FUNCTIONAL SERVICING & PRELIMINARY STORMWATER MANAGEMENT REPORT

20 SCOTT STREET

TOWN OF GRAND VALLEY
DUFFERIN COUNTY

PREPARED FOR:

HRYCYNA LAW GROUP

PREPARED BY:

C.F. CROZIER & ASSOCIATES INC.
2800 HIGH POINT DRIVE, SUITE 100
MILTON, ON L9T 6P4

MARCH 2019

CFCA FILE NO. 1559-5037

CROZIER
CONSULTING ENGINEERS

Revision Number	Date	Comments
Rev.0	March 2019	Issued for First Submission

TABLE OF CONTENTS

LIST OF TABLES

LIST OF APPENDICES

LIST OF FIGURES

1.0 Introduction

C.F. Crozier & Associates Inc. (Crozier) was retained by Hrycyna Law Group (Owner) to prepare a Functional Servicing & Preliminary Stormwater Management Report to support the Draft Plan Application to permit the residential development at 20 Scott Street in the Town of Grand Valley in Dufferin County.

The purpose of this report is to demonstrate that the proposed Site can be developed in accordance with the Town of Grand Valley guidelines from a servicing & stormwater management perspective.

The following reports and design standards were referenced during the preparation of this report:

- Town of Grand Valley Engineering Standards, updated May 2016
- Grand Valley Master Servicing Plan Update, RJ Burnside, dated May 2014
- MOE Design Requirements for Drinking-Water Systems, dated 2008
- Meritech Servicing Brief, 20 Scott Street, dated June 2018

2.0 Site Description

The subject property is approximately 1.22 ha and currently consists of a single residential dwelling, ancillary building, driveway landscaped areas, and tree cover. The property is located in a residential neighbourhood and is bounded by existing residential dwellings to the north and east, Scott Street to the south and Crozier Street to the west. The site consists of steeply sloping topography extending from the west side of Crozier Street towards Scott Street.

The elements envisioned for this development include:

- 14 condominium townhouse units
- 9 condominium single detached units
- Internal private condominium road network
- Associated parking and landscaped areas
- 3 freehold detached dwellings fronting Scott Street

3.0 Water Servicing

The following sections outline the existing and proposed water servicing infrastructure and preliminary water demands.

3.1 Existing Water Servicing

As-constructed drawings for Scott Street and surrounding roads were obtained from the Town of Grand Valley. A review of as-constructed drawing M-796-25/P21 dated July 1996 indicates that:

- An existing 150 mm diameter watermain is located along Scott Street, which connects to Crozier Street to the west and Bielby Street to the east. The 150 mm diameter watermain services the existing residential dwellings along Scott Street.

- An existing fire hydrant is located near the existing Site entrance, directly adjacent to the proposed development. This hydrant will be required to be relocated as part of the development.

Refer to **Appendix A** for the referenced as-built drawings.

3.2 Design Water Demand

The proposed domestic water demand was estimated using the following documents:

- Town of Grand Valley Engineering Standards, updated May 2016

- Grand Valley Master Servicing Plan Update, RJ Burnside, dated May 2014

- MOECP Design Requirements for Drinking-Water Systems, dated 2008

An average daily water demand of 339 L/capita/day was used with an occupancy density of 4 persons/unit for the 23 proposed units. The estimated domestic water demand design flows are presented in **Table 1**, with supporting calculations provided in **Appendix B.**

Table 1: Estimated Domestic Design Water Demand

Standard	**Average Daily Demand** (L/s)	**Maximum Daily Demand** (L/s)	**Peak Hourly Demand** (L/s)
Town of Grand Valley	0.41	1.0	1.5

3.3 Proposed Water Servicing

The development is proposed to be serviced by a 150 mm diameter watermain and two internal fire hydrants. The proposed 150 mm diameter watermain will connect to the existing 150 mm diameter watermain within Scott Street. Burnside completed a review and analysis of the existing Town water model and system, including the addition of the proposed site demands.

The proposed watermain is required to loop back to Scott Street through the existing 6.0 m wide servicing easement along the east property limit as a result of Burnside's analysis. The proposed watermain layout is shown on the Preliminary Servicing Plan, **Figure 1**.

The three freehold lots adjacent to Scott Street are proposed to be serviced with individual water connections to the existing 150 mm diameter watermain.

4.0 Sanitary Servicing

The following sections outline the existing and proposed sanitary servicing infrastructure and preliminary sanitary design flows.

4.1 Existing Sanitary Servicing

As-constructed drawings for Scott Street and surrounding roads were obtained from the Town of Grand Valley. A review of Town of Grand Valley as-constructed drawings M-796-25/P21 and M-796-24/P20 in addition to the Master Servicing Plan, indicate that:

- A 200 mm diameter sanitary sewer runs from east to west within Scott Street, which receives flows from the existing residential dwellings along Scott Street, including the existing dwelling at 20 Scott Street.

- Sanitary flows collected within the Scott Street sewer drain to an existing manhole, located adjacent to the Site. These flows are conveyed south through an existing easement to the 200 mm diameter sanitary sewer within Grier Street to the south.

4.2 Design Sanitary Flow

The Town of Grand Valley Design Criteria were referenced to calculate sanitary design flows for the proposed development. A unit sewage flow of 450 L/capita/day was used with an occupancy density of 4 persons/unit for the 26 units in the proposed development. Infiltration flow and a peaking factor was applied to the unit sewage flow to obtain the total estimated design sewage flow. The estimated domestic sanitary demand design flows are presented in **Table 2**, with supporting calculations provided in **Appendix B.**

Table 2: Estimated Sanitary Design Flows

Average Flow (L/s)	**Peaking Factor**	**Peak Flow** (L/s)	**Infiltration Flow** (L/s)	**Total Flow** (L/s)
0.54	4.0	2.2	0.22	2.4

4.3 Proposed Sanitary Servicing

The development is proposed to be serviced by the existing 200 mm diameter sanitary sewer on Scott Street. The sanitary sewer will extend from the existing manhole with a minimum slope of 1% to a property line sanitary maintenance hole within the proposed private roadway. The proposed sanitary service will be designed per the Town standards.

The three freehold lots adjacent to Scott Street are proposed to be serviced with individual sanitary connections to the existing 200 mm diameter sanitary sewer.

The Preliminary Servicing Plan (**Figure 1**) illustrates the location of the sanitary sewer and all connections.

It is our understanding based on discussions with the Town and Burnside that the existing municipal infrastructure has capacity to support the proposed development, without any required external improvements.

5.0 Existing Drainage Conditions

The following sections outline the existing drainage conditions for the site, including contributing external flows to the Site.

5.1 Existing Site Drainage Conditions

The 1.22 ha Site currently consists of trees, grassed areas and a single residential dwelling. There is no existing stormwater management infrastructure within the Site.

The topographic surveys provided by Van Harten Surveying Inc., dated December 7, 2018 indicates that the majority of the site (Catchment 101, 1.22 ha) drains from northwest to southeast towards Scott Street and the low-lying area in the southeast portion of the Site. The survey also shows an existing low-lying depressional area in the northeast portion of the Site and on neighbouring lands. Crozier Staff completed a site walk for the property and confirmed these drainage patterns.

Refer to **Figure 3** for pre-development drainage catchments.

5.2 Crozier Street External Drainage

There is an existing municipal storm drainage Block located adjacent to the north limits of the Site. This municipal drainage Block contains an existing stormwater conveyance system. The storm sewer and ditch convey municipal storm drainage from Crozier Street east, towards a low point on the adjacent private lands. The private lands are owned by Thomasfield Homes Ltd. and are proposed for future residential development.

Approximately 0.13 ha (Catchment EXT_1) of Crozier Street right-of-way adjacent to the Site contributes municipal stormwater runoff to the Site under existing conditions, as shown on **Figure 3**. Stormwater runoff flows overland along Crozier Street and discharges down the steep slope adjacent to the site, ultimately draining to a low point within Scott Street, located near the south east corner of the Site.

5.3 Scott Street External Drainage

An external area of Scott Street adjacent to the Site, consisting of residential front yards and the Scott Street right-of-way, drain overland to the existing low point on Scott Street. This stormwater will either infiltrate or spill overland onto adjacent properties.

It is our understanding that an existing storm drainage system and legal outlet does not exist for the Scott Street drainage. A gravity storm sewer outlet for Scott Street is required for the existing drainage and would ultimately be consisted in future conditions.

5.4 Adjacent Residential External Drainage

There is an existing catchbasin on Scott Street located at this low point, which currently does not have a legal outlet. Under existing conditions, stormwater ponds above the existing catchbasin, and either infiltrates over time or spills overland onto adjacent properties.

A small 0.05 ha drainage catchment (Catchment EXT_2) of private lawn property adjacent to the eastern Site limits contributes minor drainage to the Site. This minor drainage ponds and infiltrates under existing conditions.

6.0 Proposed Drainage Conditions

Under proposed conditions, the Site is separated into northern and southern drainage catchments. The northern Catchment 201(0.78 ha), drains from south west to north east discharging into the existing municipal ditch north east of the Site. Runoff from Catchment 201 is collected and conveyed by the Site's internal storm sewer system located along the internal road network and will discharge to the existing municipal drainage ditch to the northeast. Stormwater runoff generated from Catchment 201 is primarily from the majority of the internal roadway and clean rooftops and lawn areas.

Given that the existing municipal drainage ditch outlets to the private lands owned by Thomasfield Developments, a formal Temporary Storm Drainage Easement will be required between Thomasfield, the Town of Grand Valley and Hrycyna Law Group. A Letter of Understanding for the Temporary Storm Drainage Easement between Hrycyna Law Group and Thomasfield, dated February 5, 2019 has been prepared and authorized by the required parties until the formal drainage agreement is prepared. Upon ultimate build out of the residential development proposed by Thomasfield, stormwater drainage will be accommodated and conveyed through future storm drainage systems to the Grand River.

The runoff from the southern Catchment 202 (0.39 ha) generally sheet flows from north to southeast discharging to Scott Street and the low-lying area in the southeast portion of the Site, consistent with existing conditions. Stormwater runoff generated from Catchment 202 is primarily from a small portion of the internal condo road and clean rooftops and lawn areas.

Overall, the total area discharging to Scott Street from pre-development conditions is reduced by approximately 70%. Therefore, the proposed drainage pattern will significantly reduce contributing stormwater runoff to the existing low point on Scott Street as well as overland spills to adjacent properties. A summary of the change in land areas discharging to Scott Street is presented in **Table 3** and **Figure 3** illustrates the proposed drainage patterns.

Table 3: Drainage Area Comparison for Scott Street Outlet

Conditions	Impervious Area (ha)	Pervious Area (ha)	Total Area (ha)
Pre-Development[1]	0.06	1.29	1.35
Post-Development[2]	0.12	0.27	0.39

Note: 1) The total pre-development area contributing to Scott Street was determined by adding Catchment EXT_1 and Catchment 101.
2) The total post-development contributing area is represented by Catchment 202.

Conveyance of stormwater runoff from the majority of the Site (Catchment 201) will be provided through the internal storm sewer system (sized to convey the 100-year storm event). Storms greater than the 100-year rainfall event will be conveyed overland through the internal roadway to the proposed drainage swale between Lots 5 and 6 for the majority of Catchment 201, ultimately discharging to the existing municipal drainage ditch at the northeast corner of the Site.

The major overland flow route for Catchment 202 will drain towards the low-point within Scott Street, consistent with the minor drainage from the Site.

A small 0.03 ha drainage catchment consisting of landscaped area (Catchment 203) will drain uncontrolled to Crozier Street. Stormwater runoff from this catchment is considered negligible considering the proposed land use and small contributing area.

External catchments draining onto the site will continue to be collected and conveyed under proposed conditions.

7.0 Stormwater Management

Stormwater management design criteria was established with the Town of Grand Valley and Burnside. The Site is not regulated by the Grand River Conservation Authority and therefore their stormwater management criteria has not been applied. The stormwater management criteria for the Site include:

Quantity Control

- No quantity controls are required for the Site. Collection of runoff and conveyance of drainage to the Grand River is encouraged to beat the peak flows from upstream drainage areas.

Quality Control

- An enhanced level of water quality control is required (80% Total Suspended Solids removal).

The following sections outline the details associated with stormwater quantity and quality control for the Site.

7.1 Stormwater Quantity Control

A MIDUSS hydrologic model was prepared to determine the 100-year pre- and post-development peak flows as well as runoff volumes discharging into the ditch north east of the Site and to Scott Street from the Site. A summary of the peak flows and volumes is presented in **Table 4** and detailed MIDUSS model results are provided in **Appendix C**.

Table 4: Pre-Development and Post-Development Site Peak Flows and Volumes (100-Year Storm)

Outlet	Pre-Development		Post-Development	
	Peak Flow (L/s)	**Runoff Volume** (m^3)	**Peak Flow** (L/s)	**Runoff Volume** (m^3)
Scott Street	351	719	122	244
Ex. Municipal Ditch	0	0	328	547

Note: 1) Refer to **Figure 3** for the pre-development and post-development catchments contributing to each outlet.

As indicated in **Table 5**, contributing peak flow and runoff volume to Scott Street is reduced by approximately 66% and 65%, respectively under post-development conditions. This solution ultimately improves upon the existing conditions by providing a net-reduction in overall contributing stormwater, which will reduce the frequency of nuisance ponding within the area of the existing low-lying area of Scott Street.

The temporary drainage agreement with Thomasfield will allow for the peak flow discharging from drainage Catchment 201 through the Thomasfield lands, to the Grand River. The stormwater flows from Catchment 201 will require a trapezoidal channel of 1.0 m bottom width, 2.8 m top width and 0.3 m depth at a 0.3% slope to convey 328 L/s. Refer to the preliminary channel sizing sheet in **Appendix C**.

7.2 Stormwater Quality Control

To achieve the stormwater quality standards, an oil/grit separator (OGS) was sized to meet the enhanced level of water quality (80% Total Suspended Solids removal). A Stormceptor STC 1000 OGS or approved equivalent is proposed for the Site.

The OGS will be located downstream of the cul-de-sac and upstream of the ditch. A detailed report of the OGS sizing is provided in **Appendix C** and the location of the OGS is shown in the Preliminary Servicing Plan, **Figure 1**.

8.0 Erosion and Sediment Controls During Construction

Erosion and sediment controls will be installed prior to the beginning of any construction activities. They will be maintained until the Site is stabilized or as directed by the Site Engineer and/or Town of Grand Valley. Controls will be inspected after each significant rainfall event and maintained in proper working condition.

The following erosion and sediment controls will be included during construction on the Site:

Heavy Duty Silt Fencing

Silt fencing will be installed on the perimeter of the Site to intercept sheet flow. Additional silt fence may be added based on field decisions by the Site Engineer and Owner, prior to, during and following construction.

Rock Mud Mat

A rock mud mat will be installed at the entrance to the construction zone to prevent mud tracking from the Site onto surrounding lands and the perimeter roadway network. All construction traffic will be restricted to this access only.

Silt Sacks in Catch Basins

Silt Sacks shall be installed in all new catch basins until the finished surfaces are stabilized.

9.0 Conclusions

Based on the information presented in this report, we offer the following conclusions:

1. Water servicing for the Site will be provided through a new looped connection to the existing 150 mm diameter watermain on Scott Street.

2. Sanitary servicing will be provided through a new connection to the existing 200 mm diameter sanitary sewer on Scott Street.

3. Individual water and sanitary services will be provided from Scott Street for the three freehold units.

4. The proposed development will be designed such that the drainage area discharging to Scott Street will be reduced by approximately 70%.

5. The majority of the Site's stormwater runoff will discharge into the existing municipal ditch north east of the Site and will be conveyed to the adjacent private lands and ultimately to the Grand River.

6. An agreement and drainage easement between the Owner and adjacent private land owners is required for the proposed stormwater drainage outlet for the Site.

7. Stormwater quality control will be provided through an oil-grit separator (STC 1000 or approved equivalent) which will treat runoff prior to discharging to the municipal ditch.

8. Erosion and sediment controls will be implemented on-site prior to construction and maintained during construction. A sediment and erosion control plan will be developed during the detailed design process.

Therefore, we conclude that the proposed development meets the requirements of the Town of Grand Valley from a site servicing perspective.

Respectfully submitted,

C.F. CROZIER & ASSOCIATES INC.

Brendan Walton, E.I.T.
Land Development

C.F. CROZIER & ASSOCIATES INC.

Jurgen Koehler, P.Eng.
Associate

/CK

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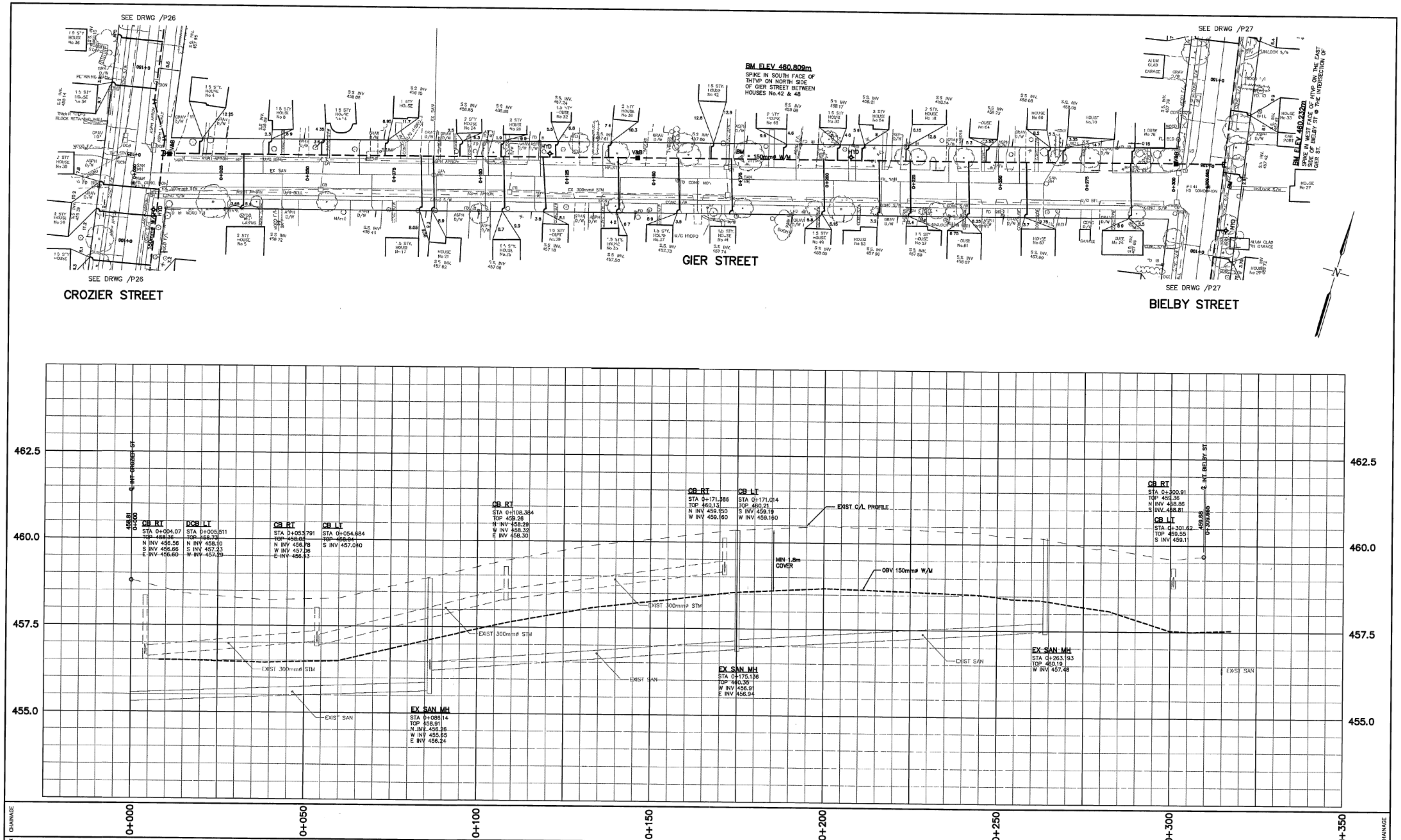
APPENDIX A

Reference Material



NOTES

M.K. O'HARA

NO.	REVISIONS	DATE	APP'D
1	WATERMAIN AND ASSOCIATED APPURTENANCES AS PER ADDENDUM No. 3	11/93	M.K.O.
2	STREET NAMES ADDED	11/93	M.K.O.
3	HYDRANT FROM STA 0+299 (GIER ST) TO STA 0+107 (BIELBY ST)	11/93	M.K.O.
4	W/M ROAD CROSSING FROM STA 0+303 TO STA 0+316	11/93	M.K.O.
5	REVISED' AS CONSTRUCTED'	05/95	M.K.O.

COMMUNAL WATER SUPPLY SYSTEM

MOEE PROJECT N° 41-3011-01

CONTRACT N° 5

CLIENT

VILLAGE OF GRAND VALLEY

BOX 249, 5 MAIN STREET NORTH, GRAND VALLEY LON 1G0

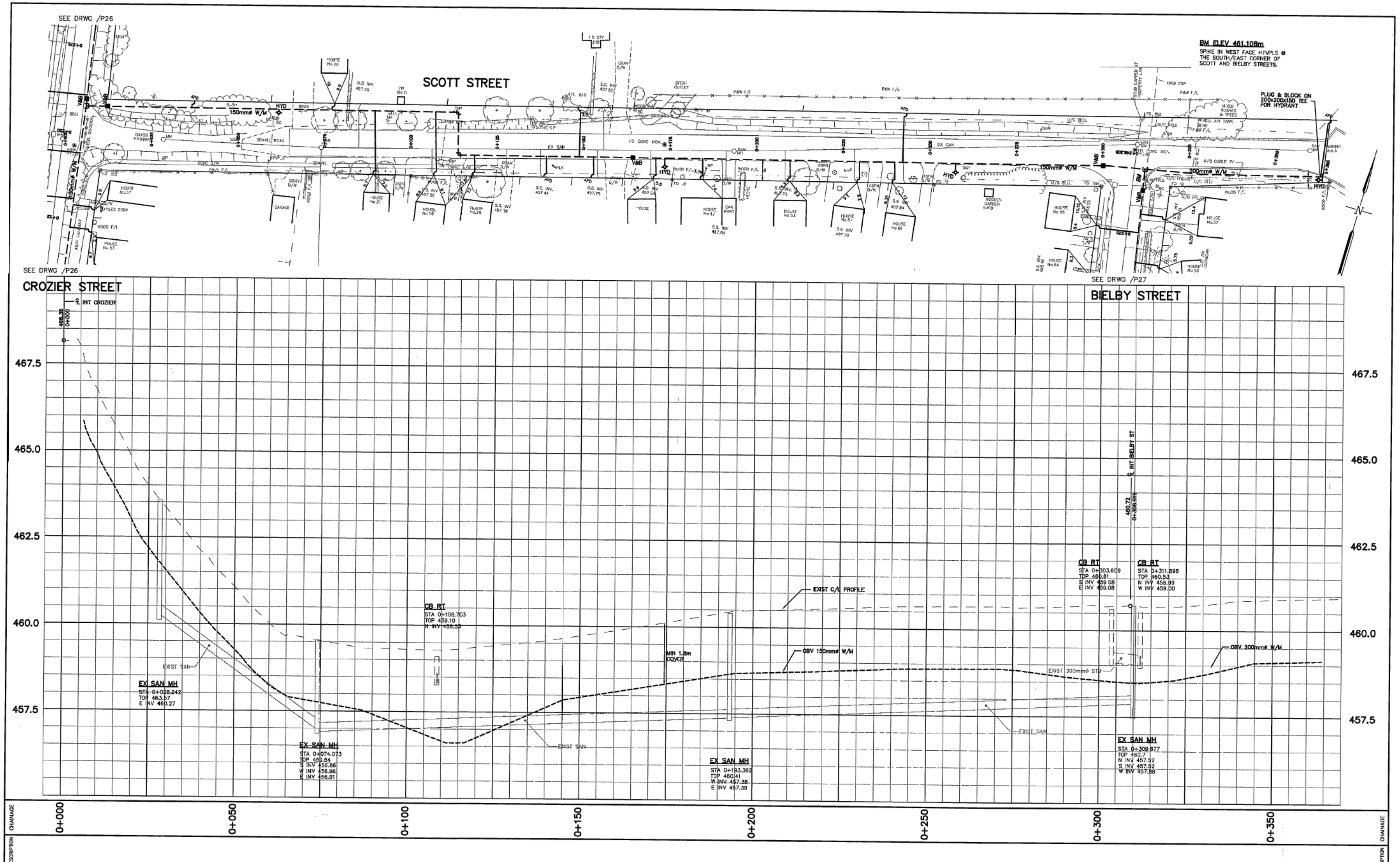
TITLE

PLAN & PROFILE
GIER STREET
0+000 to 0+309.665

R.J. BURNSIDE & ASSOCIATES LTD.
CONSULTING MUNICIPAL ENGINEERS & PLANNERS
15 TOWNLINE, ORANGEVILLE, ONTARIO L9W 3R4

DRAWN C.G.HUNTER	DRAWING NO. M-796-24/P20
DESIGNED D.G.HOWELLS	SCALE HORIZ. 1:500 VERT. 1:50
DATE OCT 1993	ISSUED

M796P20.DWG



NOTES

LICENSED PROFESSIONAL ENGINEER
23/01/97
M.K. O'HARA
PROVINCE OF ONTARIO

NO.	REVISIONS	DATE	APP'D
1	WATERMAIN AND ASSOCIATED APPURTENANCES AS PER ADDENDUM No. 3	11/93	M.K.O.
2	STREET NAMES ADDED	11/93	M.K.O.
3	REVISED 'AS CONSTRUCTED'	05/95	M.K.O.

COMMUNAL WATER SUPPLY SYSTEM

MOEE PROJECT N° 41-3011-01

CONTRACT N° 5

CLIENT
VILLAGE OF GRAND VALLEY
BOX 249, 5 MAIN STREET NORTH, GRAND VALLEY L0N 1G0

TITLE
PLAN & PROFILE
SCOTT STREET
0+000 to 0+365

R.J. BURNSIDE & ASSOCIATES LTD.
CONSULTING MUNICIPAL ENGINEERS & PLANNERS
15 TOWNLINE, ORANGEVILLE, ONTARIO L9W 3R4

DRAWN C.G.HUNTER	DRAWING NO. M-796-25/P21
DESIGNED D.G.HOWELLS	SCALE HORIZ. 1:500 VERT. 1:50
DATE OCT 1993	ISSUED

M796P21.DWG

APPENDIX B

Water and Sanitary Calculations

Domestic Water Demand

Notes & References

			Notes & References
Site Area:	1.12	ha	
Population Density:	4	persons/unit	Section 2-1, Town of Grand Valley Engineering Standards, 2016
Number of units:	26		
Population:	104		

Design Parameters

Average Demand (L/capita/d)
339

Section 3-2, Grand Valley Engineering Standards, May 2016
Page 3, Grand Valley Master Servicing Plan Update, RJ Burnside, May 2014

Water Demand:

Average Daily Demand = 35,256 L/day
0.41 **L/s**

Peaking Factors
Max Day = 2.5
Peak Hour = 3.8

Section 3-2, Grand Valley Engineering Standards, May 2016
Section 3.4.2, MOECP Design Requirements for Drinking-Water Systems, 2008

Average Day = 0.41 L/s
Max Day = **1.02** L/s
Peak Hour = **1.53** L/s

Max Day = Average Day Demand * Max Day
Peak Hour = Average Day Demand * Peak Hour

Municipality	Average Daily Water Demand (L/s)	Max Day Demand (L/s)	Peak Hourly Demand (L/s)
Town of Grand Valley	0.41	1.02	1.53

CROZIER & ASSOCIATES Consulting Engineers	**Project:** 20 Scott Street **Project No.:** 1559-5037	**Created By:** CK **Checked By:** BW/JRK	**Date:** 2019.02.25 **Updated:** 2019.03.08

Domestic Sanitary Design Flow

			Notes & References
Site Area:	1.12	ha	
Population Density:	4	persons/unit	Section 2-1, Town of Grand Valley Engineering Standards, 2016
Number of units:	26		
Population:	104		

Design Parameters

Average Flow (L/capita/d)
450

Section 2-1, Town of Grand Valley Engineering Standards, 2016

Sanitary Design Flow:

				Notes & References
	Average Daily Flow =	450.0	L/capita/d	Average Daily Flow = Average Daily Flow (L/cap./day) * population / 86400
	Average Daily Flow =	**0.54**	L/s	
Harmon Peak Factor:	M =	**4.00**		M = 1 + 14 / (4 + (p/1000)^.5) Section 2-2, Town of Grand Valley Engineering Standards, 2016
	Peak Flow =	**2.17**	L/s	Peak Flow = Average Daily Flow * M
Infiltration Flow:	Infiltration =	0.20	L/ha/s	
	Total Infiltration =	**0.22**	L/s	Section 2-1, Town of Grand Valley Engineering Standards, 2016
	Total Peak Flow =	**2.39**	L/s	Total Peak Flow = Peak Flow + Total Infiltration

Summary Table

Average Daily Flow (L/s)	Peaking Factor	Peak Flow (L/s)	Infiltration Flow (L/s)	Total Peak Flow (L/s)
0.54	4.00	2.17	0.22	2.39

APPENDIX C

Stormwater Management Calculations

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"               MIDUSS created                                    February 7, 2010"
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"       5.000   Time Step"
"     180.000   Max. Storm length"
"    1500.000   Max. Hydrograph"
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"      20.560   Constant B"
"       0.937   Exponent C"
"       0.400   Fraction R"
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"       1.000   Time step multiplier"
"            Maximum intensity          215.158    mm/hr"
"            Total depth                 93.661    mm"
"           6   100hyd   Hydrograph extension used in this file"
" 33         CATCHMENT 1"
"           2   Rectangular"
"           1   Equal length"
"           1   SCS method"
"           1   (#EXT 1) External Catchment West of Site"
"      31.700   % Impervious"
"       0.130   Total Area"
"     123.800   Flow length"
"      45.200   Overland Slope"
"       0.089   Pervious Area"
"     123.800   Pervious length"
"      45.200   Pervious slope"
"       0.041   Impervious Area"
"     123.800   Impervious length"
"      45.200   Impervious slope"
"       0.250   Pervious Manning 'n'"
"      80.000   Pervious SCS Curve No."
"       0.551   Pervious Runoff coefficient"
"       0.079   Pervious Ia/S coefficient"
"       5.016   Pervious Initial abstraction"
"       0.013   Impervious Manning 'n'"
"      98.000   Impervious SCS Curve No."
"       0.937   Impervious Runoff coefficient"
"       0.193   Impervious Ia/S coefficient"
"       1.000   Impervious Initial abstraction"
"                    0.046     0.000     0.000     0.000 c.m/sec"
"            Catchment 1            Pervious   Impervious Total Area "
"            Surface Area           0.089      0.041      0.130      hectare"
"            Time of concentration  10.127     1.385      6.273      minutes"
"            Time to Centroid       98.769     84.871     92.641     minutes"
"            Rainfall depth         93.661     93.661     93.661     mm"
"            Rainfall volume        83.16      38.60      121.76     c.m"
"            Rainfall losses        42.014     5.909      30.569     mm"
"            Runoff depth           51.647     87.752     63.092     mm"
"            Runoff volume          45.86      36.16      82.02      c.m"
"            Runoff coefficient     0.551      0.937      0.674      "
"            Maximum flow           0.031      0.024      0.046      c.m/sec"
" 40         HYDROGRAPH Add Runoff "
"           4   Add Runoff "
"                    0.046     0.046     0.000     0.000"
" 33         CATCHMENT 101"
"           1   Triangular SCS"
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"            1   Equal length"
"            1   SCS method"
"          101   Catchment 101"
"        2.200   % Impervious"
"        1.220   Total Area"
"       44.600   Flow length"
"       10.700   Overland Slope"
"        1.193   Pervious Area"
"       44.600   Pervious length"
"       10.700   Pervious slope"
"        0.027   Impervious Area"
"       44.600   Impervious length"
"       10.700   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       80.000   Pervious SCS Curve No."
"        0.550   Pervious Runoff coefficient"
"        0.079   Pervious Ia/S coefficient"
"        5.016   Pervious Initial abstraction"
"        0.013   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.916   Impervious Runoff coefficient"
"        0.193   Impervious Ia/S coefficient"
"        1.000   Impervious Initial abstraction"
"                     0.323     0.046     0.000     0.000 c.m/sec"
"              Catchment 101          Pervious   Impervious Total Area "
"              Surface Area           1.193      0.027      1.220      hectare"
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"              Time to Centroid       103.642    86.793     103.033    minutes"
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"              Rainfall volume        1117.53    25.14      1142.67    c.m"
"              Rainfall losses        42.186     7.906      41.432     mm"
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"              Maximum flow           0.316      0.014      0.323      c.m/sec"
" 40           HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.323     0.351     0.000     0.000"
" 33           CATCHMENT 2"
"            2   Rectangular"
"            1   Equal length"
"            1   SCS method"
"            2   (# EXT2) External Catchment East of Limits"
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"        0.090   Total Area"
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"        9.600   Overland Slope"
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"        9.600   Impervious slope"
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"        0.551   Pervious Runoff coefficient"
"        0.079   Pervious Ia/S coefficient"
"        5.016   Pervious Initial abstraction"
"        0.013   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.000   Impervious Runoff coefficient"
"        0.193   Impervious Ia/S coefficient"
"        1.000   Impervious Initial abstraction"
```

```
"                   0.031     0.351     0.000     0.000 c.m/sec"
"           Catchment 2            Pervious   Impervious Total Area "
"           Surface Area           0.090      0.000      0.090      hectare"
"           Time of concentration  2.099      0.287      2.099      minutes"
"           Time to Centroid       92.671     84.831     92.671     minutes"
"           Rainfall depth         93.661     93.661     93.661     mm"
"           Rainfall volume        84.29      0.00       84.30      c.m"
"           Rainfall losses        42.014     5.909      42.014     mm"
"           Runoff depth           51.647     87.752     51.647     mm"
"           Runoff volume          46.48      0.00       46.48      c.m"
"           Runoff coefficient     0.551      0.000      0.551      "
"           Maximum flow           0.031      0.000      0.031      c.m/sec"
" 40        HYDROGRAPH Add Runoff "
"          4   Add Runoff "
"                   0.031     0.374     0.000     0.000"
" 40        HYDROGRAPH Start - New Tributary"
"          2   Start - New Tributary"
"                   0.031     0.000     0.000     0.000"
" 33        CATCHMENT 102"
"          2   Rectangular"
"          1   Equal length"
"          1   SCS method"
"        102   Area Outletting Towards Ditch"
"      0.000   % Impervious"
"      0.010   Total Area"
"      2.500   Flow length"
"     13.100   Overland Slope"
"      0.010   Pervious Area"
"      2.500   Pervious length"
"     13.100   Pervious slope"
"      0.000   Impervious Area"
"      2.500   Impervious length"
"     13.100   Impervious slope"
"      0.250   Pervious Manning 'n'"
"     80.000   Pervious SCS Curve No."
"      0.551   Pervious Runoff coefficient"
"      0.079   Pervious Ia/S coefficient"
"      5.016   Pervious Initial abstraction"
"      0.013   Impervious Manning 'n'"
"     98.000   Impervious SCS Curve No."
"      0.000   Impervious Runoff coefficient"
"      0.193   Impervious Ia/S coefficient"
"      1.000   Impervious Initial abstraction"
"                   0.003     0.000     0.000     0.000 c.m/sec"
"           Catchment 102          Pervious   Impervious Total Area "
"           Surface Area           0.010      0.000      0.010      hectare"
"           Time of concentration  1.413      0.193      1.413      minutes"
"           Time to Centroid       92.491     84.831     92.491     minutes"
"           Rainfall depth         93.661     93.661     93.661     mm"
"           Rainfall volume        9.37       0.00       9.37       c.m"
"           Rainfall losses        42.014     5.909      42.014     mm"
"           Runoff depth           51.647     87.752     51.647     mm"
"           Runoff volume          5.16       0.00       5.16       c.m"
"           Runoff coefficient     0.551      0.000      0.551      "
"           Maximum flow           0.003      0.000      0.003      c.m/sec"
" 40        HYDROGRAPH Add Runoff "
"          4   Add Runoff "
"                   0.003     0.003     0.000     0.000"
```

```
                 100yr 20 Scott St post development 3hr CHI e txt
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                      Version 2.25  rev. 473"
"                MIDUSS created                            February 7, 2010"
"           10   Units used:                                      ie METRIC"
"                Job folder:                  C:\Users\milton.swm\Desktop\Other\"
"                                    MIDUSS Files\20 Scott St\Preliminary Model"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     4483.750   Coefficient A"
"       20.560   Constant B"
"        0.937   Exponent C"
"        0.400   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          215.158    mm/hr"
"             Total depth                 93.661    mm"
"            6   100hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 1"
"            2   Rectangular"
"            1   Equal length"
"            1   SCS method"
"            1   (#EXT 1) West External Catchment Outletting to Catchment 201"
"        0.000   % Impervious"
"        0.030   Total Area"
"       50.000   Flow length"
"       10.000   Overland Slope"
"        0.030   Pervious Area"
"       50.000   Pervious length"
"       10.000   Pervious slope"
"        0.000   Impervious Area"
"       50.000   Impervious length"
"       10.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       80.000   Pervious SCS Curve No."
"        0.552   Pervious Runoff coefficient"
"        0.079   Pervious Ia/S coefficient"
"        4.997   Pervious Initial abstraction"
"        0.013   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.000   Impervious Runoff coefficient"
"        0.193   Impervious Ia/S coefficient"
"        1.000   Impervious Initial abstraction"
"                     0.010     0.000     0.000     0.000 c.m/sec"
"             Catchment 1           Pervious   Impervious Total Area "
"             Surface Area          0.030      0.000      0.030      hectare"
"             Time of concentration 9.241      1.264      9.241      minutes"
"             Time to Centroid      98.034     0.000      98.034     minutes"
"             Rainfall depth        93.661     93.661     93.661     mm"
"             Rainfall volume       28.10      0.00       28.10      c.m"
"             Rainfall losses       41.998     93.661     41.998     mm"
"             Runoff depth          51.663     0.000      51.663     mm"
"             Runoff volume         15.50      0.00       15.50      c.m"
"             Runoff coefficient    0.552      0.000      0.552      "
"             Maximum flow          0.010      0.000      0.010      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.010     0.010     0.000     0.000"
" 33          CATCHMENT 201"
"            2   Rectangular"
```

```
"            1   Equal length"
"            1   SCS method"
"          201   Area Outletting to Ditch"
"       51.000   % Impervious"
"        0.780   Total Area"
"       39.000   Flow length"
"        5.000   Overland Slope"
"        0.382   Pervious Area"
"       39.000   Pervious length"
"        5.000   Pervious slope"
"        0.398   Impervious Area"
"       39.000   Impervious length"
"        5.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       80.000   Pervious SCS Curve No."
"        0.552   Pervious Runoff coefficient"
"        0.079   Pervious Ia/S coefficient"
"        4.997   Pervious Initial abstraction"
"        0.013   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.937   Impervious Runoff coefficient"
"        0.193   Impervious Ia/S coefficient"
"        1.000   Impervious Initial abstraction"
"                     0.328     0.010     0.000     0.000 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           0.382      0.398      0.780      hectare"
"             Time of concentration  9.802      1.340      4.397      minutes"
"             Time to Centroid       98.491     84.862     89.786     minutes"
"             Rainfall depth         93.661     93.661     93.661     mm"
"             Rainfall volume        357.97     372.58     730.56     c.m"
"             Rainfall losses        41.998     5.909      23.593     mm"
"             Runoff depth           51.663     87.752     70.069     mm"
"             Runoff volume          197.46     349.08     546.54     c.m"
"             Runoff coefficient     0.552      0.937      0.748      "
"             Maximum flow           0.131      0.234      0.328      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.328     0.336     0.000     0.000"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.328     0.000     0.000     0.000"
" 33          CATCHMENT 2"
"            2   Rectangular"
"            1   Equal length"
"            1   SCS method"
"            2   (#EXT 2) External Catchment on Western Property Limit Outletting to 
202"
"        0.000   % Impervious"
"        0.090   Total Area"
"       25.000   Flow length"
"        2.000   Overland Slope"
"        0.090   Pervious Area"
"       25.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       25.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       80.000   Pervious SCS Curve No."
"        0.552   Pervious Runoff coefficient"
"        0.079   Pervious Ia/S coefficient"
"        4.997   Pervious Initial abstraction"
"        0.013   Impervious Manning 'n'"
```

```
"        98.000   Impervious SCS Curve No."
"         0.000   Impervious Runoff coefficient"
"         0.193   Impervious Ia/S coefficient"
"         1.000   Impervious Initial abstraction"
"                     0.031     0.000     0.000     0.000 c.m/sec"
"              Catchment 2            Pervious   Impervious Total Area "
"              Surface Area           0.090      0.000      0.090      hectare"
"              Time of concentration  9.881      1.351      9.881      minutes"
"              Time to Centroid       98.554     0.000      98.554     minutes"
"              Rainfall depth         93.661     93.661     93.661     mm"
"              Rainfall volume        84.30      0.00       84.30      c.m"
"              Rainfall losses        41.998     93.661     41.998     mm"
"              Runoff depth           51.663     0.000      51.663     mm"
"              Runoff volume          46.50      0.00       46.50      c.m"
"              Runoff coefficient     0.552      0.000      0.552      "
"              Maximum flow           0.031      0.000      0.031      c.m/sec"
" 40           HYDROGRAPH Add Runoff "
"             4   Add Runoff "
"                     0.031     0.031     0.000     0.000"
" 33           CATCHMENT 202"
"             2   Rectangular"
"             1   Equal length"
"             1   SCS method"
"           202   Section Outletting to Scott St"
"        30.000   % Impervious"
"         0.390   Total Area"
"        58.200   Flow length"
"         5.000   Overland Slope"
"         0.273   Pervious Area"
"        58.200   Pervious length"
"         5.000   Pervious slope"
"         0.117   Impervious Area"
"        58.200   Impervious length"
"         5.000   Impervious slope"
"         0.250   Pervious Manning 'n'"
"        80.000   Pervious SCS Curve No."
"         0.552   Pervious Runoff coefficient"
"         0.079   Pervious Ia/S coefficient"
"         4.997   Pervious Initial abstraction"
"         0.013   Impervious Manning 'n'"
"        98.000   Impervious SCS Curve No."
"         0.937   Impervious Runoff coefficient"
"         0.193   Impervious Ia/S coefficient"
"         1.000   Impervious Initial abstraction"
"                     0.122     0.031     0.000     0.000 c.m/sec"
"              Catchment 202          Pervious   Impervious Total Area "
"              Surface Area           0.273      0.117      0.390      hectare"
"              Time of concentration  12.463     1.704      7.931      minutes"
"              Time to Centroid       100.798    84.953     94.123     minutes"
"              Rainfall depth         93.661     93.661     93.661     mm"
"              Rainfall volume        255.70     109.58     365.28     c.m"
"              Rainfall losses        41.998     5.909      31.171     mm"
"              Runoff depth           51.663     87.752     62.490     mm"
"              Runoff volume          141.04     102.67     243.71     c.m"
"              Runoff coefficient     0.552      0.937      0.667      "
"              Maximum flow           0.078      0.069      0.122      c.m/sec"
" 40           HYDROGRAPH Add Runoff "
"             4   Add Runoff "
"                     0.122     0.152     0.000     0.000"
" 40           HYDROGRAPH Start - New Tributary"
"             2   Start - New Tributary"
"                     0.122     0.000     0.000     0.000"
" 33           CATCHMENT 203"
```

```
"            2   Rectangular"
"            1   Equal length"
"            1   SCS method"
"          203   Area Outletting to Crozier St"
"       10.000   % Impervious"
"        0.030   Total Area"
"      100.000   Flow length"
"        2.000   Overland Slope"
"        0.027   Pervious Area"
"      100.000   Pervious length"
"        2.000   Pervious slope"
"        0.003   Impervious Area"
"      100.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       80.000   Pervious SCS Curve No."
"        0.552   Pervious Runoff coefficient"
"        0.079   Pervious Ia/S coefficient"
"        5.000   Pervious Initial abstraction"
"        0.013   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.937   Impervious Runoff coefficient"
"        0.193   Impervious Ia/S coefficient"
"        1.000   Impervious Initial abstraction"
"                     0.006     0.000     0.000     0.000 c.m/sec"
"              Catchment 203          Pervious   Impervious Total Area "
"              Surface Area           0.027      0.003      0.030      hectare"
"              Time of concentration  22.702     3.104      19.590     minutes"
"              Time to Centroid       109.512    85.613     105.718    minutes"
"              Rainfall depth         93.661     93.661     93.661     mm"
"              Rainfall volume        25.29      2.81       28.10      c.m"
"              Rainfall losses        42.000     5.909      38.391     mm"
"              Runoff depth           51.661     87.752     55.270     mm"
"              Runoff volume          13.95      2.63       16.58      c.m"
"              Runoff coefficient     0.552      0.937      0.590      "
"              Maximum flow           0.005      0.002      0.006      c.m/sec"
" 40           HYDROGRAPH Add Runoff "
"           4   Add Runoff "
"                     0.006     0.006     0.000     0.000"
```

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              25mm 20 Scott St post development 3hr CHI a txt
"             MIDUSS Output ----------------------------------------------->"
"             MIDUSS version                          Version 2.25  rev. 473"
"             MIDUSS created                                February 7, 2010"
"        10   Units used:                                         ie METRIC"
"             Job folder:                   C:\Users\milton.swm\Desktop\Other\"
"                                   MIDUSS Files\20 Scott St\Preliminary Model"
" 31        TIME PARAMETERS"
"     5.000   Time Step"
"   240.000   Max. Storm length"
"  3000.000   Max. Hydrograph"
" 32        STORM Chicago storm"
"         1   Chicago storm"
"   513.000   Coefficient A"
"     7.000   Constant B"
"     0.800   Exponent C"
"     0.400   Fraction R"
"   240.000   Duration"
"     1.000   Time step multiplier"
"           Maximum intensity           67.604    mm/hr"
"           Total depth                 25.005    mm"
"         6   025hyd   Hydrograph extension used in this file"
" 33        CATCHMENT 1"
"         2   Rectangular"
"         1   Equal length"
"         1   SCS method"
"         1   (#EXT 1) West External Catchment Outletting to Catchment 201"
"     0.000   % Impervious"
"     0.030   Total Area"
"    50.000   Flow length"
"    10.000   Overland Slope"
"     0.030   Pervious Area"
"    50.000   Pervious length"
"    10.000   Pervious slope"
"     0.000   Impervious Area"
"    50.000   Impervious length"
"    10.000   Impervious slope"
"     0.250   Pervious Manning 'n'"
"    80.000   Pervious SCS Curve No."
"     0.191   Pervious Runoff coefficient"
"     0.079   Pervious Ia/S coefficient"
"     5.016   Pervious Initial abstraction"
"     0.013   Impervious Manning 'n'"
"    98.000   Impervious SCS Curve No."
"     0.000   Impervious Runoff coefficient"
"     0.193   Impervious Ia/S coefficient"
"     1.000   Impervious Initial abstraction"
"                 0.000     0.000     0.000     0.000 c.m/sec"
"           Catchment 1           Pervious   Impervious Total Area "
"           Surface Area          0.030      0.000      0.030      hectare"
"           Time of concentration 23.724     2.095      23.724     minutes"
"           Time to Centroid      153.334    118.347    153.334    minutes"
"           Rainfall depth        25.005     25.005     25.005     mm"
"           Rainfall volume       7.50       0.00       7.50       c.m"
"           Rainfall losses       20.219     5.264      20.219     mm"
"           Runoff depth          4.785      19.741     4.785      mm"
"           Runoff volume         1.44       0.00       1.44       c.m"
"           Runoff coefficient    0.191      0.000      0.191      "
"           Maximum flow          0.000      0.000      0.000      c.m/sec"
" 40        HYDROGRAPH Add Runoff "
"         4   Add Runoff "
"                 0.000     0.000     0.000     0.000"
" 33        CATCHMENT 201"
"         2   Rectangular"
```

```
"            1   Equal length"
"            1   SCS method"
"          201   Area Outletting to Ditch"
"       51.000   % Impervious"
"        0.780   Total Area"
"       39.000   Flow length"
"        5.000   Overland Slope"
"        0.382   Pervious Area"
"       39.000   Pervious length"
"        5.000   Pervious slope"
"        0.398   Impervious Area"
"       39.000   Impervious length"
"        5.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       80.000   Pervious SCS Curve No."
"        0.191   Pervious Runoff coefficient"
"        0.079   Pervious Ia/S coefficient"
"        5.016   Pervious Initial abstraction"
"        0.013   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.789   Impervious Runoff coefficient"
"        0.193   Impervious Ia/S coefficient"
"        1.000   Impervious Initial abstraction"
"                     0.069     0.000     0.000     0.000 c.m/sec"
"              Catchment 201          Pervious   Impervious Total Area "
"              Surface Area           0.382      0.398      0.780      hectare"
"              Time of concentration  25.163     2.222      6.556      minutes"
"              Time to Centroid       154.662    118.422    125.268    minutes"
"              Rainfall depth         25.005     25.005     25.005     mm"
"              Rainfall volume        95.57      99.47      195.04     c.m"
"              Rainfall losses        20.219     5.263      12.592     mm"
"              Runoff depth           4.785      19.741     12.413     mm"
"              Runoff volume          18.29      78.53      96.82      c.m"
"              Runoff coefficient     0.191      0.789      0.496      "
"              Maximum flow           0.005      0.066      0.069      c.m/sec"
" 40           HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.069     0.069     0.000     0.000"
" 40           HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.069     0.000     0.000     0.000"
" 33           CATCHMENT 2"
"            2   Rectangular"
"            1   Equal length"
"            1   SCS method"
"            2   (#EXT 2) External Catchment on Western Property Limit Outletting to 
202"
"        0.000   % Impervious"
"        0.090   Total Area"
"       25.000   Flow length"
"        2.000   Overland Slope"
"        0.090   Pervious Area"
"       25.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       25.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       80.000   Pervious SCS Curve No."
"        0.191   Pervious Runoff coefficient"
"        0.079   Pervious Ia/S coefficient"
"        5.016   Pervious Initial abstraction"
"        0.013   Impervious Manning 'n'"
```

```
"        98.000   Impervious SCS Curve No."
"         0.000   Impervious Runoff coefficient"
"         0.193   Impervious Ia/S coefficient"
"         1.000   Impervious Initial abstraction"
"                     0.001     0.000     0.000     0.000 c.m/sec"
"              Catchment 2            Pervious   Impervious Total Area "
"              Surface Area           0.090      0.000      0.090      hectare"
"              Time of concentration  25.367     2.240      25.367     minutes"
"              Time to Centroid       154.860    118.433    154.859    minutes"
"              Rainfall depth         25.005     25.005     25.005     mm"
"              Rainfall volume        22.50      0.00       22.50      c.m"
"              Rainfall losses        20.219     5.263      20.219     mm"
"              Runoff depth           4.785      19.741     4.785      mm"
"              Runoff volume          4.31       0.00       4.31       c.m"
"              Runoff coefficient     0.191      0.000      0.191      "
"              Maximum flow           0.001      0.000      0.001      c.m/sec"
" 40           HYDROGRAPH Add Runoff "
"             4   Add Runoff "
"                     0.001     0.001     0.000     0.000"
" 33           CATCHMENT 202"
"             2   Rectangular"
"             1   Equal length"
"             1   SCS method"
"           202   Section Outletting to Scott St"
"        30.000   % Impervious"
"         0.390   Total Area"
"        58.200   Flow length"
"         5.000   Overland Slope"
"         0.273   Pervious Area"
"        58.200   Pervious length"
"         5.000   Pervious slope"
"         0.117   Impervious Area"
"        58.200   Impervious length"
"         5.000   Impervious slope"
"         0.250   Pervious Manning 'n'"
"        80.000   Pervious SCS Curve No."
"         0.191   Pervious Runoff coefficient"
"         0.079   Pervious Ia/S coefficient"
"         5.016   Pervious Initial abstraction"
"         0.013   Impervious Manning 'n'"
"        98.000   Impervious SCS Curve No."
"         0.789   Impervious Runoff coefficient"
"         0.193   Impervious Ia/S coefficient"
"         1.000   Impervious Initial abstraction"
"                     0.021     0.001     0.000     0.000 c.m/sec"
"              Catchment 202          Pervious   Impervious Total Area "
"              Surface Area           0.273      0.117      0.390      hectare"
"              Time of concentration  31.994     2.826      13.364     minutes"
"              Time to Centroid       161.083    118.855    134.111    minutes"
"              Rainfall depth         25.005     25.005     25.005     mm"
"              Rainfall volume        68.26      29.26      97.52      c.m"
"              Rainfall losses        20.219     5.263      15.732     mm"
"              Runoff depth           4.785      19.741     9.272      mm"
"              Runoff volume          13.06      23.10      36.16      c.m"
"              Runoff coefficient     0.191      0.789      0.371      "
"              Maximum flow           0.003      0.019      0.021      c.m/sec"
" 40           HYDROGRAPH Add Runoff "
"             4   Add Runoff "
"                     0.021     0.022     0.000     0.000"
" 40           HYDROGRAPH Start - New Tributary"
"             2   Start - New Tributary"
"                     0.021     0.000     0.000     0.000"
" 33           CATCHMENT 203"
```

```
"            2   Rectangular"
"            1   Equal length"
"            1   SCS method"
"          203   Area Outletting to Crozier St"
"       10.000   % Impervious"
"        0.030   Total Area"
"      100.000   Flow length"
"        2.000   Overland Slope"
"        0.027   Pervious Area"
"      100.000   Pervious length"
"        2.000   Pervious slope"
"        0.003   Impervious Area"
"      100.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       80.000   Pervious SCS Curve No."
"        0.191   Pervious Runoff coefficient"
"        0.079   Pervious Ia/S coefficient"
"        5.016   Pervious Initial abstraction"
"        0.013   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.789   Impervious Runoff coefficient"
"        0.193   Impervious Ia/S coefficient"
"        1.000   Impervious Initial abstraction"
"                     0.001     0.000     0.000     0.000 c.m/sec"
"             Catchment 203          Pervious   Impervious Total Area "
"             Surface Area           0.027      0.003      0.030      hectare"
"             Time of concentration  58.277     5.147      41.578     minutes"
"             Time to Centroid       185.714    120.959    165.362    minutes"
"             Rainfall depth         25.005     25.005     25.005     mm"
"             Rainfall volume        6.75       0.75       7.50       c.m"
"             Rainfall losses        20.219     5.263      18.724     mm"
"             Runoff depth           4.785      19.741     6.281      mm"
"             Runoff volume          1.29       0.59       1.88       c.m"
"             Runoff coefficient     0.191      0.789      0.251      "
"             Maximum flow           0.000      0.001      0.001      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.001     0.001     0.000     0.000"
```

Worksheet for Site Outlet Channel to Thomasfield

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.025	
Channel Slope	0.30000	%
Normal Depth	0.30	m
Left Side Slope	3.00	m/m (H:V)
Right Side Slope	3.00	m/m (H:V)
Bottom Width	1.00	m

Results

Discharge	0.42	m^3/s
Flow Area	0.57	m^2
Wetted Perimeter	2.90	m
Hydraulic Radius	0.20	m
Top Width	2.80	m
Critical Depth	0.21	m
Critical Slope	0.01194	m/m
Velocity	0.74	m/s
Velocity Head	0.03	m
Specific Energy	0.33	m
Froude Number	0.52	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	m
Length	0.00	m
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	m
Profile Description		
Profile Headloss	0.00	m
Downstream Velocity	Infinity	m/s
Upstream Velocity	Infinity	m/s
Normal Depth	0.30	m
Critical Depth	0.21	m
Channel Slope	0.30000	%

Worksheet for Site Outlet Channel to Thomasfield

GVF Output Data

Critical Slope	0.01194	m/m

Stormceptor® FORTERRA™

Detailed Stormceptor Sizing Report – 20 Scott St

Project Information & Location			
Project Name	20 Scott St	**Project Number**	1559-5037
City	Grand Valley	**State/ Province**	Ontario
Country	Canada	**Date**	2/25/2019
Designer Information		**EOR Information (optional)**	
Name	Chris Kwan	**Name**	
Company	C.F. Crozier and Associates	**Company**	
Phone #	905-875-0026	**Phone #**	
Email	ckwan@cfcrozier.ca	**Email**	

Stormwater Treatment Recommendation

The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

Site Name	20 Scott St
Recommended Stormceptor Model	STC 1000
Target TSS Removal (%)	80.0
TSS Removal (%) Provided	80
PSD	City of Toronto PSD
Rainfall Station	WATERLOO WELLINGTON A

The recommended Stormceptor model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

Stormceptor Sizing Summary		
Stormceptor Model	**% TSS Removal Provided**	**% Runoff Volume Captured Provided**
STC 300	68	85
STC 750	78	94
STC 1000	80	94
STC 1500	80	94
STC 2000	83	97
STC 3000	85	97
STC 4000	88	99
STC 5000	88	99
STC 6000	90	99
STC 9000	93	100
STC 10000	93	100
STC 14000	95	100
StormceptorMAX	Custom	Custom

Stormceptor

The Stormceptor oil and sediment separator is sized to treat stormwater runoff by removing pollutants through gravity separation and flotation. Stormceptor's patented design generates positive TSS removal for each rainfall event, including large storms. Significant levels of pollutants such as heavy metals, free oils and nutrients are prevented from entering natural water resources and the re-suspension of previously captured sediment (scour) does not occur.
Stormceptor provides a high level of TSS removal for small frequent storm events that represent the majority of annual rainfall volume and pollutant load. Positive treatment continues for large infrequent events, however, such events have little impact on the average annual TSS removal as they represent a small percentage of the total runoff volume and pollutant load.

Design Methodology

Stormceptor is sized using PCSWMM for Stormceptor, a continuous simulation model based on US EPA SWMM. The program calculates hydrology using local historical rainfall data and specified site parameters. With US EPA SWMM's precision, every Stormceptor unit is designed to achieve a defined water quality objective. The TSS removal data presented follows US EPA guidelines to reduce the average annual TSS load. The Stormceptor's unit process for TSS removal is settling. The settling model calculates TSS removal by analyzing:

- Site parameters
- Continuous historical rainfall data, including duration, distribution, peaks & inter-event dry periods
- Particle size distribution, and associated settling velocities (Stokes Law, corrected for drag)
- TSS load
- Detention time of the system

Hydrology Analysis

PCSWMM for Stormceptor calculates annual hydrology with the US EPA SWMM and local continuous historical rainfall data. Performance calculations of Stormceptor are based on the average annual removal of TSS for the selected site parameters. The Stormceptor is engineered to capture sediment particles by treating the required average annual runoff volume, ensuring positive removal efficiency is maintained during each rainfall event, and preventing negative removal efficiency (scour).
Smaller recurring storms account for the majority of rainfall events and average annual runoff volume, as observed in the historical rainfall data analyses presented in this section.

Rainfall Station

State/Province	Ontario	**Total Number of Rainfall Events**	2980
Rainfall Station Name	WATERLOO WELLINGTON A	**Total Rainfall (mm)**	16119.1
Station ID #	9387	**Average Annual Rainfall (mm)**	474.1
Coordinates	43°27'N, 80°23'W	**Total Evaporation (mm)**	680.0
Elevation (ft)	1028	**Total Infiltration (mm)**	8137.8
Years of Rainfall Data	34	**Total Rainfall that is Runoff (mm)**	7301.3

Notes

- Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules.
- Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed.
- For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.

Drainage Area	
Total Area (ha)	0.81
Imperviousness %	49.0

Up Stream Storage	
Storage (ha-m)	Discharge (cms)
0.000	0.000

Water Quality Objective	
TSS Removal (%)	80.0
Runoff Volume Capture (%)	90.00
Oil Spill Capture Volume (L)	
Peak Conveyed Flow Rate (L/s)	69.00
Water Quality Flow Rate (L/s)	

Up Stream Flow Diversion	
Max. Flow to Stormceptor (cms)	

Design Details	
Stormceptor Inlet Invert Elev (m)	
Stormceptor Outlet Invert Elev (m)	
Stormceptor Rim Elev (m)	
Normal Water Level Elevation (m)	
Pipe Diameter (mm)	
Pipe Material	
Multiple Inlets (Y/N)	No
Grate Inlet (Y/N)	No

Particle Size Distribution (PSD)

Removing the smallest fraction of particulates from runoff ensures the majority of pollutants, such as metals, hydrocarbons and nutrients are captured. The table below identifies the Particle Size Distribution (PSD) that was selected to define TSS removal for the Stormceptor design.

City of Toronto PSD		
Particle Diameter (microns)	Distribution %	Specific Gravity
10.0	20.0	2.65
30.0	10.0	2.65
50.0	10.0	2.65
95.0	20.0	2.65
265.0	20.0	2.65
1000.0	20.0	2.65

Site Name	20 Scott St

Site Details

Drainage Area	
Total Area (ha)	0.81
Imperviousness %	49.0

Surface Characteristics	
Width (m)	180.00
Slope %	2
Impervious Depression Storage (mm)	0.508
Pervious Depression Storage (mm)	5.08
Impervious Manning's n	0.015
Pervious Manning's n	0.25

Maintenance Frequency	
Maintenance Frequency (months) >	12

Infiltration Parameters	
Horton's equation is used to estimate infiltration	
Max. Infiltration Rate (mm/hr)	61.98
Min. Infiltration Rate (mm/hr)	10.16
Decay Rate (1/sec)	0.00055
Regeneration Rate (1/sec)	0.01

Evaporation	
Daily Evaporation Rate (mm/day)	2.54

Dry Weather Flow	
Dry Weather Flow (lps)	0

Winter Months	
Winter Infiltration	0

TSS Loading Parameters	
TSS Loading Function	

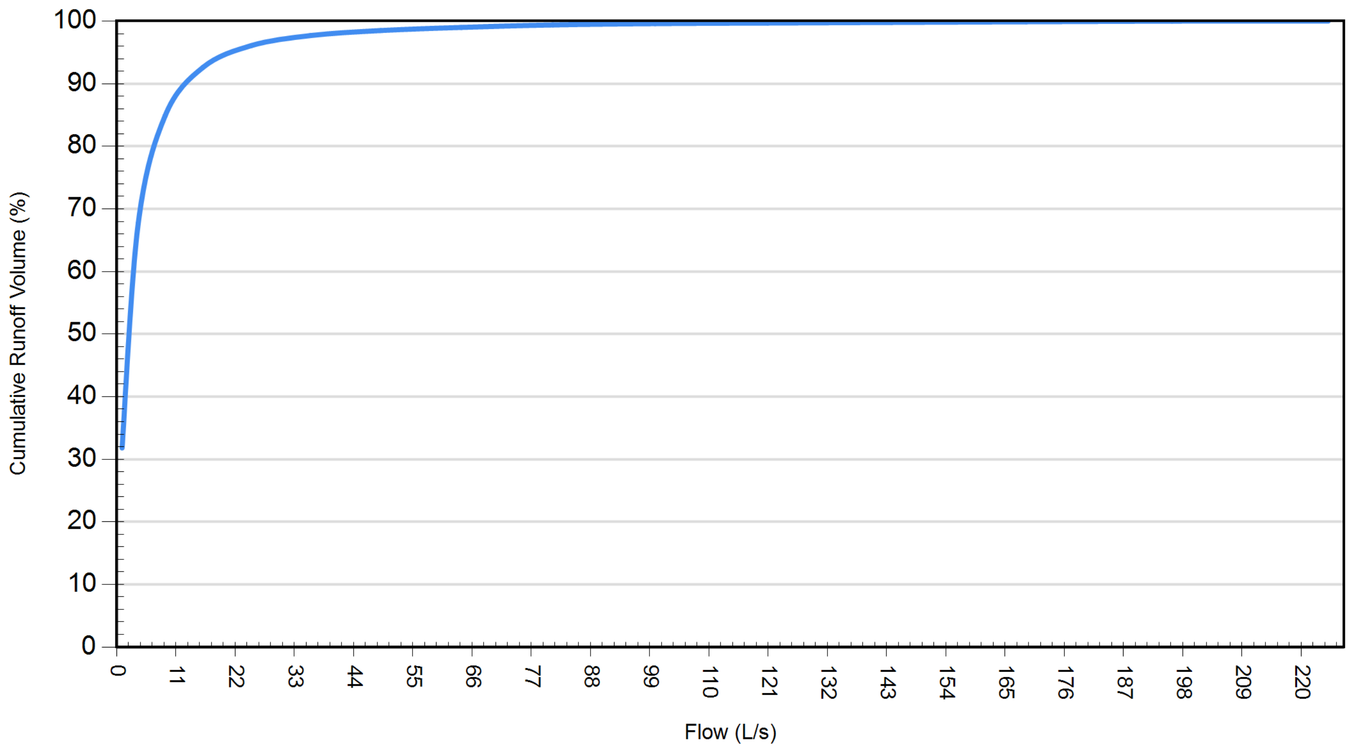
Buildup/Wash-off Parameters	
Target Event Mean Conc. (EMC) mg/L	
Exponential Buildup Power	
Exponential Washoff Exponent	

TSS Availability Parameters	
Availability Constant A	
Availability Factor B	
Availability Exponent C	
Min. Particle Size Affected by Availability (micron)	

Cumulative Runoff Volume by Runoff Rate			
Runoff Rate (L/s)	Runoff Volume (m³)	Volume Over (m³)	Cumulative Runoff Volume (%)
1	18940	40614	31.8
4	40286	19267	67.7
9	50555	8996	84.9
16	55123	4427	92.6
25	57198	2352	96.1
36	58162	1388	97.7
49	58657	893	98.5
64	58951	599	99.0
81	59165	384	99.4
100	59314	235	99.6
121	59394	155	99.7
144	59456	93	99.8
169	59511	38	99.9
196	59533	16	100.0
225	59544	5	100.0

Cumulative Runoff Volume by Runoff Rate

For area: 0.81(ha), imperviousness: 49.0%, rainfall station: WATERLOO WELLINGTON A



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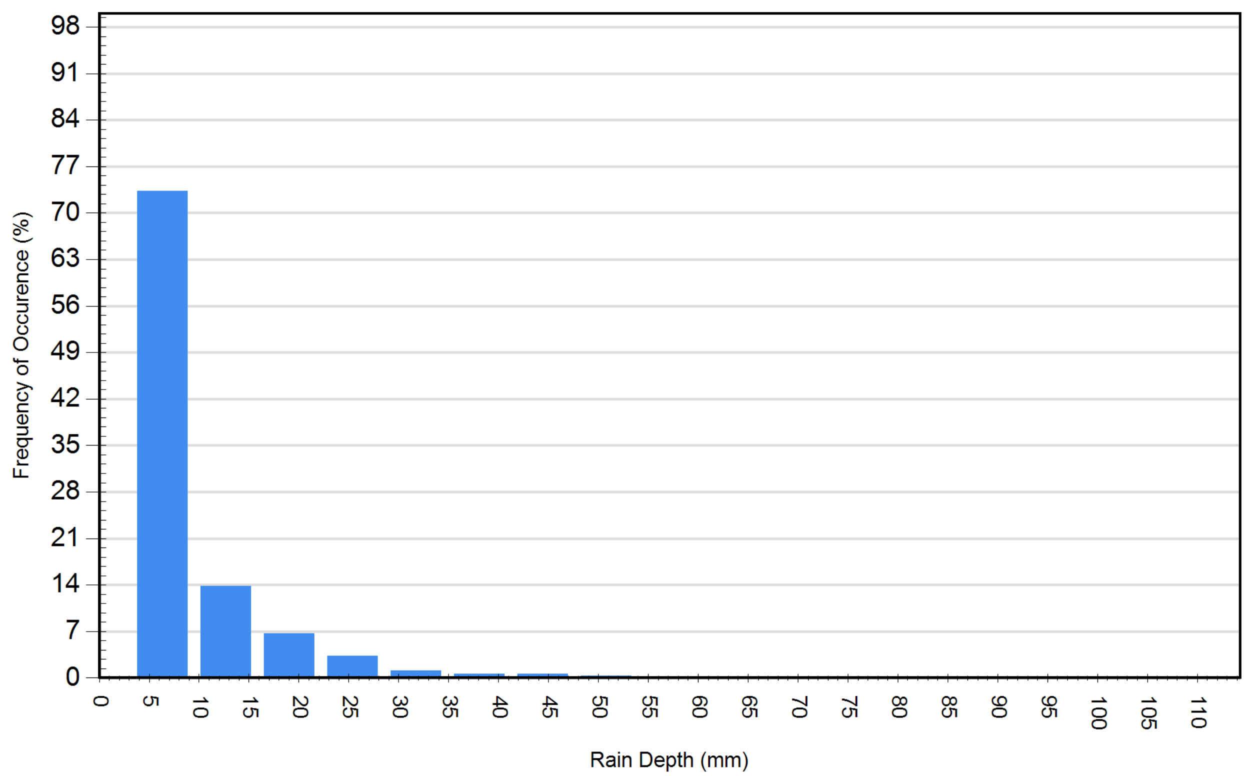
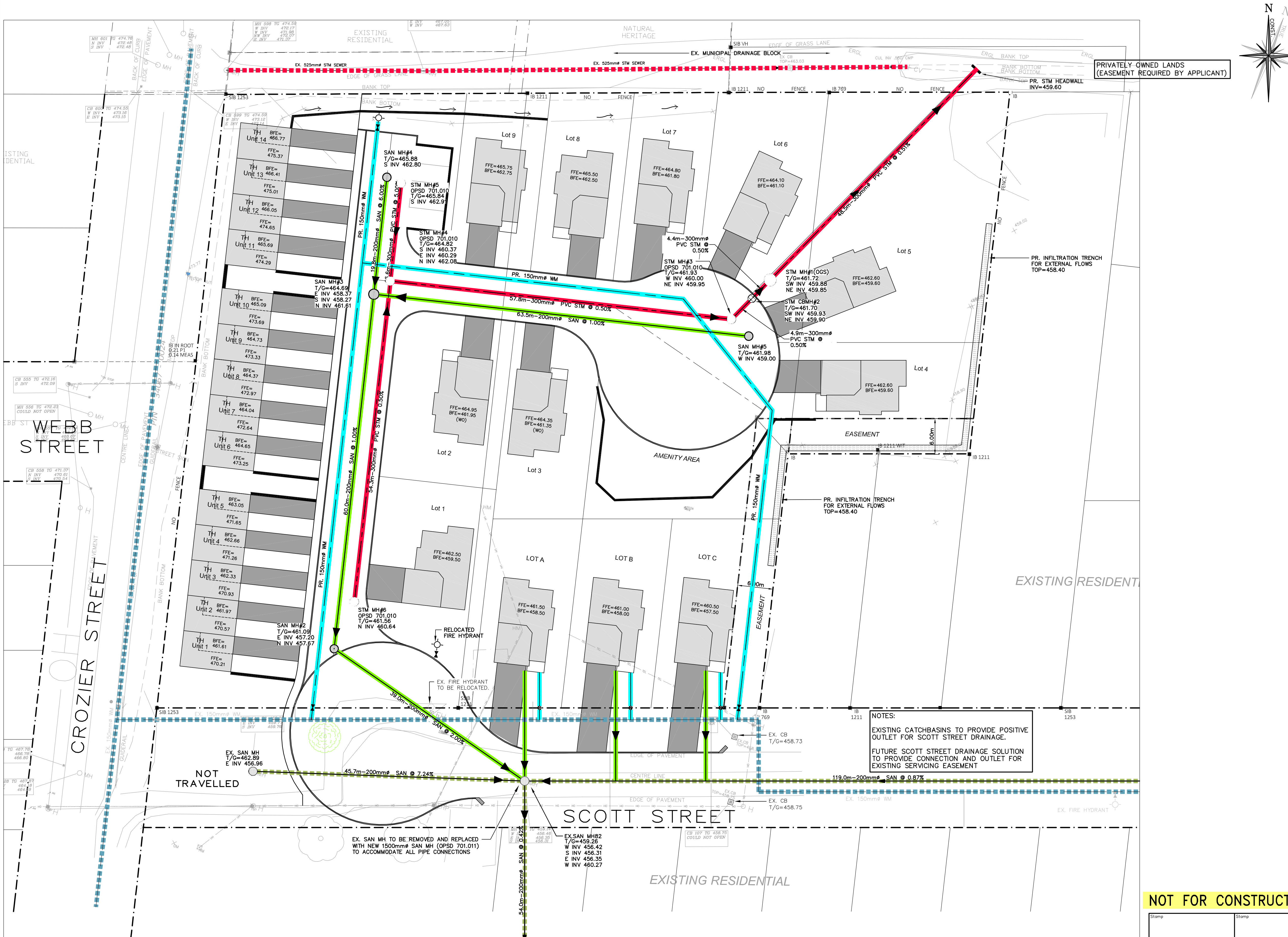
Rainfall Event Analysis				
Rainfall Depth (mm)	**No. of Events**	**Percentage of Total Events (%)**	**Total Volume (mm)**	**Percentage of Annual Volume (%)**
6.35	2184	73.3	3643	22.6
12.70	411	13.8	3779	23.4
19.05	199	6.7	3108	19.3
25.40	97	3.3	2102	13.0
31.75	34	1.1	964	6.0
38.10	17	0.6	590	3.7
44.45	18	0.6	723	4.5
50.80	8	0.3	380	2.4
57.15	4	0.1	212	1.3
63.50	0	0.0	0	0.0
69.85	4	0.1	267	1.7
76.20	0	0.0	0	0.0
82.55	0	0.0	0	0.0
88.90	3	0.1	256	1.6
95.25	1	0.0	93	0.6
101.60	0	0.0	0	0.0
107.95	0	0.0	0	0.0

Frequency of Occurence by Rainfall Depths



For Stormceptor Specifications and Drawings Please Visit:
http://www.imbriumsystems.com/technical-specifications

FIGURES



NOTES:

EXISTING CATCHBASINS TO PROVIDE POSITIVE OUTLET FOR SCOTT STREET DRAINAGE.

FUTURE SCOTT STREET DRAINAGE SOLUTION TO PROVIDE CONNECTION AND OUTLET FOR EXISTING SERVICING EASEMENT

KEY PLAN
SCALE: N.T.S.

LEGEND

- PROPERTY LINE
- EXISTING WATERMAIN & GATE VALVE
- EXISTING STORM SEWER & MANHOLE
- EXISTING SINGLE / DOUBLE CATCHBASIN
- EXISTING SANITARY SEWER & MANHOLE
- PROPOSED WATERMAIN & GATE VALVE
- PROPOSED WATER SERVICE LATERAL (XXmmø)
- PROPOSED FIRE HYDRANT & GATE VALVE
- PROPOSED SIAMESE CONNECTION
- PROPOSED WATER METER
- PROPOSED BACKFLOW PREVENTOR
- PROPOSED STORM SEWER & MANHOLE
- PROPOSED SINGLE / DOUBLE CATCHBASIN
- PROPOSED SANITARY SEWER & MANHOLE
- PROPOSED SAN. SERVICE LATERAL (125mmø)
- PROPOSED ELECTRICAL TRANSFORMER
- PROPOSED RETAINING WALL
- W/O PROPOSED WALK-OUT UNIT

No.	ISSUE / REVISION	YYYY/MMM/DD
0	ISSUED FOR FIRST SUBMISSION	2019/MAR/15

ELEVATION NOTE:

ELEVATIONS ARE RELATED TO THE CANADIAN GEODETIC VERTICAL DATUM 1972. A LOCAL BENCHMARK WAS ESTABISHED ON THE TOP NUT OF A FIRE HYDRANT, LOCATED ON SCOTT STREET, SOUTH OF LOT A, HAVING AN ELEVATION OF 460.67 m.

SURVEY NOTES:

TOPOGRAPHIC SURVEY PREPARED BY VAN HARTEN SURVEYING AND ENGINEERING, DATED JANUARY 29, 2019.

BEARINGS ARE UTM GRID BEARINGS AND ARE DERIVED FROM GPS OBSERVATIONS AND ARE REFERRED TO THE UTM PROJECTION, CENTRAL MERIDIAN 81°00' W LONGITUDE, ZONE 17, NAD 83 (CSRS), EPOCH 2010.

DISTANCES ARE GROUND AND CAN BE CONVERTED TO GRID BY MULTIPLYING BY THE COMBINED SCALE FACTOR OF 0.999759

SITE PLAN NOTES:

DESIGN ELEMENTS ARE BASED ON DEVELOPMENT CONCEPT PLAN BY WESTON CONSULTING

DRAWING No.: C3 (2019/MAR/05)
FILE No.: 8947

DRAWING NOTES:

THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS, LEVELS, AND DATUMS ON SITE AND REPORT ANY DISCREPANCIES OR OMISSIONS TO THIS OFFICE PRIOR TO CONSTRUCTION.

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ALL EXISTING UNDERGROUND UTILITIES TO BE VERIFIED IN THE FIELD BY THE CONTRACTOR PRIOR TO CONSTRUCTION.

Project
PROPOSED RESIDENTIAL DEVELOPMENT
20 SCOTT STREET
TOWN OF GRAND VALLEY

Drawing
PRELIMINARY SERVICING PLAN

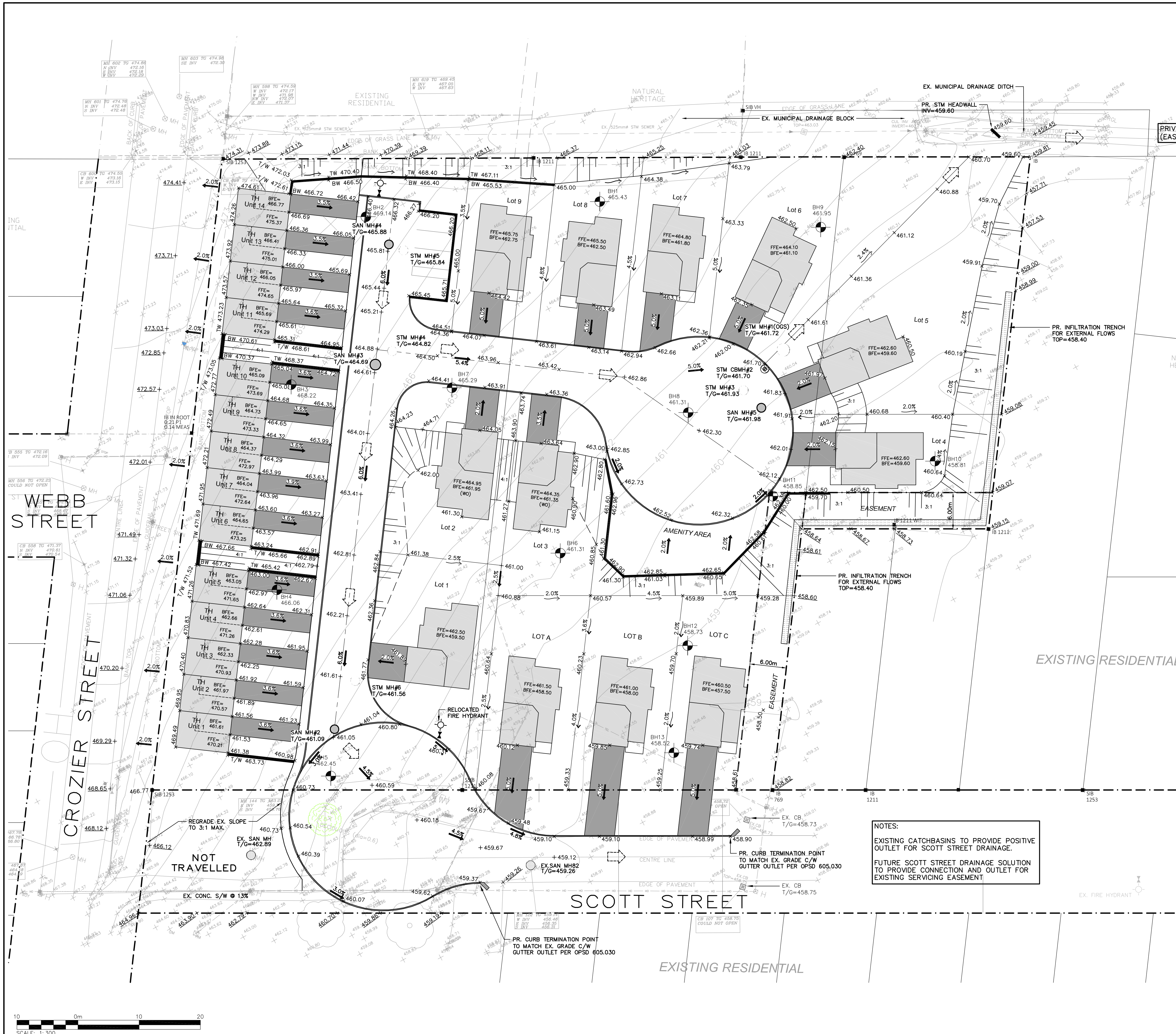
NOT FOR CONSTRUCTION

Stamp | Stamp

FOR REVIEW

CROZIER CONSULTING ENGINEERS
2800 HIGH POINT DRIVE
SUITE 100
MILTON, ON L9T 6P4
905.875.0026 T
905.875.4915 F
WWW.CFCROZIER.CA

Drawn	M.I.M	Design	B.W.	Project No.	1559–5037
Check	S.C.	Check	K.J.F./J.K.	Scale	Dwg. FIG 1



NOTES:

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FUTURE SCOTT STREET DRAINAGE SOLUTION TO PROVIDE CONNECTION AND OUTLET FOR EXISTING SERVICING EASEMENT

KEY PLAN
SCALE: N.T.S.

LEGEND

PROPERTY LINE
EXISTING CONTOUR (0.5m)
EXISTING CONTOUR (1.0m)
EXISTING DITCH
EXISTING FENCE
EXISTING GRADE
PROPOSED GRADE
PROPOSED GRADE (TO MATCH EXISTING)
PROPOSED MINOR FLOW DIRECTION
PROPOSED GRASSED SWALE
PROPOSED EXTENTS OF SURFACE PONDING
PROPOSED SNOW STORAGE AREA
PROPOSED RETAINING WALL
PROPOSED SLOPE (3:1 MAX.)
BUILDING ENTRANCE (PERSONNEL DOOR)
BUILDING ENTRANCE (OVERHEAD DOOR)
PROPOSED MAJOR OVERLAND FLOW DIRECTION
PROPOSED ELECTRICAL TRANSFORMER
PROPOSED FIRE HYDRANT & GATE VALVE
BOREHOLE LOCATION PER PLAN PREPARED BY CHUNG & VANDER DOELEN ENGINEERING LTD. DATED, FEBRUARY 2019 – FILE No. G17440
W/O PROPOSED WALK-OUT UNIT

No.	ISSUE / REVISION	YYYY/MMM/DD
0	ISSUED FOR FIRST SUBMISSION	2019/MAR/15

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SURVEY NOTES:

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Project
PROPOSED RESIDENTIAL DEVELOPMENT
20 SCOTT STREET
TOWN OF GRAND VALLEY

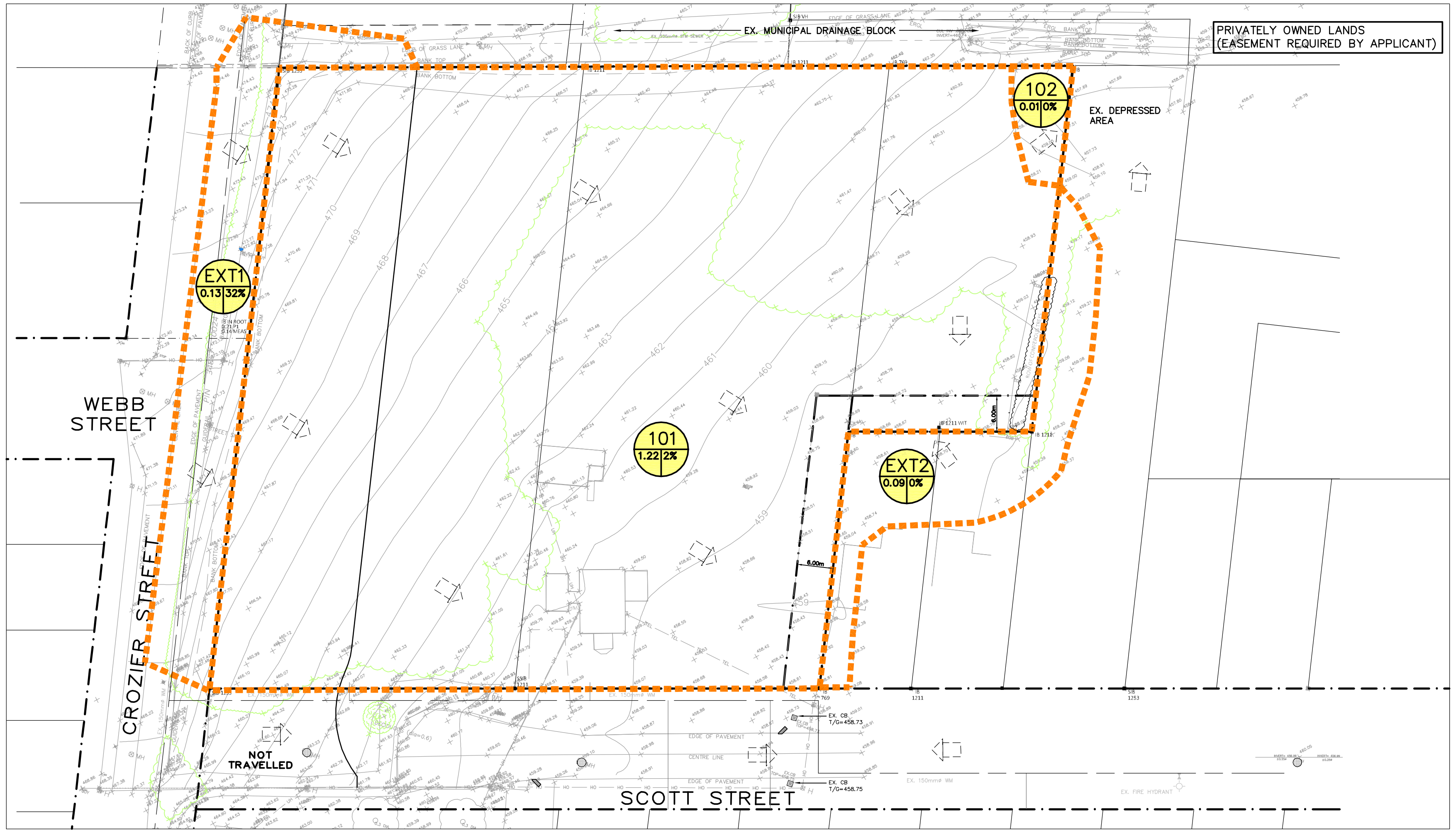
Drawing
PRELIMINARY GRADING PLAN

NOT FOR CONSTRUCTION

Stamp
FOR REVIEW

CROZIER CONSULTING ENGINEERS
2800 HIGH POINT DRIVE
SUITE 100
MILTON, ON L9T 6P4
905-875-0026 T
905-875-4915 F
WWW.CFCROZIER.CA

Drawn	Design	Project No.	
M.I.M	B.W.	1559–5037	
Check S.C.	Check K.J.F./J.K.	Scale	Dwg. FIG 2



SCALE: 1:500

KEY PLAN
SCALE: N.T.S.

— · — · —	PROPERTY LINE
	EXISTING CONTOUR (1.0m)
	EXISTING DITCH
+ 215.00	EXISTING GRADE
	PROPOSED OVERLAND FLOW DIRECTION
	EXISTING OVERLAND FLOW DIRECTION
	STORM DRAINAGE CATCHMENT
ID / A | IMP	CATCHMENT I.D. / AREA (ha) | PERCENT IMPERVIOUS (%)

0	ISSUED FOR FIRST SUBMISSION	2019/MAR/15
No.	ISSUE / REVISION	YYYY/MMM/DD

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Project

PROPOSED RESIDENTIAL DEVELOPMENT
20 SCOTT STREET
TOWN OF GRAND VALLEY

Drawing

EXISTING & PROPOSED DRAINAGE PLAN

NOT FOR CONSTRUCTION

Stamp | Stamp

FOR REVIEW

CROZIER CONSULTING ENGINEERS
2800 HIGH POINT DRIVE
SUITE 100
MILTON, ON L9T 6P4
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905-875-4915 F
WWW.CFCROZIER.CA

Drawn	Design	Project No.
M.I.M	B.W.	1559-5037
Check	Check	Scale	Dwg.
S.C.	K.J.F./J.K.	1:500	FIG 3