



October 16, 2020

Our File: 420023

City of Cambridge  
50 Dickson Street  
Cambridge ON, N1R 5W8

Attention: Mr. Adam Ripper, P.Eng.

Re: Stormwater Management Brief  
355 Guelph Avenue and 11 Fletcher Circle  
City of Cambridge

Dear Mr. Ripper,

This letter has been prepared by GM BluePlan Engineering Limited to identify the stormwater management measures for the proposed residential development at 355 Guelph Avenue and 11 Fletcher Circle in the City of Cambridge. The 0.240-hectare site is bound by existing residential to the north and east, Fletcher Circle to the south and Guelph Avenue to the east. The 355 Guelph Avenue site is currently developed as a single-family residential lot. The 11 Fletcher Circle site is currently vacant.

Under existing conditions, runoff generated from a portion of the site sheetflows overland in a southeasterly direction to the existing swale on the 11 Fletcher Circle property, ultimately discharging to the existing DICB at the southeast corner of the property, and to the existing storm sewer on Fletcher Circle. The remainder of the site, consisting of the existing dwelling at 355 Guelph Avenue and landscaped areas, sheetflows overland to the east of the site towards the existing lots along Fletcher Circle. The subject site is part of the greater drainage catchment for the existing Mill Pond Subdivision and the existing Stormwater Management Facility at Shaw Avenue.

The Development Concept was prepared by Urbe Developments Inc.. The topographic survey of the site was completed by J.D. Barnes Limited (dated March 25, 2020). The existing and proposed site details, along with the stormwater management controls, are shown on the Existing Conditions and Removals Plan, Site Servicing, and Site Grading Plan (GM BluePlan Limited).

#### **PROPOSED DEVELOPMENT**

The intent of the Owner at this time is to construct nine (9) townhouses, along with the associated asphalt driving and parking areas, and landscaped areas. Following development, runoff generated from the site will be directed to on-site swales, ultimately discharging to the existing municipal storm sewers on Fletcher Circle and to the existing stormwater management facility on Shaw Avenue. Runoff generated from the north portion of the site will continue to be directed towards the existing lots on Fletcher Circle, ultimately discharging to the existing stormwater management facility on Shaw Avenue.

#### **STORMWATER MANAGEMENT CRITERIA**

Based on the information provided by the City of Cambridge in the Pre-Consultation Comments, the criteria for the site is as follows:

1. Drainage from the subject properties was accounted for in the design of the adjacent Mill Pond subdivision and stormwater management facilities.

On-site quality control is required under post-development conditions for any portion of the site that exceeds the imperviousness of the stormwater management design for the Mill Pond Subdivision as identified below.

2. Peak flows from the post-development site for the 5-year and 100-year design storm events are to be attenuated to the design peak flows from the Mill Pond Subdivision, based on a runoff coefficient of 0.40 for the 355 Guelph Avenue property and a runoff coefficient of 0.55 for the 11 Fletcher Circle property.

The City of Cambridge Rainfall Distribution parameters and the total depth of rainfall used for the 5-year and 100-year design storm analysis are as follows:

**Table No. 1: Rainfall Distribution Parameters**

	<b>5-Year</b>	<b>100-Year</b>
a =	1219.8	3015.1
b =	10.5	21.0
c =	0.823	0.870
r =	0.400	0.400
Duration (minutes)=	180.0	180.0
Maximum Intensity (mm/hr) =	127.834	177.123
Rainfall Depth (mm)=	48.647	89.669

**ALLOWABLE RELEASE RATES**

As per the stormwater management criteria, the Mill Pond Subdivision stormwater management design utilized a runoff coefficient of 0.40 for 355 Guelph Avenue, and 0.55 for 11 Fletcher Circle. This following flow rates were calculated utilizing the Rational Method, utilizing a weighted average of the runoff coefficients identified for each property, and the individual property areas.

**Table No. 2: Design Flows**

	<b>Runoff Coefficient</b>	<b>Site Area</b>	<b>5-Year Flow Rate</b>	<b>100-Year Flow Rate</b>
355 Guelph Avenue	0.40	0.188-ha	0.026 m <sup>3</sup> /s	0.037 m <sup>3</sup> /s
11 Fletcher Circle	0.55	0.052-ha	0.010 m <sup>3</sup> /s	0.014 m <sup>3</sup> /s
Total Site	0.433	0.240-ha	0.037 m <sup>3</sup> /s	0.051 m <sup>3</sup> /s

Therefore, the allowable release rates for the site are as follows:

**Table No. 3: Allowable Release Rate**

	<b>5-Year</b>	<b>100-Year</b>
Allowable Release Rates	0.037 m <sup>3</sup> /s	0.051 m <sup>3</sup> /s

**POST DEVELOPMENT CONDITIONS**

For the post-development condition (illustrated in Figure No. 1), the 0.24-ha site was modelled as three (3) catchments.

**Catchment 100 (0.16-ha @ 43% Impervious)** represents the portion of the site which discharges uncontrolled to the Guelph Avenue and Fletcher Circle right-of-ways.

**Catchment 200 (0.03-ha @ 45% Impervious)** represents the back half of the roofs of the houses that front Guelph Avenue, as well as a portion of the rear yards of those lots.

Runoff generated from Catchment 200 will be convey to a subsurface infiltration gallery via inline drains. The subsurface infiltration gallery (18.5m long x 2.5m wide x 1.2m deep) has the capacity to infiltrate the 100-year design storm event from catchment 200. Based on our history in the area, the native subsurface soils are a sandy silt till. We have conservatively estimated the infiltration rate at 5 mm/hour.

**Catchment 300 (0.05-ha @ 40% Impervious)** represents the back half of the roofs of the houses that front Fletecher Circle, as well as a portion of the rear yards of those lots.

Runoff generated from Catchment 300 will be conveyed to a subsurface infiltration gallery via inline drains. The subsurface infiltration gallery (29.8m long x 2.5m wide x 1.2m deep) has the capacity to infiltrate the 100-year design storm event from catchment 300. Based on our history in the area, the native subsurface soils are a sandy silt till. We have conservatively estimated the infiltration rate at 5 mm/hour.

**ROUTING**

The hydrologic model MIDUSS was used to create the design storm runoff hydrographs and to route the hydrographs. A copy of the final printout of the hydrologic modelling is appended.

The results of the routing analysis are as follows:

**Table No. 4: Catchment 200 Infiltration Stage/Storage/Discharge Capacities**

	Available Capacity			Actual Capacity Used		
	Peak Flow m <sup>3</sup> /s	Storage Volume m <sup>3</sup>	Storage Elevation m	Peak Flow m <sup>3</sup> /s	Storage Volume m <sup>3</sup>	Storage Elevation m
Bottom of Stone	0.000	0.0	312.20	---	---	---
5-Year	---	---	---	0.000	7.3	312.68
100-Year	---	---	---	0.000	17.8	313.36
Top of Stone	0.0001	18.50	313.40	---	---	---
Top of Gate	0.0001	18.58	313.93	---	---	---

**Table No. 5: Catchment 300 Infiltration Stage/Storage/Discharge Capacities**

	Available Capacity			Actual Capacity Used		
	Peak Flow m <sup>3</sup> /s	Storage Volume m <sup>3</sup>	Storage Elevation m	Peak Flow m <sup>3</sup> /s	Storage Volume m <sup>3</sup>	Storage Elevation m
Bottom of Stone	0.000	0.0	310.40	---	---	---
5-Year	---	---	---	0.000	11.4	310.86
100-Year	---	---	---	0.000	28.7	311.56
Top of Stone	0.0002	29.80	311.60	---	---	---
Top of Gate	0.0002	18.58	313.93	---	---	---

In summary, the post-development flow rates from the site are as follows:

**Table No. 6: Post-Development Flow Rates**

	<b>5-Year</b>	<b>100-Year</b>
Catchment 100 (uncontrolled)	0.022 m <sup>3</sup> /s	0.049 m <sup>3</sup> /s
Catchment 200 (controlled)	0.000 m <sup>3</sup> /s	0.000 m <sup>3</sup> /s
Catchment 300 (controlled)	0.000 m <sup>3</sup> /s	0.000 m <sup>3</sup> /s
<b>Total</b>	<b>0.022 m<sup>3</sup>/s</b>	<b>0.049 m<sup>3</sup>/s</b>

The following table compares the post-development condition flow rates to the existing condition release rates for the full range of design storm events.

**Table No. 7: Comparison of Allowable Release Rates and Post-Development Condition Flow Rates**

	<b>5-Year</b>	<b>100-Year</b>
Allowable Release Rates	0.037 m <sup>3</sup> /s	0.051 m <sup>3</sup> /s
Post-Development Condition	0.022 m <sup>3</sup> /s	0.049 m <sup>3</sup> /s

Therefore, the 5 and 100-year post-development flow rates from the site have been attenuated to be less than the allowable release rates.

#### **QUALITY CONTROL**

The downstream Mill Pond subdivision and stormwater management facility was designed to treat flows from this site (area = 0.24 ha) at a runoff coefficient (RC) of 0.433, as noted above. As Catchments 200 and 300 are infiltrated on site, the only Catchment that will contribute to the downstream pond is Catchment 100, which is 0.16 ha at 43% impervious, which is equivalent to a runoff coefficient (RC) of approximately 0.53.

So, the pond was design for:  $RC \times Area = 0.433 \times 0.24ha = 0.10$

The site contributes:  $RC \times Area = 0.53 \times 0.16ha = 0.08$

Therefore, on-site quality control will not be required as the proposed development is contributing less impervious area to the pond than it was designed for.

#### **SEDIMENT AND EROSION CONTROLS**

Silt fence will be installed along the property boundary in all locations where runoff will discharge from the site to adjacent lands. The silt fence will serve to minimize the opportunity for water borne sediments to be washed on to the adjacent properties.

Once catch basins have been relocated/installed, the grates will be wrapped with filter cloth. This feature will be maintained until all building and landscaping has been completed.

Inspection and maintenance of all silt fencing will start after installation is complete. The silt fence will be inspected on a weekly basis during active construction or after a rainfall event of 13 mm or greater. Maintenance will be carried out, within 48 hours, on any part of the facility found to need repair.

Once construction and landscaping has been substantially completed, the silt fence will be removed, any accumulated sediment will be removed and the landscaping will be completed.

After construction of the complete development, erosion and sediment transport will be minimal.

## MAINTENANCE PLAN

To ensure that the stormwater management system continues to function as designed and constructed, we recommend that the following inspections and maintenance activities be completed on an annual basis:

1. Is there any noticeable damage to the asphalt and grassed swale (i.e. erosion, blockages)? If yes, complete any necessary repairs.
2. Inspect all ditch inlets, catch basins, and manholes. Remove and dispose of any accumulated sediment, trash/litter, debris (i.e. sediment, garbage, leaves, etc.).
3. Inspect all swales and overflow locations. Remove and dispose of any accumulated sediment, trash/litter, debris (i.e. sediment, garbage, leaves, etc.).
4. Is there any indication of a spill (i.e. frothy water, oily sheen on the water)? If yes, investigate, inform the appropriate agencies and complete the necessary clean-up and restoration.

Please note that any structures identified during the annual inspection to be worn, missing or damaged are to be repaired or replaced within 48 hours.

## CONCLUSIONS

In summary, the preliminary stormwater management design for the development at 355 Guelph Avenue and 11 Fletcher Circle in the City of Cambridge is as follows:

1. Runoff generated from the site during the 5-year and 100-year design storm events has been attenuated to less than the allowable release rates from the site.
2. Quality control treatment for runoff generated from the site is provided through the existing stormwater management facility on Shaw Avenue, constructed as part of the Mill Pond Subdivision.

We trust this is the information you require at this time. If you have any questions or require additional information, please do not hesitate to call.

Yours truly,

**GM BLUEPLAN ENGINEERING LIMITED**

Per:



Sarah Primmer, P.Eng.

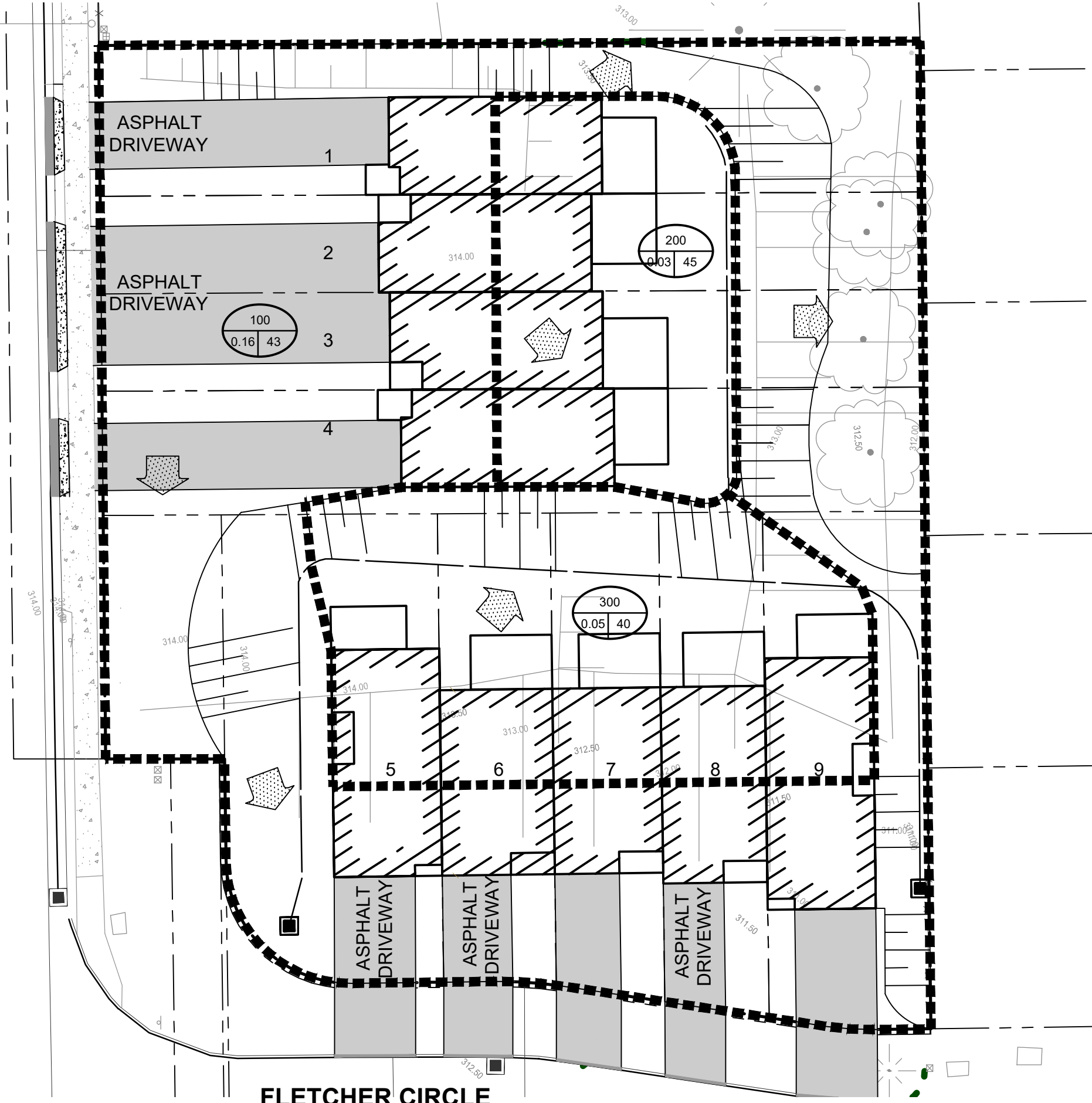
SP/rdj

W:\Kitchener\420-2020\420023 - 355 Guelph Avenue, Cambridge\GMBP Reports - SWM, FSR, Design Brief, etc\420023 SWM Brief\_2020-10-16.docx



FILE:W:\Kitchener\420-2020\420023 - 355 Guelph Avenue, Cambridge\Drawings\420023 - SWM-FIG.dwg LAYOUT:POST-DEV  
LAST SAVED BY:Sprimmer, 10/15/2020 6:13:41 PM PLOTTED BY:Sarah Pfirmer - GM BluePlan 10/16/2020 8:51:37 AM


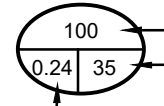

**GUELPH AVENUE**



**CITY OF  
CAMBRIDGE**



**LEGEND**

-  DRAINAGE AREA BOUNDARY
-  CATCHMENT NUMBER  
% IMPERVIOUS  
CATCHMENT AREA IN HECTARES
-  MAJOR OVERLAND FLOW PATH

**355 GUELPH AVENUE  
POST DEVELOPMENT  
CONDITIONS DRAINAGE  
AREA PLAN**

**FIGURE 1**



420023  
OCTOBER 2020  
Scale: 1:250 | NAD 1983 UTM Zone 17N

**355 GUELPH AVENUE, CAMBRIDGE**

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**Catchment 200: Proposed Infiltration Gallery**

**STORAGE VOLUME CALCULATIONS**

<b>ELEV</b>	<b>INC D</b>	<b>SURFACE AREA</b> <b>(Infil. Gall)</b>	<b>INCR. STORAGE VOL</b> <b>(cu m)</b>	<b>ACCUM STORAGE VOL</b> <b>(cu m)</b>	
<b>(m)</b>	<b>(m)</b>	<b>(sq m)</b>	<b>(cu m)</b>	<b>(cu m)</b>	
312.20	0.000	46.3	0.00	0.00	Bottom of Stone
312.40	0.200	46.3	3.08	3.08	
312.60	0.400	46.3	3.08	6.17	
312.80	0.600	46.3	3.08	9.25	
313.00	0.800	46.3	3.08	12.33	
313.20	1.000	46.3	3.08	15.42	
313.40	1.200	46.3	3.08	18.50	Top of Stone
313.75	1.550	0.6	0.04	18.54	
313.93	1.730	0.6	0.04	18.58	T/G

**BOTTOM INFILTRATION**

L(dw) = 18.5 m  
 W(dw) = 2.5 m  
 D(dw) = 1.20 m  
  
 A(c) = 46.3 sq m  
 VOL(dw)= 55.5 cu m  
 VOL(st)= 18.5 cu m  
 K = 5 mm/hr  
 = 1.39E-04 cm/s

**SIDE INFILTRATION**

**ALL SIDES**

L(dw) = 18.5 m  
 W(dw) = 2.5 m  
 D(dw) = 1.20 m  
  
 A(c) = 55.5 sq m  
  
 K = 5 mm/hr  
 = 1.39E-04 cm/s

<b>ELEVATION</b>	<b>STAGE (m)</b>	<b>STORAGE (cu m)</b>	<b>INFILTRATION DISCHARGE (cu m/s)</b>	<b>TOTAL DISCHARGE (cu m/s)</b>	
312.20	0.000	0.00	0.0000	0.0000	Bottom of Stone
312.40	0.200	3.08	0.0001	0.0001	
312.60	0.400	6.17	0.0001	0.0001	
312.80	0.600	9.25	0.0001	0.0001	
313.00	0.800	12.33	0.0001	0.0001	
313.20	1.000	15.42	0.0001	0.0001	
313.40	1.200	18.50	0.0001	0.0001	Top of Stone
313.75	1.550	18.54	0.0001	0.0001	
313.93	1.730	18.58	0.0001	0.0001	T/G

**355 GUELPH AVENUE, CAMBRIDGE**

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**Catchment 300: Proposed Infiltration Gallery**

**STORAGE VOLUME CALCULATIONS**

<b>ELEV</b>	<b>INC</b>	<b>SURFACE</b>	<b>INCR.</b>	<b>ACCUM</b>	
<b>(m)</b>	<b>D</b>	<b>AREA</b>	<b>STORAGE</b>	<b>STORAGE</b>	
	<b>(m)</b>	<b>(Infil. Gall)</b>	<b>VOL</b>	<b>VOL</b>	
		<b>(sq m)</b>	<b>(cu m)</b>	<b>(cu m)</b>	
310.40	0.000	74.5	0.00	0.00	Bottom of Stone
310.60	0.200	74.5	4.97	4.97	
310.80	0.400	74.5	4.97	9.93	
311.00	0.600	74.5	4.97	14.90	
311.20	0.800	74.5	4.97	19.87	
311.40	1.000	74.5	4.97	24.83	
311.60	1.200	74.5	4.97	29.80	Top of Stone
311.95	1.550	0.6	0.04	29.84	
312.13	1.730	0.6	0.04	29.88	T/G

**BOTTOM INFILTRATION**

L(dw) = 29.8 m  
 W(dw) = 2.5 m  
 D(dw) = 1.20 m  
  
 A(c) = 74.5 sq m  
 VOL(dw)= 89.4 cu m  
 VOL(st)= 29.8 cu m  
 K = 5 mm/hr  
 = 1.39E-04 cm/s

**SIDE INFILTRATION**

**ALL SIDES**

L(dw) = 29.8 m  
 W(dw) = 2.5 m  
 D(dw) = 1.20 m  
  
 A(c) = 89.4 sq m  
  
 K = 5 mm/hr  
 = 1.39E-04 cm/s

<b>ELEVATION</b>	<b>STAGE</b>	<b>STORAGE</b>	<b>INFILTRATION</b>	<b>TOTAL</b>	
	<b>(m)</b>	<b>(cu m)</b>	<b>DISCHARGE</b>	<b>DISCHARGE</b>	
			<b>(cu m/s)</b>	<b>(cu m/s)</b>	
310.40	0.000	0.00	0.0000	0.0000	Bottom of Stone
310.60	0.200	4.97	0.0001	0.0001	
310.80	0.400	9.93	0.0001	0.0001	
311.00	0.600	14.90	0.0002	0.0002	
311.20	0.800	19.87	0.0002	0.0002	
311.40	1.000	24.83	0.0002	0.0002	
311.60	1.200	29.80	0.0002	0.0002	Top of Stone
311.95	1.550	29.84	0.0002	0.0002	
312.13	1.730	29.88	0.0002	0.0002	T/G



```

"          MIDUSS Output ----->"
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"          MIDUSS created                      Sunday, February 07, 2010"
"          10  Units used:                      ie METRIC"
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"          Output filename:                     420023_POST_5_r4.out"
"          Licensee name:                       gmbp"
"          Company                              "
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" 31      TIME PARAMETERS"
"          5.000  Time Step"
"          180.000 Max. Storm length"
"          1500.000 Max. Hydrograph"
" 32      STORM Chicago storm"
"          1  Chicago storm"
"          1219.800 Coefficient A"
"          10.500  Constant B"
"          0.823  Exponent C"
"          0.400  Fraction R"
"          180.000 Duration"
"          1.000  Time step multiplier"
"          Maximum intensity                    127.834  mm/hr"
"          Total depth                          48.647  mm"
"          6  005hyd  Hydrograph extension used in this file"
" 33      CATCHMENT 100"
"          1  Triangular SCS"
"          1  Equal length"
"          2  Horton equation"
"          100  Catchment 100"
"          43.000  % Impervious"
"          0.160  Total Area"
"          25.000  Flow length"
"          2.000  Overland Slope"
"          0.091  Pervious Area"
"          25.000  Pervious length"
"          2.000  Pervious slope"
"          0.069  Impervious Area"
"          25.000  Impervious length"
"          2.000  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"
"          0.022  0.000  0.000  0.000 c.m/sec"

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	Catchment 100	Pervious	Impervious	Total Area	
"	Surface Area	0.091	0.069	0.160	hectare"
"	Time of concentration	13.431	1.802	4.456	minutes"
"	Time to Centroid	92.172	87.542	88.598	minutes"
"	Rainfall depth	48.647	48.647	48.647	mm"
"	Rainfall volume	44.37	33.47	77.84	c.m"
"	Rainfall losses	38.282	2.167	22.752	mm"
"	Runoff depth	10.365	46.480	25.895	mm"
"	Runoff volume	9.45	31.98	41.43	c.m"
"	Runoff coefficient	0.213	0.955	0.532	"
"	Maximum flow	0.007	0.021	0.022	c.m/sec"
" 40	HYDROGRAPH Add Runoff "				
"	4 Add Runoff "				
"		0.022	0.022	0.000	0.000"
" 40	HYDROGRAPH Copy to Outflow"				
"	8 Copy to Outflow"				
"		0.022	0.022	0.022	0.000"
" 40	HYDROGRAPH Combine 1"				
"	6 Combine "				
"	1 Node #"				
"	Combine"				
"	Maximum flow		0.022		c.m/sec"
"	Hydrograph volume		41.431		c.m"
"		0.022	0.022	0.022	0.022"
" 40	HYDROGRAPH Start - New Tributary"				
"	2 Start - New Tributary"				
"		0.022	0.000	0.022	0.022"
" 33	CATCHMENT 200"				
"	1 Triangular SCS"				
"	1 Equal length"				
"	2 Horton equation"				
"	200 Catchmet 200"				
"	45.000 % Impervious"				
"	0.030 Total Area"				
"	25.000 Flow length"				
"	2.000 Overland Slope"				
"	0.016 Pervious Area"				
"	25.000 Pervious length"				
"	2.000 Pervious slope"				
"	0.013 Impervious Area"				
"	25.000 Impervious length"				
"	2.000 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"
"          0.004      0.000      0.022      0.022 c.m/sec"
"      Catchment 200      Pervious  Impervious Total Area  "
"      Surface Area      0.016      0.013      0.030      hectare"
"      Time of concentration 13.431      1.802      4.293      minutes"
"      Time to Centroid      92.172      87.542      88.534      minutes"
"      Rainfall depth      48.647      48.647      48.647      mm"
"      Rainfall volume      8.03      6.57      14.59      c.m"
"      Rainfall losses      38.282      2.167      22.030      mm"
"      Runoff depth      10.365      46.480      26.617      mm"
"      Runoff volume      1.71      6.27      7.99      c.m"
"      Runoff coefficient      0.213      0.955      0.547      "
"      Maximum flow      0.001      0.004      0.004      c.m/sec"
" 40      HYDROGRAPH Add Runoff  "
"      4      Add Runoff  "
"          0.004      0.004      0.022      0.022"
" 54      POND DESIGN"
"      0.004  Current peak flow      c.m/sec"
"      0.005  Target outflow      c.m/sec"
"      8.0    Hydrograph volume      c.m"
"      9.    Number of stages"
"      312.200  Minimum water level      metre"
"      313.930  Maximum water level      metre"
"      312.200  Starting water level      metre"
"      0      Keep Design Data: 1 = True; 0 = False"
"          Level Discharge      Volume"
"      312.200      0.000      0.000"
"      312.400  7.60E-05      3.080"
"      312.600  8.80E-05      6.170"
"      312.800  9.90E-05      9.250"
"      313.000  0.00011      12.330"
"      313.200  0.00012      15.420"
"      313.400  0.00012      18.500"
"      313.750  0.00013      18.540"
"      313.930  0.00013      18.580"
"          Peak outflow      0.000      c.m/sec"
"          Maximum level      312.675      metre"
"          Maximum storage      7.332      c.m"
"          Centroidal lag      15.755      hours"
"          0.004      0.004      0.000      0.022 c.m/sec"
" 40      HYDROGRAPH Combine  1"
"      6      Combine  "
"      1      Node #"
"          Combine"
"          Maximum flow      0.022      c.m/sec"
"          Hydrograph volume      47.875      c.m"
"          0.004      0.004      0.000      0.022"
" 40      HYDROGRAPH Start - New Tributary"
"      2      Start - New Tributary"

```

```

"          0.004      0.000      0.000      0.022"
" 33      CATCHMENT 300"
"          1  Triangular SCS"
"          1  Equal length"
"          2  Horton equation"
"          300  Catchment 300"
"         40.000  % Impervious"
"          0.050  Total Area"
"         25.000  Flow length"
"          2.000  Overland Slope"
"          0.030  Pervious Area"
"         25.000  Pervious length"
"          2.000  Pervious slope"
"          0.020  Impervious Area"
"         25.000  Impervious length"
"          2.000  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"
"          0.006      0.000      0.000      0.022 c.m/sec"
"          Catchment 300      Pervious      Impervious      Total Area  "
"          Surface Area      0.030      0.020      0.050      hectare"
"          Time of concentration  13.431      1.802      4.717      minutes"
"          Time to Centroid      92.172      87.542      88.703      minutes"
"          Rainfall depth      48.647      48.647      48.647      mm"
"          Rainfall volume      14.59      9.73      24.32      c.m"
"          Rainfall losses      38.282      2.167      23.836      mm"
"          Runoff depth      10.365      46.480      24.811      mm"
"          Runoff volume      3.11      9.30      12.41      c.m"
"          Runoff coefficient      0.213      0.955      0.510      "
"          Maximum flow      0.002      0.006      0.006      c.m/sec"
" 40      HYDROGRAPH Add Runoff "
"          4  Add Runoff "
"          0.006      0.006      0.000      0.022"
" 54      POND DESIGN"
"          0.006  Current peak flow      c.m/sec"
"          0.005  Target outflow      c.m/sec"
"          12.4  Hydrograph volume      c.m"
"          9.  Number of stages"
"         310.400  Minimum water level      metre"
"         312.130  Maximum water level      metre"
"         310.400  Starting water level      metre"
"          0  Keep Design Data: 1 = True; 0 = False"

```

	Level	Discharge	Volume		
"	310.400	0.000	0.000	"	
"	310.600	0.00012	4.970	"	
"	310.800	0.00014	9.930	"	
"	311.000	0.00016	14.900	"	
"	311.200	0.00017	19.870	"	
"	311.400	0.00019	24.830	"	
"	311.600	0.00019	29.800	"	
"	311.950	0.00020	29.840	"	
"	312.130	0.00020	29.880	"	
"	Peak outflow		0.000	c.m/sec"	
"	Maximum level		310.858	metre"	
"	Maximum storage		11.383	c.m"	
"	Centroidal lag		15.696	hours"	
"	0.006	0.006	0.000	0.022	c.m/sec"
" 40	HYDROGRAPH	Combine	1"		
"	6	Combine "			
"	1	Node #"			
"		Combine"			
"	Maximum flow		0.022	c.m/sec"	
"	Hydrograph volume		57.891	c.m"	
"	0.006	0.006	0.000	0.022"	
" 40	HYDROGRAPH	Confluence	1"		
"	7	Confluence "			
"	1	Node #"			
"		Combine"			
"	Maximum flow		0.022	c.m/sec"	
"	Hydrograph volume		57.891	c.m"	
"	0.006	0.022	0.000	0.000"	
" 38	START/RE-START TOTALS	1"			
"	3	Runoff Totals on EXIT"			
"	Total Catchment area		0.240	hectare"	
"	Total Impervious area		0.102	hectare"	
"	Total % impervious		42.625"		
" 19	EXIT"				

```

"          MIDUSS Output ----->"
"          MIDUSS version                Version 2.25  rev. 473"
"          MIDUSS created                Sunday, February 07, 2010"
"          10 Units used:                ie METRIC"
"          Job folder:                   Y:\SPrimmer\Miduss Modelling\420023"
"          Output filename:              420023_POST_100_r4.out"
"          Licensee name:                gmbp"
"          Company                       "
"          Date & Time last used:        10/16/2020 at 8:16:53 AM"
" 31          TIME PARAMETERS"
"          5.000 Time Step"
"          180.000 Max. Storm length"
"          1500.000 Max. Hydrograph"
" 32          STORM Chicago storm"
"          1 Chicago storm"
"          3015.100 Coefficient A"
"          21.000 Constant B"
"          0.870 Exponent C"
"          0.400 Fraction R"
"          180.000 Duration"
"          1.000 Time step multiplier"
"          Maximum intensity              177.123 mm/hr"
"          Total depth                    89.669 mm"
"          6 100hyd Hydrograph extension used in this file"
" 33          CATCHMENT 100"
"          1 Triangular SCS"
"          1 Equal length"
"          2 Horton equation"
"          100 Catchment 100"
"          43.000 % Impervious"
"          0.160 Total Area"
"          25.000 Flow length"
"          2.000 Overland Slope"
"          0.091 Pervious Area"
"          25.000 Pervious length"
"          2.000 Pervious slope"
"          0.069 Impervious Area"
"          25.000 Impervious length"
"          2.000 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 100	Pervious	Impervious	Total Area	
"	Surface Area	0.091	0.069	0.160	hectare"
"	Time of concentration	8.974	1.582	4.488	minutes"
"	Time to Centroid	93.374	86.798	89.383	minutes"
"	Rainfall depth	89.669	89.669	89.669	mm"
"	Rainfall volume	81.78	61.69	143.47	c.m"
"	Rainfall losses	47.202	2.757	28.090	mm"
"	Runoff depth	42.467	86.912	61.579	mm"
"	Runoff volume	38.73	59.80	98.53	c.m"
"	Runoff coefficient	0.474	0.969	0.687	"
"	Maximum flow	0.026	0.030	0.049	c.m/sec"
" 40	HYDROGRAPH Add Runoff "				
"	4 Add Runoff "				
"	0.049	0.049	0.000	0.000"	
" 40	HYDROGRAPH Copy to Outflow"				
"	8 Copy to Outflow"				
"	0.049	0.049	0.049	0.000"	
" 40	HYDROGRAPH Combine 1"				
"	6 Combine "				
"	1 Node #"				
"	Combine"				
"	Maximum flow		0.049	c.m/sec"	
"	Hydrograph volume		98.526	c.m"	
"	0.049	0.049	0.049	0.049"	
" 40	HYDROGRAPH Start - New Tributary"				
"	2 Start - New Tributary"				
"	0.049	0.000	0.049	0.049"	
" 33	CATCHMENT 200"				
"	1 Triangular SCS"				
"	1 Equal length"				
"	2 Horton equation"				
"	200 Catchmet 200"				
"	45.000 % Impervious"				
"	0.030 Total Area"				
"	25.000 Flow length"				
"	2.000 Overland Slope"				
"	0.016 Pervious Area"				
"	25.000 Pervious length"				
"	2.000 Pervious slope"				
"	0.013 Impervious Area"				
"	25.000 Impervious length"				
"	2.000 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"
"          0.009      0.000      0.049      0.049 c.m/sec"
"      Catchment 200      Pervious  Impervious Total Area  "
"      Surface Area      0.016      0.013      0.030      hectare"
"      Time of concentration  8.974      1.582      4.346      minutes"
"      Time to Centroid      93.374      86.798      89.256      minutes"
"      Rainfall depth      89.669      89.669      89.669      mm"
"      Rainfall volume      14.80      12.11      26.90      c.m"
"      Rainfall losses      47.202      2.757      27.201      mm"
"      Runoff depth      42.467      86.912      62.468      mm"
"      Runoff volume      7.01      11.73      18.74      c.m"
"      Runoff coefficient      0.474      0.969      0.697      "
"      Maximum flow      0.005      0.006      0.009      c.m/sec"
" 40      HYDROGRAPH Add Runoff  "
"      4  Add Runoff  "
"          0.009      0.009      0.049      0.049"
" 54      POND DESIGN"
"      0.009  Current peak flow  c.m/sec"
"      0.005  Target outflow  c.m/sec"
"      18.7  Hydrograph volume  c.m"
"      9.  Number of stages"
"      312.200  Minimum water level  metre"
"      313.930  Maximum water level  metre"
"      312.200  Starting water level  metre"
"      0  Keep Design Data: 1 = True; 0 = False"
"      Level Discharge  Volume"
"      312.200  0.000  0.000"
"      312.400  7.60E-05  3.080"
"      312.600  8.80E-05  6.170"
"      312.800  9.90E-05  9.250"
"      313.000  0.00011  12.330"
"      313.200  0.00012  15.420"
"      313.400  0.00012  18.500"
"      313.750  0.00013  18.540"
"      313.930  0.00013  18.580"
"      Peak outflow      0.000  c.m/sec"
"      Maximum level      313.356  metre"
"      Maximum storage      17.821  c.m"
"      Centroidal lag      26.511  hours"
"          0.009      0.009      0.000      0.049 c.m/sec"
" 40      HYDROGRAPH Combine  1"
"      6  Combine  "
"      1  Node #"
"      Combine"
"      Maximum flow      0.049  c.m/sec"
"      Hydrograph volume      108.350  c.m"
"          0.009      0.009      0.000      0.049"
" 40      HYDROGRAPH Start - New Tributary"
"      2  Start - New Tributary"

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"          0.009      0.000      0.000      0.049"
" 33      CATCHMENT 300"
"          1  Triangular SCS"
"          1  Equal length"
"          2  Horton equation"
"          300  Catchment 300"
"         40.000  % Impervious"
"          0.050  Total Area"
"         25.000  Flow length"
"          2.000  Overland Slope"
"          0.030  Pervious Area"
"         25.000  Pervious length"
"          2.000  Pervious slope"
"          0.020  Impervious Area"
"         25.000  Impervious length"
"          2.000  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"
"          0.015      0.000      0.000      0.049 c.m/sec"
"          Catchment 300      Pervious      Impervious      Total Area  "
"          Surface Area      0.030      0.020      0.050      hectare"
"          Time of concentration  8.974      1.582      4.708      minutes"
"          Time to Centroid      93.374      86.798      89.579      minutes"
"          Rainfall depth      89.669      89.669      89.669      mm"
"          Rainfall volume      26.90      17.93      44.83      c.m"
"          Rainfall losses      47.202      2.757      29.424      mm"
"          Runoff depth      42.467      86.912      60.245      mm"
"          Runoff volume      12.74      17.38      30.12      c.m"
"          Runoff coefficient      0.474      0.969      0.672      "
"          Maximum flow      0.008      0.009      0.015      c.m/sec"
" 40      HYDROGRAPH Add Runoff  "
"          4  Add Runoff  "
"          0.015      0.015      0.000      0.049"
" 54      POND DESIGN"
"          0.015  Current peak flow      c.m/sec"
"          0.005  Target outflow      c.m/sec"
"          30.1  Hydrograph volume      c.m"
"          9.  Number of stages"
"         310.400  Minimum water level      metre"
"         312.130  Maximum water level      metre"
"         310.400  Starting water level      metre"
"          0  Keep Design Data: 1 = True; 0 = False"

```

	Level	Discharge	Volume		
"	310.400	0.000	0.000	"	"
"	310.600	0.00012	4.970	"	"
"	310.800	0.00014	9.930	"	"
"	311.000	0.00016	14.900	"	"
"	311.200	0.00017	19.870	"	"
"	311.400	0.00019	24.830	"	"
"	311.600	0.00019	29.800	"	"
"	311.950	0.00020	29.840	"	"
"	312.130	0.00020	29.880	"	"
"	Peak outflow		0.000	c.m/sec"	
"	Maximum level		311.555	metre"	
"	Maximum storage		28.688	c.m"	
"	Centroidal lag		27.056	hours"	
"	0.015	0.015	0.000	0.049	c.m/sec"
" 40	HYDROGRAPH	Combine	1"		
"	6	Combine "			
"	1	Node #"			
"		Combine"			
"	Maximum flow		0.049	c.m/sec"	
"	Hydrograph volume		123.845	c.m"	
"	0.015	0.015	0.000	0.049"	
" 40	HYDROGRAPH	Confluence	1"		
"	7	Confluence "			
"	1	Node #"			
"		Combine"			
"	Maximum flow		0.049	c.m/sec"	
"	Hydrograph volume		123.845	c.m"	
"	0.015	0.049	0.000	0.000"	
" 38	START/RE-START TOTALS	1"			
"	3	Runoff Totals on EXIT"			
"	Total Catchment area		0.240	hectare"	
"	Total Impervious area		0.102	hectare"	
"	Total % impervious		42.625"		
" 19	EXIT"				