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August 30, 2020 21201-13

Dunnink Homes 4988 Jones Base Line Guelph, Ontario NOB 2J0

Attention: John Dunnink

Dear Sir:

Re: Stormwater Management Report
Hyland Road and Glenburnie Drive Extensions
City of Guelph, Ontario

1.0 Introduction

Van Harten Surveying Inc. is pleased to submit this report regarding the proposed residential development located in the northeast section of Guelph. This work was authorized by Mr. John Dunnink of Dunnink Homes.

The project involves the proposed construction of six (6) fully serviced single family homes as an extension of Hyland Road and an additional three (3) fully serviced single family homes in order to protect the existing woodlot on the property off Glenburnie Drive. These three (3) lots will be serviced by the existing cul-de-sac and infrastructure from Glenburnie Drive. The purpose of the stormwater management report is to evaluate the general surface drainage characteristics and the impact of the development along with the stormwater management criteria. The wetlands, east of the proposed development, are also presently owned by the applicant.

2.0 Site Location and Existing Conditions

The subject lands are located near Eramosa Road and Victoria Road in the northeast section of Guelph. The northern part of this development will be an eastern extension of Hyland Road and the southern part will be an eastern residential extension fronting on the cul-de-sac off Glenburnie Drive. The proposed Hyland Road extension is abutting existing residential developments and surface drainage is generally directed to an existing 450 mm diameter culvert in the southeast corner that conveys water to a protected wetland to the south. The proposed Glenburnie Drive extension is abutting existing residential



developments to the north, west and south with overland surface flow towards protected wetlands to the east. The existing building on the Hyland Road development will be demolished including the asphalt driveway. There are no private wells on either property.

3.0 Proposed Development

The subject lands are located at the eastern limit of a fully serviced and established residential subdivision in the northeast section of Guelph. The Hyland Road extension covers 1.065 ha and includes the development of six (6) lots under a Draft Plan of Subdivision Development with the provision that the City of Guelph will not accept the responsibility of a Communal Pumping Station. The proposed houses on the Hyland Road development will be constructed without basements and will be no more than 1.20 m belpw grade and weepers will be pumped to the surface.

The existing cul-de-sac at the east limit of Glenburnie Drive is to remain to accommodate three (3) new single family residences on 0.674 ha of land in accordance with the City of standards.

4.0 Design Criteria

The design criteria is to model the development for the minor and major storm systems conveyance using MIDUSS Version 2.25 for the pre and post development with the City of Guelph Intensity-Duration Frequency Parameters for the 2, 5, and 100-years return period storms flows.

The City of Guelph's current IDF parameters are presented in the Table 1 as follows:

Table 1. Cit	y of Guelp	h Intensity	/-Duration	Frequency	Parameters		
Parameter	IDF P	IDF Parameters for Specified Return					
	2	5	25	50	100		
а	743	1593	3158	3886	4688		
b	6	11	15	16	17		
С	0.7989	0.8789	0.9355	0.9495	0.9624		

Pertinent pre and post development pervious and imperious parameters are presented in Table 2 as follows:



	Hyland Road	Road	Glenb	urnie
	pre-dev.	post dev.	pre-dev.	post dev.
Area	1.065	1.065	0.674	0.674
Pervious (%)	97.2	76.4	100	89.3
Imperious (%)	2.80	23.60	0.00	10.70
td (min)	10	10	10	10

Referring to the attached Drainage Catchment Areas Plan, the post development drainage areas are divided into three (3) distinct areas as follows:

Catchment Area 1

The eastbound lane of Hyland Road drain in sheet flow directly into the wetland as it presently exists. The drainage will across the proposed rip-rap protecting the slope for erosion.

Catchment Area 2

 Hyland Road Development - the lot grading is split drainage to the front and balance to approximately the midpoint of the rear lot area with an outlet into the wetlands. The rear of the lots are drained generally into a north/east direction via vegetated swales to the eastern boundary line of the development to a cross-culvert or storm sewer system on Hyland Road into the wetlands.

Catchment Area 3

The Glenburnie Drive development drainage is directed to the wetlands via vegetated swales, east of the proposed development.

The calculated run-off coefficients as calculated by MIDUSS are as follows:



MIDUSS	RUNOFF C	OEFFICIENT (ALCULATIO	NS		
		Hyland Road		Glen	burnie Drive	
	Pre Devel	opment				
	Pervious	Impervious	Combined	Pervious	Impervious	Combined
2 yrs	0.058	0.934	0.083	0.058	0.000	0.058
5 Yrs	0.234	0.951	0.254	0.233	0.000	0.233
100 yrs	0.513	0.964	0.526	0.510	0.000	0.510
	Post Deve	lopment				
2 yrs	0.058	0.934	0.253	0.058	0.937	0.152
5 yrs	0.234	0.951	0.393	0.233	0.953	0.310
100 yrs	0.513	0.964	0.613	0.510	0.970	0.559

Summary of the peak flow rates are illustrated below.

	Peak Flo	Peak Flow Rate (m3/sec)							
Storm Event	Hylar	nd Road	Glenburie Drive						
	Pre-Dev.	Post-Dev.	Pre-Dev.	Post-Dev.					
	Flow	Fow	Flow	Flow					
2 yrs	0.008	0.055	0.007	0.017					
5 yrs	0.061	0.089	0.049	0.054					
100 yrs	0.294	0.294	0.218	0.215					

The infill development is adjacent to the existing wetlands and generally sufficient storage facilities are not available within the proposed development. It is noted that, based on the calculations presented in the above table, post-development flow rates from the site are only slightly higher than existing conditions, and no increase in flow is anticipated for major storms including the 100-year event.

Prior to construction, a heavy duty silt fence will be installed along the boundary to protect the existing wetlands as well as straw bales at the inlet of the culvert to prevent silt entering

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the culvert/wetlands during construction. In addition, mud slabs will be provided as per City of Guelph standards and specifications at the entrances to the project (start of Hyland Road construction and the entrance to Glenburnie Drive.

5.0 Water Quality Treatment

The objective of water quality as noted in the City of Guelph Stormwater Management Master Plan is to improve sediment, surface water, groundwater quality, minimize pollutants loadings to groundwater and surface water. The development requires fill. The emphasis is to obtain select fill, if available, with favorable infiltration rates such as reclaimed granular material from Hyland Road re-construction.

The Hyland Road development lot drainage will be conveyed to the proposed catchbasin located on Hyland Road via vegetated swales, and french drains as illustrated on grading plans. Along the eastern rear property lines, perforated pipe with sock will be installed in the French drain and subsurface connection to the above noted catchbasin will be provided. A cross-culvert/storm sewer will be installed spanning Hyland Road with an outlet into the wetlands designed with adequately capacity as per City's requirements. The outlet will be protected with 150mm rip-rap configured in a V-figure to promote diverging flow. The roof drainage will be discharged in soak away pits and vegetated swales are illustrated on the preliminary grading plan

6.0 Water Balance

The water level in the wetlands is controlled by an outlet at a fixed elevation in a south- east location of the wetlands. The development is located adjacent/near the wetland and is classified as infill development. The wetlands may be classified as a natural storm water management pond as there is a controlled outlet in a south-east location of the wetlands. The implementation of infiltration trenches is ineffective due to the very low infiltration rate of the native soils. It may be concluded that any water imbalance from the theoretical calculations is of short duration and any intervention is of very little benefit.

The water balance is reviewed based on the results of pre and post development run-off volumes into the wetlands as illustrated on the next page.



			WATER B	ALANCE				
			Runoff \	/olume (cn	n)			
Storm		Hyland Ro	ad	Glen	Glenburnie Drive			
Event	to Wetland			to We				
	Pre-Dev.	Post Dev.	Incr/	Pre-Dev.	Post Dev.	Incr/	Incr./	
	Volume	Volume	Decr.	Volume	Volume	Decr.	Decr.	
2 yrs	29.17	93.45	64.28	12.97	33.97	21	85.28	
5 Yrs	126.46	200.84	74.38	73.47	70.47	97.74	172.12	
100 yrs	495.06	583.38	88.32	303.85	333.23	29.38	117.7	

The Miduss model shows a net runoff volume increase of 64.28, 74.38, 88.32 cubic meters for the Hyland Road development and 80.95, 167.12, and 111.75 cubic meters increase in runoff volume for the Glenburnie Drive development directed towards the wetlands for the 2-, 5-, and 100-year return period storm event respective.

7.0 Conclusions

Dunhill Homes, the applicant, is applying for the infill development located north of Hyland Road and east of Glenburnie Drive. This report has been prepared to support the application for draft approval of the proposed development.

The above concludes that the infill development is feasible as follows:

- Storm drainage will be provided via vegetated swales, curb & gutter, and catchbasin/ditch-inlet to the wetlands
- Water quality control will be provided through the use of French drains, vegetated swales, soak away pits, and catch basins/ditch inlet.
- Any engineering concerns may be addressed during the engineering design approval process.

Respectfully submitted,





MIDUSS OUTPUT

2 YEAR PRE AND POST DEVELOPMENT

Hyland Road: 2-Year Storm - Existing Conditions

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    100.000 Flow length"
4.000 Overland Slope"
        1.036 Pervious Area"
     100.000 Pervious length"
      4.000 Pervious slope"
        0.030 Impervious Area"
      100.000 Impervious length"
      4.000 Impervious slope"
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                Pervious Manning 'n'"
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       5.000 Pervious Depression storage"
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        0.000
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        1.500
                 Impervious Depression storage"
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                                                    0.000 c.m/sec"
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Surface Area 1.036 0.030 1.065 hectare"
Time of concentration 44.433 3.580 31.504 minutes"
                                                                       minutes"
             Time to Centroid 108.225 84.569 100.738 minutes"
             Rainfall depth 33.124 33.124
Rainfall volume 343.02 9.88
Rainfall losses 31.199 2.177
Runoff depth 1.925 30.947
                                                           33.124
                                                                       mm"
                                                            352.90
                                                                      c.m"
                                                         30.386 mm"
                                                            2.738
                                                                        mm"
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16		Runoff	volume		19.94		9.23		29.17		c.m"	
10		Runoff	coefficien	it	0.058		0.934	1	0.083		11	
17		Maximu	m flow		0.008	;	0.006	5	0.008		c.m/sec"	ı
17	40	HYDROG:	RAPH Add Ru	noff '	1							
***		4 Add	Runoff "									
**			0.008	0.008	3	0.000	(0.000"				
77	38	START/	RE-START TO	TALS 2	201"							
***		3 Run	off Totals	on EX	IT"							
11		Total	Catchment a	rea				1	.065	hect	are"	
64		Total	Impervious	area				0	.030	hect	are"	
94		Total	% imperviou	IS				2	.800"			
**	19	EXIT"										

Hyland Road: 2-Year Storm - Proposed Conditions

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11
        0.814 Pervious Area"
      100.000 Pervious length"
        4.000 Pervious slope"
      0.251 Impervious Area"
100.000 Impervious length"
        4.000 Impervious slope"
        0.250 Pervious Manning 'n'"
       75.000 Pervious Max.infiltration"
      12.500 Pervious Min.infiltration"
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        5.000 Pervious Depression storage"
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        0.000 Impervious Max.infiltration"
        0.000 Impervious Min.infiltration"
               Impervious Lag constant (hours)"
        0.050
                Impervious Depression storage"
        1.500
                                                 0.000 c.m/sec"
                    0.055 0.000 0.000
                                  Pervious Impervious Total Area "
             Catchment 202
                                             0.251 1.065 hectare"
                                   0.814
             Surface Area
             Time of concentration
Time to Centroid 108.225
33.124
             Time of concentration 44.433
                                                                 minutes"
                                             3.580
                                                       10.429
                                             84.569
                                                      88.535
                                                                 minutes"
                                             33.124
                                                      33.124
                                 269.52
31.199
                                            83.25
                                                      352.77
                                                                 c.m"
             Rainfall volume
                                            2.177
             Rainfall losses
                                             30.947
                                                      24.350
                                                                  ının"
                                 1.925
                                                                  mm"
             Runoff depth
                                                      8.774
```

17		Runoff volume	15.67	77.78	93.45	C.M"
11		Runoff coefficient	0.058	0.934	0.265	78
**		Maximum flow	0.006	0.054	0.055	c.m/sec"
93	40	HYDROGRAPH Add Runoff	11			
17		4 Add Runoff "				
**		0.055 0.05	5 0.000	0,000"		
TT	38	START/RE-START TOTALS :	202"			
**		3 Runoff Totals on EX	IT"			
TT		Total Catchment area		1	.065	hectare"
**		Total Impervious area		0	.251	hectare"
171		Total % impervious		23	.600"	
Li.	19	EXIT"				

Glenburnie Drive: 2-Year Storm - Existing Conditions

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10.000 Overland Slope"
0.674 Pervious Area"
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      10.000 Pervious slope"
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      86.500 Impervious length"
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12.500 Pervious Min.infiltration"
0.250 Pervious Lag constant (hours)"
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         0.015 Impervious Manning 'n'"
         0.000 Impervious Max.infiltration"
         0.000 Impervious Min.infiltration"
         0.050 Impervious Lag constant (hours)"
         1.500 Impervious Depression storage"
                      0.007 0.000 0.000
                                                        0.000 c.m/sec"
              Catchment 101 Pervious Impervious Total Area "
Surface Area 0.674 0.000 0.674 he
Time of concentration 30.941 2.493 30.941 mm
Time to Centroid 97.700 0.000 97.700 mm
Rainfall volume 222.22 33.124 mm
Rainfall volume 222.22
                                                    0.000 0.674 hectare"
                                                                            minutes"
                                                              97.700 minutes"
                                                                           mm"
                                      223.22 0.00 223.22 c.m
31.198 33.124 31.198 mm"
1.926 0.000 1.926 mm"
                                                                            c.m"
               Rainfall volume
               Rainfall losses
               Runoff depth
```

	i	Runoff volume	12.98	0.00	12.98	C.M"
*	•	Runoff coefficient	0.058	0.000	0.058	H
**	,	Maximum flow	0.007	0.000	0.007	c.m/sec"
*1	40	HYDROGRAPH Add Runoff	71			
*1	Ī	4 Add Runoff"				
**	1	0.007 0.00	7 0.000	0.000"		
*1	' 38	START/RE-START TOTALS	101"			
**	r	3 Runoff Totals on EX	IT"			
*1	•	Total Catchment area		0	.674	hectare"
81	1	Total Impervious area		0	.000	hectare"
*1	,	Total % impervious		0	.000"	
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Glenburnie Drive: 2-Year Storm - Proposed Conditions

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86.500 Pervious length"
       86.500
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       86.500 Impervious length"
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      10.000 Impervious slope"
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       75.000 Pervious Max.infiltration"
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        5.000
                Pervious Depression storage"
        0.015 Impervious Manning 'n'"
        0.000 Impervious Max.infiltration"
        0.000 Impervious Min.infiltration"
        0.050 Impervious Lag constant (hours)"
        1.500
                Impervious Depression storage"
                                                0.000 c.m/sec"
                   0.017 0.000 0.000
                            Pervious Impervious Total Area "
             Catchment 102
                                             Surface Area
                                  0.602
             Time of concentration 30.941
                                                                  minutes"
             Time to Centroid 97.700 82.917 87.961 Rainfall depth 33.124 33.124 33.124
                                                                 minutes"
                                                      33.124
                                                                 mm"
                                           23.89 223.26
2.092 28.084
31.032 5.040
                                 199.37
                                                                 c.m"
             Rainfall volume
             Rainfall losses
                                 31.198 2.092
1.926 31.032
                                                                  mm"
             Runoff depth
```

III.	Runoff volume	11.59	22.38	33.97	c.m"
n	Runoff coefficient	0.058	0.937	0.152	.00
ur.	Maximum flow	0.006	0.017	0.017	c.m/sec"
" 40	HYDROGRAPH Add Runoff	17			
u	4 Add Runoff "				
**	0.017 0.0	17 0.00	0.00	0"	
" 38	START/RE-START TOTALS	102"			
iii.	3 Runoff Totals on E	XIT"			
	Total Catchment area			0.674	hectare"
**	Total Impervious area			0.072	hectare"
**	Total % impervious			10.700"	
" 19	EXIT"				



MIDUSS OUTPUT

5 YEAR PRE AND POST DEVELOPMENT

Hyland Avenue: 5-Year Storm - Existing Conditions

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      100.000 Flow length"
4.000 Overland
      100.000
                  Overland Slope"
        1.035 Pervious Area"
      100.000 Pervious length"
       4.000 Pervious slope"
        0.030 Impervious Area"
      100.000 Impervious length"
       4.000 Impervious slope"
                 Pervious Manning 'n'"
         0.250
        75.000
                  Pervious Max.infiltration"
        12.500 Pervious Min.infiltration"
        0.250 Pervious Lag constant (hours)"
         5.000 Pervious Depression storage"
         0.015 Impervious Manning 'n'"
         0.000 Impervious Max.infiltration"
         0.000 Impervious Min.infiltration"
         0.050
                 Impervious Lag constant (hours)"
         1.500 Impervious Depression storage"
               Catchment 201
                       0.061 0.000 0.000
                                                          0.000 c.m/sec"
              Catchment 201 Pervious Impervious Total Area "
Surface Area 1.035 0.030 1.065 he
Time of concentration 23.736 3.250 21.586 mi
Time to Centroid 96.030 83.522 94.717 mi
Rainfall depth 46.810 46.810 46.810 mm
Rainfall volume 484.57 13.96 498.53 c.
Rainfall losses 35.876 2.299 34.936 mm
Runoff depth 10.934 44.511 11.874 mm
                                                     0.030 1.065 hectare"
                                                                             minutes"
                                                                 94.717 minutes"
                                                                             mm **
                                                                             c.m"
                                                                 34.936 mm"
11.874 mm"
```

***		Runoff v	olume		113.1	9	13.27		126.46		c.m"
17		Runoff c	oefficient		0.234		0.951		0.254		II .
77		Maximum	flow		0.058		0.009		0.061		c.m/sec"
11	40	HYDROGRA	PH Add Rui	noff "							,
77	4	Add R	unoff"								
•			0.061	0.061		0.000	0	.000"			
1.00	38	START/RE	-START TO	TALS 2	201"						
	3	Runof	f Totals	on EXI	T"						
		Total Ca	tchment a	rea				1.	.065	hect	are"
Ħ		Total Im	pervious a	area				0	.030	hect	are"
ŧτ		Total %	impervious	3				2.	.800"		
77	19	EXIT"	-								

(8)

Hyland Road: 5-Year Storm - Proposed Conditions

```
MIDUSS Output -----
**
                                                       Version 2.25 rev. 465"
                MIDUSS version
11
                                                    Tuesday, February 05, 2008"
                MIDUSS created
                                                                  ie METRIC"
           10
                Units used:
                Job folder:
                                        Q:\13-212\21203-13 (Dunnink - Hyland)\"
                                                           20-jul-31 swm calcs"
                Output filename:
                                                               5-yr design.out"
                                                                  Mike.Vaughan"
                Licensee name:
IŢ
                Company
11
                Date & Time last used:
                                                      7/31/2020 at 3:01:05 PM"
11
 31
             TIME PARAMETERS"
11
        5.000 Time Step"
TT
      180.000 Max. Storm length"
TF
      1500.000 Max. Hydrograph"
88
 47
             FILEI O Read/Open quelph5.stm"
            1 1=read/open; 2=write/save"
11
            1 1=rainfall; 2=hydrograph"
71
            1 1=rain; 2=imperv; 3=perv"
17
             guelph5.stm"
11
             Guelph, ON 5 year storm"
п
             New storm defined"
                                                  mm**
             Total depth
                                         46.810
             Maximum intensity
                                         139.290
                                         170.000 minutes"
             Duration
                         0.000 0.000 0.000 c.m/sec"
                   0.000
               005hyd Hydrograph extension used in this file"
            CATCHMENT 202"
  33
               Triangular SCS"
            1
11
            1
               Equal length"
11
               Horton equation"
**
          202
               Hyland Road Post-Development"
41
       23.600
               % Impervious"
11
        1.065 Total Area"
FĢ
       100.000
               Flow length"
        4.000 Overland Slope"
TV
        0.814 Pervious Area"
**
       100.000 Pervious length"
**
        4.000 Pervious slope"
77
         0.251
                Impervious Area"
71
       100.000
                Impervious length"
         4.000
                Impervious slope"
                Pervious Manning 'n'"
        0.250
       75.000
                Pervious Max.infiltration"
       12.500 Pervious Min.infiltration"
        0.250 Pervious Lag constant (hours)"
11
        5.000 Pervious Depression storage"
ķķ
                Impervious Manning 'n'"
        0.015
**
        0.000
                Impervious Max.infiltration"
44
        0.000
                Impervious Min.infiltration"
17
                 Impervious Lag constant (hours)"
        0.050
        1.500
                 Impervious Depression storage"
                     0.089 0.000 0.000
                                                   0.000 c.m/sec"
                                    Pervious Impervious Total Area "
              Catchment 202
                                               0.251 1.065
3.250 12.325
                                                                     hectare"
              Surface Area
                                    0.814
              Time of concentration 23.736
                                                                     minutes"
                                              83,522
              Time to Centroid
                                                         89.063
                                                                     minutes"
                                 96.030
46.810
46.810
380.87
117.65
35.876
2.299
44.511
                                    96.030
                                                         46.810
                                                                    mm"
              Rainfall depth
                                                         498.53
                                                                     c.m"
              Rainfall volume
              Rainfall losses
                                                         27.952
                                                                     mm **
                                   10.934
                                              44.511
                                                         18.858
                                                                     mm"
              Runoff depth
```

11		Runoff volume	88.97	111.87	200.84	c.m"
W		Runoff coefficient	0.234	0.951	0.403	
27		Maximum flow	0.046	0.073	0.089	c.m/sec"
71	40	HYDROGRAPH Add Runoff	n			
W		4 Add Runoff "				
77		0.089 0.08	9 0.000	0.000"		
TT	38	START/RE-START TOTALS	202"			
71		3 Runoff Totals on EX	IT"			
**		Total Catchment area		1	.065	hectare"
VI)		Total Impervious area		0	.251	hectare"
77		Total % impervious		23	.600 "	
10	19	EXIT"				

Glenburnie Drive: 5-Year Storm - Existing Conditions

```
MIDUSS Output -----
                 MIDUSS version
                                                           Version 2.25 rev. 465"
                 MIDUSS created
                                                       Tuesday, February 05, 2008"
                                                                      ie METRIC"
            10
                Units used:
                 Job folder:
                                         Q:\13-212\21203-13 (Dunnink - Hyland)\"
                                                              20-mar-18 SWM calcs"
                 Output filename:
                                                            5-yr ex Glenburnie.out"
                 Licensee name:
                                                                      Mike.Vaughan"
                 Company
                 Date & Time last used:
                                                          3/18/2020 at 2:35:35 PM"
              TIME PARAMETERS"
         5.000 Time Step"
      180.000 Max. Storm length"
      1500.000 Max. Hydrograph"
             FILEI O Read/Open guelph5.stm"
             1 1=read/open; 2=write/save"
             1 1=rainfall; 2=hydrograph"
             1 1=rain; 2=imperv; 3=perv"
              quelph5.stm"
              Guelph, ON 5 year storm"
              New storm defined"
              Total depth
                                            46.810
                                          139.290 mm/hr"
              Maximum intensity
             Duration 170.000 minutes" 0.000 0.000 0.000 0.000 c.m/sec"
                 005hyd Hydrograph extension used in this file"
             6
" 33
             CATCHMENT 101"
             1 Triangular SCS"
                Equal length"
Horton equation"
             1
             2
         101 Glenburnie Pre-Development"
       0.000 % Impervious"
       0.674 Total Area"
      86.500 Flow length"
      10.000 Overland Slope"
       0.674 Pervious Area"
      86.500 Pervious length"
10.000 Pervious slope"
       0.000
                 Impervious Area"
      86.500 Impervious length"
      10.000 Impervious slope"
       0.250 Pervious Manning 'n'"
      75.000 Pervious Max.infiltration"
      12.500 Pervious Min.infiltration"
       0.250 Pervious Lag constant (hours)"
        5.000 Pervious Depression storage"
0.015 Impervious Manning 'n'"
        0.000 Impervious Max.infiltration"
        0.000 Impervious Min.infiltration"
        0.050 Impervious Lag constant (hours)"
         1.500 Impervious Depression storage"
                      0.049 0.000 0.000
                                                     0.000 c.m/sec"
              Catchment 101 Pervious Impervious Total Area "

      Surface Area
      0.674
      0.000

      Time of concentration
      16.529
      2.263

      Time to Centroid
      89.389
      82.032

      Rainfall depth
      46.810
      46.810

                                                  0.000 0.674 hectare"
                                                             16.529
                                                                         minutes"
                                                            89.389 minutes"
                                                            46.810 mm"
                                     315.50 0.00
                                                            315.50 c.m"
              Rainfall volume
                                                            35.916 mm"
10.894 mm"
              Rainfall losses
                                    35.916 2.210
                                      10.894 44.600
              Runoff depth
```

**		Runoff volume Runoff coefficient	73.43 0.233	0.00	73.43 0.233	c.m"
11		Maximum flow	0.049	0.000	0.049	c.m/sec"
77	40	HYDROGRAPH Add Runoff	H			
11		4 Add Runoff "				
77		0.049 0.04	9 0.000	0.000"		
77	38	START/RE-START TOTALS	101"			
77		3 Runoff Totals on EX	KIT"			
44		Total Catchment area		0	.674	hectare"
6.8		Total Impervious area		0	.000	hectare"
**		Total % impervious		0	.000"	
"	19	EXIT				

Glenburnie Drive: 5-Year Storm - Proposed Conditions

```
MIDUSS Output -----
                MIDUSS version
                                                       Version 2.25 rev. 465"
                MIDUSS created
                                                    Tuesday, February 05, 2008"
                                                                  ie METRIC"
           10 Units used:
                                      0:\13-212\21203-13 (Dunnink - Hyland)\"
                Job folder:
                                                         20-mar-18 SWM calcs"
                Output filename:
                                                       5-yr pr Glenburnie.out"
                Licensee name:
                                                                 Mike.Vaughan"
                Company
                Date & Time last used:
                                                      3/18/2020 at 2:44:20 PM"
" 31
             TIME PARAMETERS"
        5.000 Time Step"
      180.000 Max. Storm length"
**
     1500.000 Max. Hydrograph"
            FILEI O Read/Open quelph5.stm"
            1 1=read/open; 2=write/save"
            1 1=rainfall; 2=hydrograph"
               1=rain; 2=imperv; 3=perv"
             quelph5.stm"
             Guelph, ON 5 year storm"
             New storm defined"
             Total depth
                                         46.810
                                                 mm"
             Maximum intensity
                                       139.290 mm/hr"
                  tion 170.000 minutes" 0.000 0.000 0.000 c.m/sec"
             Duration
               005hyd Hydrograph extension used in this file"
            6
 33
            CATCHMENT 102"
            1 Triangular SCS"
            1
               Equal length"
           2 Horton equation"
         102 Glenburnie Post-Development"
     10.700 % Impervious"
       0.674 Total Area"
     86.500 Flow length"
10.000 Overland Slope"
     0.602 Pervious Area"
86.500 Pervious length"
      10.000 Pervious slope"
       0.072 Impervious Area"
     86.500 Impervious length"
     10.000 Impervious slope"
       0.250 Pervious Manning 'n'"
       75.000 Pervious Max.infiltration"
      12.500 Pervious Min.infiltration"
0.250 Pervious Lag constant (hou
                Pervious Lag constant (hours) "
        5.000 Pervious Depression storage"
        0.015 Impervious Manning 'n'"
        0.000 Impervious Max.infiltration"
        0.000 Impervious Min.infiltration"
        0.050 Impervious Lag constant (hours)"
                Impervious Depression storage"
        1.500
                   0.054 0.000 0.000
                                                  0.000 c.m/sec"
             Catchment 102 Pervious Impervious Total Area "
             Surface Area 0.602 0.072
Time of concentration 16.529 2.263
                                              0.072 0.674 hectare"
                                                        11.834
                                                                    minutes"
             Time to Centroid 89.389 82.032 86.968 minutes"
             Rainfall depth
                                  46.810 46.810
                                                        46.810 mm"
             Rainfall volume 281.74 33.76
Rainfall losses 35.916 2.210
Runoff depth 10.894 44.600
                                                        315.50 c.m"
                                                        32.309 mm"
14.501 mm"
```

(F	Runoff volume	65.57	32.16	97.74	C.m"
19	Runoff coefficient	0.233	0.953	0.310	n
	Maximum flow	0.044	0.023	0.054	c.m/sec"
40	HYDROGRAPH Add Runoff	11			
n .	4 Add Runoff "				
•	0.054 0.05	54 0.000	0.000"	1	
" 38	START/RE-START TOTALS	102"			
77	3 Runoff Totals on EX	KIT"			
***	Total Catchment area		C	.674	hectare"
77	Total Impervious area		C	.072	hectare"
77	Total % impervious		10	.700"	
" 19	EXIT"				



MIDUSS OUTPUT

100 YEAR PRE AND POST DEVELOPMENT

Hyland Road: 100-Year Storm - Existing Conditions

```
MIDUSS Output -----
               MIDUSS version
                                                     Version 2.25 rev. 465"
                                                  Tuesday, February 05, 2008"
               MIDUSS created
                                                               ie METRIC"
          10
               Units used:
                                     Q:\13-212\21203-13 (Dunnink - Hyland)\"
               Job folder:
                                                        20-mar-18 SWM calcs"
                                                       100-yr ex Hyland.out"
               Output filename:
                                                              Mike.Vaughan"
               Licensee name:
               Company
                                                    3/18/2020 at 2:52:00 PM"
               Date & Time last used:
            TIME PARAMETERS"
       5.000 Time Step"
              Max. Storm length"
      360.000
     3000.000 Max. Hydrograph"
            FILEI O Read/Open guelph100.stm"
           1 1=read/open; 2=write/save"
           1 1=rainfall; 2=hydrograph"
           1 1=rain; 2=imperv; 3=perv"
            quelph100.stm"
            Guelph, ON 100 year storm"
            New storm defined"
            Total depth
                                       88.431
                                       239.350 mm/hr"
            Maximum intensity
                                      210.000 minutes"
            Duration
                       210.000 minutes"
0.000 0.000 0.000 c.m/sec"
                 0.000
               100hyd Hydrograph extension used in this file"
" 33
            CATCHMENT 201"
            1 Triangular SCS"
               Equal length"
              Horton equation"
            2
          201 Hyland Road Pre-Development"
       2.800 % Impervious"
       1.065 Total Area"
     100.000 Flow length"
       4.000 Overland Slope"
              Pervious Area"
       1.035
      100.000
               Pervious length"
       4.000 Pervious slope"
       0.030 Impervious Area"
      100.000 Impervious length"
       4.000 Impervious slope"
       0.250 Pervious Manning 'n'"
       75.000 Pervious Max.infiltration"
       12.500 Pervious Min.infiltration"
       0.250 Pervious Lag constant (hours)"
       5.000 Pervious Depression storage"
0.015 Impervious Manning 'n'"
               Impervious Manning 'n'"
       0.000 Impervious Max.infiltration"
        0.000 Impervious Min.infiltration"
        0.050 Impervious Lag constant (hours)"
        1.500
                Impervious Depression storage"
                                                0.000 c.m/sec"
                    0.294 0.000 0.000
                                Pervious Impervious Total Area "
             Catchment 201
                                             0.030 1.065 hectare"
             Surface Area
                                   1.035
             Time of concentration 14.749
                                                      14.126
                                             2.617
                                                                  minutes"
             Time to Centroid 106.704 96.912
                                                      106.201 minutes"
                                 88.431 88.431
                                                      88.431
                                                                mm"
             Rainfall depth
                                                      941.79
                                 915.42 26.37
                                                                 C.m"
             Rainfall volume
                                 43.062 3.195
45.369 85.236
                                                      41.946
46.485
                                                                  mm"
             Rainfall losses
                                 45.369
                                             85.236
                                                                  mm **
             Runoff depth
```

"		Runoff volume	469.65	25.42	495.06	c.m"
11		Runoff coefficient	0.513	0.964	0.526	11
W		Maximum flow	0.285	0.016	0.294	c.m/sec"
11	40	HYDROGRAPH Add Runoff	Ħ			
**		4 Add Runoff "				
**		0.294 0.29	0.000	0.000"		
11	38	START/RE-START TOTALS	201"			
17		3 Runoff Totals on EX	KIT"			
11		Total Catchment area		1	.065	hectare"
44		Total Impervious area		0	.030	hectare"
11		Total % impervious		2	.800"	
н	19	EXIT"				

3 E

Hyland Road: 100-Year Storm - Proposed Conditions

```
MIDUSS Output ----->"
TŦ
                                                    Version 2.25 rev. 465"
               MIDUSS version
TT
               MIDUSS created
                                                 Tuesday, February 05, 2008"
           10
               Units used:
                                                                ie METRIC"
                                     Q:\13-212\21203-13 (Dunnink - Hyland)\"
                Job folder:
                                                        20-jul-31 swm calcs"
                                                          100-yr design.out"
                Output filename:
                                                               Mike. Vaughan"
                Licensee name:
п
                Company
п
                Date & Time last used:
                                                    7/31/2020 at 3:06;48 PM"
11
             TIME PARAMETERS"
        5.000 Time Step"
п
      360.000 Max. Storm length"
11
     3000.000 Max. Hydrograph"
11
 47
            FILEI O Read/Open guelph100.stm"
11
            1 1=read/open; 2=write/save"
11
            1 1=rainfall; 2=hydrograph"
11
              1=rain; 2=imperv; 3=perv"
            1
11
             guelph100.stm"
11
             Guelph, ON 100 year storm"
**
             New storm defined"
11
             Total depth
                                       88.431 mm"
                                       239.350 mm/hr"
**
             Maximum intensity
                                      210.000 minutes"
             Duration
                         0.000 0.000 0.000 c.m/sec"
                  0.000
            6 100hyd Hydrograph extension used in this file"
            CATCHMENT 202"
 33
ľű
            1 Triangular SCS"
11
           1 Equal length"
**
           2 Horton equation"
**
          202 Hyland Road Post-Development"
Ŧŧ
       23.600 % Impervious"
        1.065 Total Area"
      100.000 Flow length"
9 V
        4.000 Overland Slope"
.
        0.814 Pervious Area"
              Pervious length"
77
      100.000
ŦŦ
               Pervious slope"
        4.000
п
                Impervious Area"
        0.251
97
      100.000
                Impervious length"
        4.000
                Impervious slope"
               Pervious Manning 'n'"
        0.250
       75.000 Pervious Max.infiltration"
11
       12.500 Pervious Min.infiltration"
11
        0.250 Pervious Lag constant (hours)"
.
        5.000 Pervious Depression storage"
2.5
        0.015
               Impervious Manning 'n'"
.
        0.000
                Impervious Max.infiltration"
                Impervious Min.infiltration"
        0.000
                Impervious Lag constant (hours)"
        0.050
                Impervious Depression storage"
        1.500
                                                 0.000 c.m/sec"
                    0.294 0.000 0.000
                                  Pervious Impervious Total Area "
             Catchment 202
                                             0.251 1.065
2.617 10.294
                                   0.814
                                                                  hectare"
             Surface Area
             Time of concentration 14.749
                                                                  minutes"
                                                    103.108
             Time to Centroid
                                                                  minutes"
                                   106.704
                                           96.912
                                            88.431
                                                      88.431
                                                                 mm"
             Rainfall depth
                                  88.431
                                  719.53 222.26
                                                      941.79
                                                                 c.m"
             Rainfall volume
                                43.062 3.195
             Rainfall losses
                                                      33.654
                                                                 mm **
                                 45.369 85.236
                                                      54.777
             Runoff depth
```

rı		Runoff volume	369.15	214.23	583.38	c.m"
11		Runoff coefficient	0.513	0.964	0.619	97
**		Maximum flow	0.224	0.137	0.294	c.m/sec"
PF	40	HYDROGRAPH Add Runof:	E "			
88		4 Add Runoff "				
77		0.294 0.3	294 0.000	0.000"		
17	38	START/RE-START TOTAL:	5 202 "			
166		3 Runoff Totals on 1	EXIT"			
11		Total Catchment area		1	.065	hectare"
89		Total Impervious area	a	0	.251	hectare"
17		Total % impervious		23	.600"	
17	19	EXIT"				

.

Glenburnie Drive: 100-Year Storm - Existing Conditions

```
MIDUSS Output -----
               MIDUSS version
                                                     Version 2.25 rev. 465"
               MIDUSS created
                                                  Tuesday, February 05, 2008"
           10
               Units used:
                                                                ie METRIC"
               Job folder:
                                     Q:\13-212\21203-13 (Dunnink - Hyland)\"
                                                        20-mar-18 SWM calcs"
               Output filename:
                                                   100-yr ex Glenburnie.out"
               Licensee name:
                                                               Mike. Vaughan"
               Company
               Date & Time last used:
                                                    3/18/2020 at 2:36:42 PM"
" 31
            TIME PARAMETERS"
        5.000 Time Step"
      180.000
               Max. Storm length"
     1500.000 Max. Hydrograph"
            TIME PARAMETERS"
        5.000 Time Step"
      360.000 Max. Storm length"
     3000.000 Max. Hydrograph"
            FILEI O Read/Open quelph100.stm"
            1 1=read/open; 2=write/save"
           1
               1=rainfall; 2=hydrograph"
              1=rain; 2=imperv; 3=perv"
           1
            guelph100.stm"
            Guelph, ON 100 year storm"
            New storm defined"
            Total depth
                                       88.431
                                               mm"
            Maximum intensity
                                      239.350 mm/hr"
210.000 minutes"
            Duration
                       0.000 0.000 0.000 c.m/sec"
                 0.000
           6 100hyd Hydrograph extension used in this file"
            CATCHMENT 101"
           1 Triangular SCS"
           1 Equal length"
           2 Horton equation"
         101 Glenburnie Pre-Development"
       0.000
               % Impervious"
              Total Area"
       0.674
      86.500 Flow length"
      10.000 Overland Slope"
       0.674 Pervious Area"
     86.500 Pervious length"
      10.000 Pervious slope"
       0.000 Impervious Area"
      86.500 Impervious length"
10.000 Impervious slope"
       0.250 Pervious Manning 'n'"
      75.000 Pervious Max.infiltration"
      12.500 Pervious Min.infiltration"
      0.250 Pervious Lag constant (hours)"
       5.000 Pervious Depression storage"
       0.015
               Impervious Manning 'n'"
       0.000
               Impervious Max.infiltration"
       0.000
               Impervious Min.infiltration"
       0.050
               Impervious Lag constant (hours)"
       1.500
               Impervious Depression storage"
                   0.218 0.000 0.000
                                                0.000 c.m/sec"
            Catchment 101
                                 Pervious Impervious Total Area "
                                  0.674
                                            0.000 0.674 hectare"
            Surface Area
            Time of concentration 10.270
                                           1.822
                                                     10.270
                                                                minutes"
            Time to Centroid 101.764
                                           95.707
                                                      101.764 minutes"
```

10		Rainfall depth	88.431	88.431	88.431	mm "
11		Rainfall volume	596.02	0.00	596.02	c.m"
77		Rainfall losses	43.349	2.615	43.349	mm**
77		Runoff depth	45.082	85.816	45.082	IUIU AA
84		Runoff volume	303.85	0.00	303.85	c.m"
11		Runoff coefficient	0.510	0.000	0.510	(191)
17		Maximum flow	0.218	0.000	0.218	c.m/sec"
11	40	HYDROGRAPH Add Runoff '	n			
#1		4 Add Runoff "				
44		0.218 0.218	0.000	0.000"		
44	38	START/RE-START TOTALS	101"			
11		3 Runoff Totals on EX	IT"			
89		Total Catchment area		0	. 674	hectare"
**		Total Impervious area		0	.000	hectare"
44		Total % impervious		0	.000"	
17	19	EXIT"				

Glenburnie Drive: 100-Year Storm - Proposed Conditions

```
MIDUSS Output -----
                  MIDUSS version
                                                            Version 2.25 rev. 465"
                                                         Tuesday, February 05, 2008"
                  MIDUSS created
                                                                        ie METRIC"
            10
                 Units used:
                                          0:\13-212\21203-13 (Dunnink - Hyland)\"
                  Job folder:
                                                               20-mar-18 SWM calcs"
                                                           100-yr pr Glenburnie.out"
                  Output filename:
                                                                        Mike. Vaughan"
                  Licensee name:
                  Company
                  Date & Time last used:
                                                          3/18/2020 at 2:45:13 PM"
             TIME PARAMETERS"
       5.000 Time Step"
       360.000 Max. Storm length"
      3000.000 Max. Hydrograph"
             FILEI O Read/Open quelph100.stm"
             1 1=read/open; 2=write/save"
             1 1=rainfall; 2=hydrograph"
             1 1=rain; 2=imperv; 3=perv"
              quelph100.stm"
              Guelph, ON 100 year storm"
              New storm defined"
              Total depth
                                             88.431 mm"
             Maximum intensity
                                           239.350 mm/hr"
                    ion 210.000 minutes" 0.000 0.000 0.000 0.000 c.m/sec"
             Duration
            6 100hyd Hydrograph extension used in this file"
" 33
             CATCHMENT 102"
             1 Triangular SCS"
                  Equal length"
             1
                Horton equation"
             2
           102 Glenburnie Post-Development"
      10.700 % Impervious"
        0.674 Total Area"
       86.500 Flow length"
                Overland Slope"
11
       10.000
        0.602
                 Pervious Area"
        0.602 Pervious Area"
86.500 Pervious length"
       10.000 Pervious slope"
        0.072 Impervious Area"
      86.500 Impervious length"
       10.000 Impervious slope"
        0.250 Pervious Manning 'n'"
        75.000 Pervious Max.infiltration"
        12.500 Pervious Min.infiltration"
        0.250 Pervious Lag constant (hours)"
5.000 Pervious Depression storage"
0.015 Impervious Manning 'n'"
         0.000 Impervious Max.infiltration"
         0.000 Impervious Min.infiltration"
         0.050 Impervious Lag constant (hours)"
         1.500 Impervious Depression storage"
                      0.215 0.000 0.000
                                                      0.000 c.m/sec"
               Catchment 102 Pervious Impervious Total Area "
Surface Area 0.602 0.072 0.674 he
Time of concentration 10.270 1.822 8.701 mi
                                                   0.072 0.674 hectare"
               Time of concentration 10.270 1.822 8.701 minutes"
Time to Centroid 101.764 95.707 100.639 minutes"
              Rainfall depth 88.431 88.431 88.431 Rainfall volume 532.25 63.77 596.02 Rainfall losses 43.349 2.615 38.990 Runoff depth 45.082 85.816 49.441
                                                              88.431 mm"
                                                                          c.m"
                                                                           mm**
                                                                           mm*
```

**	Runoff volume	271.34	61.89	333.23	c.m"
11	Runoff coefficient	0.510	0.970	0.559	ij.
**	Maximum flow	0.195	0.041	0.215	c.m/sec"
" 40	HYDROGRAPH Add Runoff	11			
77	4 Add Runoff "				
11	0.215 0.23	15 0.00	0.000)"	
" 38	START/RE-START TOTALS	102"			
ę¥.	3 Runoff Totals on EX	KIT"			
**	Total Catchment area			0.674	hectare"
***	Total Impervious area			0.072	hectare"
FT	Total % impervious		1	10.700"	
" 19	EXIT"				