	0.28	**l/s**
Groundwater Flows	0.00	**l/s**
Flow	**1.34**	**l/s**

Appendix D

Stormwater Management Design Calculations

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SWM DESIGN CALCULATIONS
DRAINAGE AREAS AND RUNOFF COEFFICIENT CALCULATIONS

Project Name: 45 Bishop Street
Prepared by: J.L.
Municipality: Township of Selwyn, ON
Project No.: 20013
Last Revised: 4-Dec-20
Date: 4-Dec-20

Adjustment Ratio:	1	1.1	1.2	1.25
Runoff Coefficients:	**2 to 10-year**	**25-year**	**50-year**	**100-year**
Landscaped/Grass:	0.20	0.22	0.24	0.25
Gravel:	0.50	0.55	0.60	0.63
Pavement:	0.95	1.00	1.00	1.00
Roof:	0.95	1.00	1.00	1.00

Runoff Coefficients based on City of Peterborough Design Standards

PRE DEVELOPMENT CONDITIONS

Area 101 Properties:

Grass (m^2)	Gravel (m^2)	Pavement (m^2)	Roof (m^2)	Total Area (m^2)	Total Area (ha)
2621	0	0	0	2621	0.26

Area 101 Runoff Coefficients for Corresponding Storms:

Storm Event:	2 to 10-Year	25-Year	50-Year	100-Year
	0.20	0.22	0.24	0.25

Area 102 Properties:

Grass (m^2)	Gravel (m^2)	Pavement (m^2)	Roof (m^2)	Total Area (m^2)	Total Area (ha)
7461	0	0	0	7461	0.75

Area 102 Runoff Coefficients for Corresponding Storms:

Storm Event:	2 to 10-Year	25-Year	50-Year	100-Year
	0.20	0.22	0.24	0.25

POST DEVELOPMENT CONDITIONS

Area 201 Properties:

Grass (m^2)	Gravel (m^2)	Pavement (m^2)	Roof (m^2)	Total Area (m^2)	Total Area (ha)
1786		1929	689	4405	0.44

Area 201 Runoff Coefficients for Corresponding Storms:

Storm Event:	2 to 10-Year	25-Year	50-Year	100-Year
	0.65	0.68	0.69	0.70

Area 202 Properties:

Grass (m^2)	Gravel (m^2)	Pavement (m^2)	Roof (m^2)	Total Area (m^2)	Total Area (ha)
4136			1545	5680	0.57

Area 202 Runoff Coefficients for Corresponding Storms:

Storm Event:	2 to 10-Year	25-Year	50-Year	100-Year
	0.40	0.43	0.45	0.45

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SWM DESIGN CALCULATIONS
Pre-Development 2-Year Flow Rate Calculations for Area 101

Project Name: 45 Bishop Street
Municipality: Township of Selwyn, ON
Project No.: 20013
Date: 4-Dec-20

Prepared by: J.L.
Last Revised: 4-Dec-20

Rainfall Data

Location:	City of Peterborough, ON	a	662
Event	2-year	b	7.5
		c	0.79

Site Data

Area (ha)	0.26
Runoff Coefficient	0.20
AC	0.05
Tc (min)	10
Rainfall Intensity (mm/hr)	69
Rational Flow Rate (l/s)	**10**

The Rational Equation:

$$Q = \frac{(C)(i)(A)}{360}$$

where,

Q = the design flow (m^3/s)
C = the site specific runoff coefficient
A = the drainage area (ha)
i = rainfall intensity (mm/hr)

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SWM DESIGN CALCULATIONS
Pre-Development 5-Year Flow Rate Calculations for Area 101

Project Name: 45 Bishop Street
Municipality: Township of Selwyn, ON
Project No.: 20013
Date: 4-Dec-20

Prepared by: J.L.
Last Revised: 4-Dec-20

Rainfall Data

Location:	City of Peterborough, ON	a	1098
Event	5-year	b	10.1
		c	0.83

Site Data

Area (ha)	0.26
Runoff Coefficient	0.20
AC	0.05
Tc (min)	10
Rainfall Intensity (mm/hr)	91
Rational Flow Rate (l/s)	**13**

The Rational Equation:

$$Q = \frac{(C)(i)(A)}{360}$$

where,

Q = the design flow (m^3/s)
C = the site specific runoff coefficient
A = the drainage area (ha)
i = rainfall intensity (mm/hr)

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SWM DESIGN CALCULATIONS
Pre-Development 10-Year Flow Rate Calculations for Area 101

Project Name: 45 Bishop Street
Municipality: Township of Selwyn, ON
Project No.: 20013
Date: 4-Dec-20

Prepared by: J.L.
Last Revised: 4-Dec-20

Rainfall Data

Location:	City of Peterborough, ON	a	1560
Event	10-year	b	13
		c	0.860

Site Data

Area (ha)	0.26
Runoff Coefficient	0.20
AC	0.05
Tc (min)	10
Rainfall Intensity (mm/hr)	105
Rational Flow Rate (l/s)	**15**

The Rational Equation:

$$Q = \frac{(C)(i)(A)}{360}$$

where,

Q = the design flow (m^3/s)
C = the site specific runoff coefficient
A = the drainage area (ha)
i = rainfall intensity (mm/hr)

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SWM DESIGN CALCULATIONS
Pre-Development 25-Year Flow Rate Calculations for Area 101

Project Name: 45 Bishop Street
Municipality: Township of Selwyn, ON
Project No.: 20013
Date: 4-Dec-20

Prepared by: J.L.
Last Revised: 4-Dec-20

Rainfall Data

Location:	City of Peterborough, ON	a	2010
Event	25-year	b	14
		c	0.88

Site Data

Area (ha)	0.26
Runoff Coefficient	0.22
AC	0.06
Tc (min)	10
Rainfall Intensity (mm/hr)	123
Rational Flow Rate (l/s)	**20**

The Rational Equation:

$$Q = \frac{(C)(i)(A)}{360}$$

where,

Q = the design flow (m^3/s)
C = the site specific runoff coeffici
A = the drainage area (ha)
i = rainfall intensity (mm/hr)

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SWM DESIGN CALCULATIONS
Pre-Development 50-Year Flow Rate Calculations for Area 101

Project Name: 45 Bishop Street
Municipality: Township of Selwyn, ON
Project No.: 20013
Date: 4-Dec-20

Prepared by: J.L.
Last Revised: 4-Dec-20

Rainfall Data

Location:	City of Peterborough, ON	a	2200
Event	50-year	b	14.6
		c	0.87

Site Data

Area (ha)	0.26
Runoff Coefficient	0.24
AC	0.06
Tc (min)	10
Rainfall Intensity (mm/hr)	136
Rational Flow Rate (l/s)	**24**

The Rational Equation:

$$Q = \frac{(C)(i)(A)}{360}$$

where,

Q = the design flow (m^3/s)
C = the site specific runoff coefficie
A = the drainage area (ha)
i = rainfall intensity (mm/hr)

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SWM DESIGN CALCULATIONS
Pre-Development 100-Year Flow Rate Calculations for Area 101

Project Name: 45 Bishop Street
Municipality: Township of Selwyn, ON
Project No.: 20013
Date: 3-Dec-20

Prepared by: J.L.
Last Revised: 3-Dec-20

Rainfall Data

Location:	City of Peterborough, ON	a	2507
Event	100-year	b	14.8
		c	0.88

Site Data

Area (ha)	0.26
Runoff Coefficient	0.25
AC	0.07
Tc (min)	10
Rainfall Intensity (mm/hr)	149
Rational Flow Rate (l/s)	**27**

The Rational Equation:

$$Q = \frac{(C)(i)(A)}{360}$$

where,

Q = the design flow (m^3/s)
C = the site specific runoff coe
A = the drainage area (ha)
i = rainfall intensity (mm/hr)

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SWM DESIGN CALCULATIONS
Pre-Development 2-Year Flow Rate Calculations for Area 102

Project Name: 45 Bishop Street
Municipality: Township of Selwyn, ON
Project No.: 20013
Date: 4-Dec-20

Prepared by: J.L.
Last Revised: 4-Dec-20

Rainfall Data

Location:	City of Peterborough, ON	a	662
Event	2-year	b	7.5
		c	0.79

Site Data

Area (ha)	0.75
Runoff Coefficient	0.20
AC	0.15
Tc (min)	10
Rainfall Intensity (mm/hr)	69
Rational Flow Rate (l/s)	**29**

The Rational Equation:

$$Q = \frac{(C)(i)(A)}{360}$$

where,

Q = the design flow (m^3/s)
C = the site specific runoff coefficient
A = the drainage area (ha)
i = rainfall intensity (mm/hr)

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SWM DESIGN CALCULATIONS
Pre-Development 5-Year Flow Rate Calculations for Area 102

Project Name: 45 Bishop Street
Municipality: Township of Selwyn, ON
Project No.: 20013
Date: 4-Dec-20

Prepared by: J.L.
Last Revised: 4-Dec-20

Rainfall Data

Location:	City of Peterborough, ON	a	1098
Event	5-year	b	10.1
		c	0.83

Site Data

Area (ha)	0.75
Runoff Coefficient	0.20
AC	0.15
Tc (min)	10
Rainfall Intensity (mm/hr)	91
Rational Flow Rate (l/s)	**38**

The Rational Equation:

$$Q = \frac{(C)(i)(A)}{360}$$

where,

Q = the design flow (m^3/s)
C = the site specific runoff coefficient
A = the drainage area (ha)
i = rainfall intensity (mm/hr)

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SWM DESIGN CALCULATIONS
Pre-Development 10-Year Flow Rate Calculations for Area 102

Project Name: 45 Bishop Street
Municipality: Township of Selwyn, ON
Project No.: 20013
Date: 4-Dec-20

Prepared by: J.L.
Last Revised: 4-Dec-20

Rainfall Data

Location:	City of Peterborough, ON	a	1560
Event	10-year	b	13
		c	0.860

Site Data

Area (ha)	0.75
Runoff Coefficient	0.20
AC	0.15
Tc (min)	10
Rainfall Intensity (mm/hr)	105
Rational Flow Rate (l/s)	**44**

The Rational Equation:

$$Q = \frac{(C)(i)(A)}{360}$$

where,

Q = the design flow (m^3/s)
C = the site specific runoff coefficient
A = the drainage area (ha)
i = rainfall intensity (mm/hr)

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SWM DESIGN CALCULATIONS
Pre-Development 25-Year Flow Rate Calculations for Area 102

Project Name: 45 Bishop Street
Municipality: Township of Selwyn, ON
Project No.: 20013
Date: 4-Dec-20

Prepared by: J.L.
Last Revised: 4-Dec-20

Rainfall Data

Location:	City of Peterborough, ON	a	2010
Event	25-year	b	14
		c	0.88

Site Data

Area (ha)	0.75
Runoff Coefficient	0.22
AC	0.16
Tc (min)	10
Rainfall Intensity (mm/hr)	123
Rational Flow Rate (l/s)	**56**

The Rational Equation:

$$Q = \frac{(C)(i)(A)}{360}$$

where,

Q = the design flow (m^3/s)
C = the site specific runoff coeffici
A = the drainage area (ha)
i = rainfall intensity (mm/hr)

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SWM DESIGN CALCULATIONS
Pre-Development 50-Year Flow Rate Calculations for Area 102

Project Name: 45 Bishop Street
Municipality: Township of Selwyn, ON
Project No.: 20013
Date: 4-Dec-20

Prepared by: J.L.
Last Revised: 4-Dec-20

Rainfall Data

Location:	City of Peterborough, ON	a	2200
Event	50-year	b	14.6
		c	0.87

Site Data

Area (ha)	0.75
Runoff Coefficient	0.24
AC	0.18
Tc (min)	10
Rainfall Intensity (mm/hr)	136
Rational Flow Rate (l/s)	68

The Rational Equation:

$$Q = \frac{(C)(i)(A)}{360}$$

where,

Q = the design flow (m^3/s)
C = the site specific runoff coefficie
A = the drainage area (ha)
i = rainfall intensity (mm/hr)

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SWM DESIGN CALCULATIONS
Pre-Development 100-Year Flow Rate Calculations for Area 102

Project Name: 45 Bishop Street
Prepared by: J.L.
Municipality: Township of Selwyn, ON
Project No.: 20013
Last Revised: 3-Dec-20
Date: 3-Dec-20

Rainfall Data

Location:	City of Peterborough, ON	a	2507
Event	100-year	b	14.8
		c	0.88

The Rational Equation:

$$Q = \frac{(C)(i)(A)}{360}$$

where,

Q = the design flow (m^3/s)
C = the site specific runoff coe
A = the drainage area (ha)
i = rainfall intensity (mm/hr)

Site Data

Area (ha)	0.75
Runoff Coefficient	0.25
AC	0.19
Tc (min)	10
Rainfall Intensity (mm/hr)	149
Rational Flow Rate (l/s)	**77**

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SWM DESIGN CALCULATIONS
Storage Calculations for 100-Year Storm Event for Area 201 - North

Project Name: 45 Bishop Street
Municipality: Township of Selwyn, ON
Project No.: 20013
Date: 3-Dec-20

Prepared by: J.L.
Last Revised: 3-Dec-20

Rainfall Data

Location:	City of Peterborough, ON	a			2507
Event	100-year	b			14.8
		c			0.88

Site Data

Area (ha)	0.44
Runoff Coefficient	0.70
AC	0.31
Tc (min)	10
Time Increment (min)	5
Release Rate (l/s)	27
Storage Required (m^3)	0

Pre-dev Release Rate north to Bishop Street

The Rational Equation:

$$Q = \frac{(C)(i)(A)}{360}$$

where,

Q = the design flow (m^3/s)
C = the site specific runoff coefficient
A = the drainage area (ha)
i = rainfall intensity (mm/hr)

Time	Rainfall Intensity	Storm Runoff	Runoff to Bishop	Runoff to South	Runoff Volume to Bishop	Runoff Volume to South	Released Volume to Bishop	Released Volume to South	Storage Volume for North LIDs*
(min)	(mm/hr)	(m^3/s)	(m^3/s)	(m^3/s)	(m^3)	(m^3)	(m^3)	(m^3)	(m^3)
10	149	0.127	0.027	0.100	16	60	16	60	N/A
15	126	0.108	0.027	0.081	24	73	24	73	N/A
20	110	0.094	0.027	0.067	32	80	32	80	N/A
25	98	0.084	0.027	0.057	41	85	41	85	N/A
30	88	0.075	0.027	0.048	49	87	49	87	N/A
35	80	0.069	0.027	0.042	57	87	57	87	N/A
40	74	0.063	0.027	0.036	65	86	65	86	N/A
45	68	0.058	0.027	0.031	73	85	73	85	N/A
50	64	0.054	0.027	0.027	81	82	81	82	N/A
55	60	0.051	0.027	0.024	89	79	89	79	N/A
60	56	0.048	0.027	0.021	97	75	97	75	N/A
65	53	0.045	0.027	0.018	105	71	105	71	N/A
70	50	0.043	0.027	0.016	113	67	113	67	N/A
75	48	0.041	0.027	0.014	122	62	122	62	N/A
80	46	0.039	0.027	0.012	130	57	130	57	N/A
85	44	0.037	0.027	0.010	138	52	138	52	N/A
90	42	0.036	0.027	0.009	146	47	146	47	N/A
95	40	0.034	0.027	0.007	154	41	154	41	N/A
100	39	0.033	0.027	0.006	162	35	162	35	N/A
105	37	0.032	0.027	0.005	170	29	170	29	N/A
110	36	0.031	0.027	0.004	178	23	178	23	N/A
115	35	0.030	0.027	0.003	186	17	186	17	N/A
120	33	0.029	0.027	0.002	194	11	194	11	N/A
125	32	0.028	0.027	0.001	203	5	203	5	N/A
130	31	0.027	0.027	0.000	209	0	211	0	N/A
135	31	0.026	0.026	0.000	211	0	219	0	N/A
140	30	0.025	0.025	0.000	212	0	227	0	N/A
145	29	0.025	0.025	0.000	214	0	235	0	N/A
150	28	0.024	0.024	0.000	215	0	243	0	N/A
155	27	0.023	0.023	0.000	217	0	251	0	N/A
160	27	0.023	0.023	0.000	218	0	259	0	N/A
165	26	0.022	0.022	0.000	219	0	267	0	N/A
170	25	0.022	0.022	0.000	221	0	275	0	N/A
175	25	0.021	0.021	0.000	222	0	284	0	N/A
180	24	0.021	0.021	0.000	223	0	292	0	N/A
185	24	0.020	0.020	0.000	224	0	300	0	N/A
190	23	0.020	0.020	0.000	225	0	308	0	N/A
195	23	0.019	0.019	0.000	226	0	316	0	N/A
200	22	0.019	0.019	0.000	227	0	324	0	N/A
205	22	0.019	0.019	0.000	228	0	332	0	N/A
210	21	0.018	0.018	0.000	229	0	340	0	N/A
215	21	0.018	0.018	0.000	230	0	348	0	N/A
220	21	0.018	0.018	0.000	231	0	356	0	N/A
225	20	0.017	0.017	0.000	232	0	365	0	N/A
230	20	0.017	0.017	0.000	233	0	373	0	N/A

*27L/s weir control to Bishop. Excess flow captured by storm sewer to direct flows to the south

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SWM DESIGN CALCULATIONS
Storage Calculations for 100-Year Storm Event for Area 201 - South

Project Name: 45 Bishop Street
Municipality: Township of Selwyn, ON
Project No.: 20013
Date: 7-Dec-20

Prepared by: J.L.
Last Revised: 7-Dec-20

Rainfall Data

Location:	City of Peterborough, ON	a	2507
Event	100-year	b	14.8
		c	0.88

The Rational Equation:

$$Q = \frac{(C)(i)(A)}{360}$$

where,

Q = the design flow (m^3/s)
C = the site specific runoff
A = the drainage area (ha
i = rainfall intensity (mm/h

Site Data

Area (ha)	0.44
Runoff Coefficient	0.70
AC	0.31
Tc (min)	10
Time Increment (min)	5
Release Rate (l/s)	46
Storage Required (m^3)	**32**

60% of allowable release rate from Area 102 is allocated to Area 201

Time	Rainfall Intensity	Storm Runoff	Runoff Volume	Released Volume	Storage Volume	
(min)	(mm/hr)	(m^3/s)	(m^3)	(m^3)	(m^3)	
10	149	0.10	60	28	32	********
15	126	0.08	73	42	31	
20	110	0.07	80	55	25	
25	98	0.06	85	69	15	
30	88	0.05	87	83	4	
35	80	0.04	87	97	0	
40	74	0.04	86	111	0	
45	68	0.03	85	125	0	
50	64	0.03	82	139	0	
55	60	0.02	79	153	0	
60	56	0.02	75	166	0	
65	53	0.02	71	180	0	
70	50	0.02	67	194	0	
75	48	0.01	62	208	0	
80	46	0.01	57	222	0	
85	44	0.01	52	236	0	
90	42	0.01	47	250	0	
95	40	0.01	41	264	0	
100	39	0.01	35	277	0	
105	37	0.00	29	291	0	
110	36	0.00	23	305	0	
115	35	0.00	17	319	0	
120	33	0.00	11	333	0	

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SWM DESIGN CALCULATIONS
Storage Calculations for 100-Year Storm Event - Area 202

Project Name: 45 Bishop Street
Municipality: Township of Selwyn, ON
Project No.: 20013
Date: 3-Dec-20

Prepared by: J.L.
Last Revised: 3-Dec-20

Rainfall Data

Location:	City of Peterborough, ON	a	2507
Event	100-year	b	14.8
		c	0.88

Site Data

Area (ha)	0.57
Runoff Coefficient	0.45
AC	0.26
Tc (min)	10
Time Increment (min)	5
Release Rate (l/s)	31
Storage Required (m^3)	59

Release rate is the remaining 40% of the allowable rate from Area 102 (77*40%=31)

The Rational Equation:

$$Q = \frac{(C)(i)(A)}{360}$$

where,

Q = the design flow (m^3/s)
C = the site specific runoff coefficient
A = the drainage area (ha)
i = rainfall intensity (mm/hr)

Time	Rainfall Intensity	Storm Runoff	Runoff Volume	Released Volume	Storage Volume	
(min)	(mm/hr)	(m^3/s)	(m^3)	(m^3)	(m^3)	
10	149	0.11	64	18	45	
15	126	0.09	82	28	54	
20	110	0.08	95	37	58	
25	98	0.07	105	46	59	********
30	88	0.06	114	55	58	
35	80	0.06	121	65	56	
40	74	0.05	127	74	53	
45	68	0.05	133	83	49	
50	64	0.05	137	92	45	
55	60	0.04	141	102	40	
60	56	0.04	145	111	34	
65	53	0.04	149	120	28	
70	50	0.04	152	129	22	
75	48	0.03	154	139	16	
80	46	0.03	157	148	9	
85	44	0.03	160	157	2	
90	42	0.03	162	166	0	
95	40	0.03	164	176	0	
100	39	0.03	166	185	0	
105	37	0.03	168	194	0	
110	36	0.03	170	203	0	
115	35	0.02	171	213	0	
120	33	0.02	173	222	0	

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SWM DESIGN CALCULATIONS
Provided Storage Calculations

Project Name: 45 Bishop Street
Municipality: Peterborough
Project No.: 20013
Date: 8-Dec-20

Prepared by: J.P.
Last Revised: 8-Dec-20

Available Storage Underground in Sewer

UPSTREAM OF THE ORIFICE CONTROL AT MH-3:

From	To	Length Below HWL (m)	Diameter (mm)	Volume (m^3)
CBMH-1	MH-2	47.3	250	2.32
MH-2	MH-3	24.1	825	12.91
Total Storage Underground in Sewers (m^3):				**15.2**

Available Storage Underground in Sewer Catchbasins & Manholes

UPSTREAM OF THE ORIFICE CONTROL AT MH-3

MH	Manhole Top Elevation or HWL (m)	Low Invert Elevation (m)	Diameter (m)	Volume (m^3)
CBMH-1	246.58	245.40	1.20	1.33
MH-2	247.09	245.19	1.80	4.83
MH-3	247.40	245.08	2.40	10.50
CB 1	246.58	245.58	(0.6 x 0.6)	0.36
Total Storage Underground in CB's & MH's (m^3):				**17.0**

Total Available Underground Storage (m^3): **32.3**
(In Sewer, Manholes and Catchbasins)

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SWM DESIGN CALCULATIONS (Appendix D)
Orifice Calculations (In CBMH) for 100-Year Storm

Project Name: 45 Bishop Street
Municipality: Township of Selwyn, ON
Project No.: 20013
Date: 4-Dec-20

Prepared by: J.L.
Last Revised: 4-Dec-20

Area:

Orifice Characteristics

Orifice Diameter (mm)	**125**
C_d	**0.6**
Orifice Invert Elevation (m)	**244.49**
100-Year Ponding HGL (m)	**246.58**
Downstream Tailwater (m)	**244.49**
Head on Orifice (m)	2.03
Flow from Orifice (m^3/s)	**0.046**
Allowable Flow (m^3/s)	**0.046**

Orifice Equation:

$$Q = C_d x A x (2gH)^{0.5}$$

where:
Q =flow rate (m3/s)
H = head on the weir (m)
A =area of orifice (m^2)

g=9.81 (m/s^2) gravity
C_d = coefficient of discharge
C_d = 0.6 for Sharp Orifice
C_d = 0.8 for Tube Orifice

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