Derry Side Road Subdivision – Beckwith, ON Conceptual Stormwater Management Report

Prepared for:
Mr. Steve Smith

Prepared by:
Stantec Consulting Ltd.

September 25, 2017

Revision	Description	Prepared by		Reviewed by	
0	1st Submission	Ana Paerez	2017/09/15	Kris Kilborn	2017/09/25

Sign-off Sheet

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Prepared by ________________________________

(signature)

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2017-09-25
PROVINCE OF ONTARIO

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1.0 INTRODUCTION

Stantec Consulting Ltd. was retained by Mr. Steve Smith to complete a conceptual Stormwater Management (SWM) design for a new rural subdivision in the Township of Beckwith in the County of Lanark, Ontario. The site is legally described as part of Lot 20, Concession 4 and is located in the south-west corner of the intersection of Derry Side Road and Ferguson Road.

The proposed development comprises approximately 16.1 ha of land and comprises twenty-four (24) residential lots with average lot sizes of 0.6 ha (1.4 acres) and associated accessing infrastructure as shown on **Drawing SD-1**. The site is delimited to the northwest by Ferguson Road, to the northeast by Derry Side Road, to the east by a stable and to the south by forested land.

1.1 BACKGROUND AND REFERENCES

The following documents/ reports were referenced in the preparation of this conceptual SWM Report:

- *Hydrogeology, Terrain Analysis and Impact Assessment Report, Derry Side Road, Township of Beckwith, Ontario,* exp Services Inc., June 22, 2017
- *Preliminary Geotechnical Investigation Report, Proposed Residential Subdivision Part of Lot 20, Concession 4 Township of Beckwith, Ontario,* exp Services Inc., July 21, 2017
- *City of Ottawa Sewer Design Guidelines and Technical Bulletin Amendments*, 1st Ed., City of Ottawa, November 2004 amended January 31st, 2012 and September 6, 2016
- *Stormwater Management Planning and Design Manual*, MOE (Ontario), March 2003

2.0 STORMWATER MANAGEMENT CRITERIA AND OBJECTIVES

This conceptual stormwater management (SWM) plan is submitted in support of an application for Draft Plan Approval for the subdivision. This conceptual SWM plan will identify the measures that will be implemented to meet the SWM criteria for the site.

2.1 CONCEPTUAL SWM CRITERIA

The stormwater management criteria for the site are based on the recommendations discussed during the pre-application meeting with County, Township and Rideau Valley Conservation Authority (RVCA) staff in combination with City of Ottawa Sewer Design Guidelines and Ministry of the Environment Stormwater Management Planning and Design Manual. The SWM criteria are summarized as follows:

- Post to pre-development (site in its current form) quantity control for the 2, 5 and 100-year design storms
- Provide adequate emergency overflow conveyance off-site
- Provide “Enhanced” water quality protection (80% TSS removal), as per MOE guidelines (2003)
- Storm drainage to be provided through roadside ditches, side-yard and rear-yard drainage swales
- Proposed under side of footing (USF) elevations be set above road side ditch inverts with foundation drains connected to the road side ditches and equipped with sump pumps and backwater valves
- Proposed culvert along the Leach municipal drain to be sized to convey the 100-year design storm
- Road crossing culverts to have a minimum diameter of 600 mm and to be sized to convey the 10-year design storm
- Driveway crossing culverts to have a minimum diameter of 400 mm and to be sized to convey the 5-year design storm

3.0 EXISTING CONDITIONS

The 16.1 ha site is relatively flat, slightly sloping towards the Leach Municipal Drain that traverses the centre of the property and borders the north-west property line (see **Drawing EX-1**). The drain conveys runoff from external rural areas west of the site as well as site areas towards an existing 800 mm diameter culvert crossing Derry Side Road. The drain is part of the King's Creek, Jock River watershed system.

The site is primarily dense woodland with the exception of an agricultural field located in the northern portion of the site.

The Geotechnical Investigation prepared for the development (exp, July 2017) found that the soil conditions encountered at the test hole locations consist of a topsoil layer underlain by silty sand (0.3 m to 0.8 m), followed by a layer of glacial till (1.0 m to 5.1 m deep). Refusal to augering/casing was met in all the boreholes at 1.0 m to 5.1 m depth on inferred bedrock.

Groundwater levels were measured during exp's geotechnical investigation in three (3) test pits and were found to range from 0.2 m to 1.9 m below ground surface.

3.1 TARGET PEAK OUTFLOWS

Drawing EX-1 shows the existing conditions drainage plan. A conceptual hydrologic modeling exercise was completed with SWMHYMO to generate pre-development and post development runoff response from the site area for storm events up to the 100-year storm. The NASHYD command was used to generate hydrographs from the total site area under existing conditions. Runoff from external areas will be conveyed through grassed swales to the Leach municipal drain (see **Drawing SD-1**) and as such, these areas have not been included in the existing condition hydrologic model.

The 3-hr Chicago and 12-hr SCS Type II distributions derived from City of Ottawa IDF parameters were used to generate runoff from the site area. The following assumptions were applied to the hydrologic model:

- Surficial soils within the subject site are defined as silty sand over glacial till based on the geotechnical investigation and were assumed to be within Hydrologic Soil Group C
- The SCS Method was used to calculate CN* values for the site area based on existing land use and available soil information (see **Appendix A1**)
- Land use across the site was obtained from aerial photographs which show dense woodland for most of the site, with the exception of the northern corner of the site that consists of agricultural crops

- Time to peak (Tp) was calculated based on the relationship of Tp = 0.67 x Tc where Tc is the time of concentration. The time of concentration of each catchment was calculated using the Uplands Method (see **Appendix A1**)
- Initial abstraction equal to 4.67mm as per City of Ottawa guidelines
- Two (2) linear reservoirs

Table 3.1 shows the 100-year target peak outflows from the proposed site into the drain as obtained from the existing condition SWMHYMO model (see modeling files in **Appendix A2**).

Table 3.1 – Site Area Target Peak Outflows to Leach Municipal Drain

Site Peak Flows (m^3/s) 12 hr SCS Type II Storm Distributions			Site Peak Flows (m^3/s) 3 hr Chicago Storm Distributions		
100-year	**5-year**	**2-year**	**100-year**	**5-year**	**2-year**
0.915	0.369	0.216	0.756	0.289	0.159

4.0 CONCEPTUAL STORMWATER MANAGEMENT PLAN

The proposed Derry Road Subdivision consists of twenty-four (24) residential lots, two SWM easements, and associated access roads with rural cross section (see **Drawings SD-1 & GP-1**). The conceptual stormwater management (SWM) plan has been developed to provide "enhanced" quality treatment of runoff from the proposed site (80% TSS removal), and to restrict post development peak flows to pre-development levels up to the 100-year design storm as identified in **Table 3.1.**

4.1 CONCEPTUAL SWM STRATEGY

Under post development conditions, storm runoff from the site will be conveyed to the existing watercourse as follows:

- On-site storage for quantity control of runoff will be provided in two (2) separate linear dry detention areas, SWM-1 and SWM-2, controlled via pond outlet structures prior to discharging into the Leach municipal drain.

- Runoff from areas A1 and A2 will be directed to an oil/grit separator (OGS-1) through road side ditches and a ditch inlet catchbasin (DICB) to be treated to achieve 80% TSS removal. The OGS-1 unit will discharge into the storage area SWM-1.

- Quantity control for runoff from areas A1 and A2 will be provided in the proposed storage easement area SWM-1. Post development runoff from these areas will be conveyed through road side ditches to a DICB where runoff will pond and eventually spill into the drainage easement SWM-1.

- Runoff from areas A3, A4 and A5 will be directed to an oil/grit separator (OGS-2) through road side ditches and a ditch inlet catchbasin to be treated to achieve 80% TSS removal. The OGS-2 unit will discharge into the storage area SWM-2.

- Quantity control for runoff from areas A3, A4, and A5 will be provided in the proposed storage easement area SWM-2. Post development runoff from these areas will be conveyed through road side ditches to a DICB where runoff will pond and eventually spill into the drainage easement SWM-2.

- Areas UNC-1, UNC-2, UNC-3 and UNC-4 are expected to sheet drain uncontrolled towards the drain and the Ferguson Road and Derry Side Road roadside ditch. Runoff from these areas will be included in the overall peak flow calculations and storage requirement estimates.

- Runoff from external areas will be directed to the drain through grassed swales.

- Road side ditches will be set above the groundwater elevation.
- The culvert crossing at the proposed Street 1 and the Leach Municipal Drain will be sized during detailed design to convey the 100-year peak flows in the drain once the engineers report is revised.

4.2 CONCEPTUAL SITE HYDROLOGY

Rain runoff response from the proposed site was generated using the SWMHYMO hydrologic modeling software. The proposed site was subdivided in several sub-catchments based on whether they sheet drain towards the proposed SWM easements, or they sheet drain off site uncontrolled (see **Drawing SD-1**).

The NASHYD command was used to generate hydrographs from the subcatchments with total imperviousness values less than 20%, otherwise, the STANDHYD command was used (see detailed calculations in **Appendix B1**). Post development SWMHYMO input and output files have been provided in **Appendix B2**.

4.2.1 Water Quantity Control

The COMPUTE VOLUME command was used to estimate the volume required in the SWM storage areas to restrict the post development100-year peak flows from the site to pre-development levels.

The outlet structure for each the SWM easements, pond configuration and required sizes for culverts an outlet pipes will be finalized during the detailed design stage. **Table 4.1** shows the results of the hydraulic analysis for the proposed storm drainage system.

Table 4.1: 100 Year Post Development Condition Release Rates

Storm Distribution	Uncontrolled Runoff (m^3/s)	SWM-1 (Pond Bottom = 131.10m)		SWM-2 (Pond Bottom = 131.00m)		Total Discharge to the Drain (m^3/s)	Allowable Release Rate (m^3/s)
		SWM Pond Volume Required (m^3)	SWM Pond Discharge (m^3/s)	SWM Pond Volume Required (m^3)	SWM Pond Discharge (m^3/s)		
3-hr Chicago	0.465	480	0.145	1,047	0.145	0.756	0.756
12-hr SCS	0.545	494	0.185	1,106	0.185	0.915	0.915

The above table shows that quantity control can be provided through surface storage in the proposed dry ponds to meet the 100-year allowable release rates.

4.3 WATER QUALITY CONTROL

4.3.1 Lot Level and Conveyance Control

The following lot level and conveyance best management practices will be implemented to promote infiltration and filter sediment.

- Roof leaders will be directed to grass surfaces.
- Road side ditches will be vegetated and constructed with minimum longitudinal slope where possible.

Quality control will be required for developed areas A1 to A5. Runoff from these areas will be conveyed through roadside ditches and directed to two separate ditch inlet catchbasins (DICBs) connected to oil/grit separator units that will be sized to provide 80% TSS removal prior to discharge to the Leach municipal drain. Preliminary sizing for the proposed OGS units is provided in **Appendix C**.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the preceding discussion, the following conclusions can be drawn:

- The proposed SWM storage areas SWM-1 and SWM-2 will provide sufficient storage to meet pre-development peak flows from site areas
- "Enhanced" water quality treatment will be provided through two OGS units that will be discharge into the SWM storage areas
- Runoff from external areas will be directed to the Leach municipal drain through grassed swales
- The proposed roadside ditches will be set above the groundwater table

Based on the findings of the report, the following recommendations are provided:

- Proposed under side of footing (USF) elevations be set above road side ditch inverts with foundation drains connected to the road side ditches and equipped with sump pumps and backwater valves
- The conceptual stormwater management plan be revised during the detailed design stage
- An erosion and sediment control plan be provided during the detailed design stage
- The engineers report for the Leach municipal drain be revised as a result of land use change in the catchment area
- The proposed road crossing culvert along the Leach Municipal Drain be sized during the detailed design stage to convey the 100-year storm event

Appendix A EXISTING CONDITIONS

A.1 Existing Condition Parameters

A.2 Existing Condition SWMHYMO Modeling Files

A.1 EXISTING CONDITION PARAMETERS

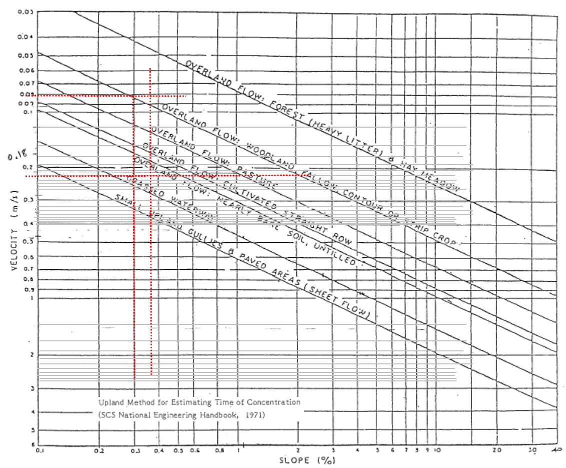
160401279: Derry Side Road Subdivision
Model Input
SWMHYMO Parameter Summary - Existing Conditions

Model Catchment ID	Description	Area (ha)	Gradient (%) Overland	Gradient (%) Ditch	XIMP (%)	TIMP (%)	Length (m) Overland	Length (m) Ditch	Velocity (m/s) Overland	Velocity (m/s) Ditch	Tc (hrs)	Tp (hrs)	Infiltration Method	CN	CN*	Ia Perv. (mm)	Ia Imp. (mm)	HYD Method
EX-1	Site Area (Overland Woodland)	7.83	1.2%	-	0.0%	0.0%	368.0	0.0	0.18	-	0.57	0.38	SCS	73	75.6	4.67	1.57	NASHYD
EX-2	Site Area (Overland Woodland)	8.32	0.4%	0.50%	0.0%	0.0%	230.0	137.0	0.10	0.32	0.79	0.53	SCS	75	76.5	4.67	1.57	NASHYD
Total Area		16.15																

1) Standard City of Ottawa Data for Initial Abstraction Parameters, Tp determination, and Infiltration (CN) values

Land Use Area (ha) woodlot	gravel	lawns	crop	fallow	pasture	meadow	residence
7.83	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6.88	0.00	0.00	1.44	0.00	0.00	0.00	0.00

Uplands Method Velocity Determination



160401279: Derry Side Road Subdivision
NRCS (SCS) Curve Number Determination
Existing Drainage Areas

Site Soils: (as per exp Geotechnical Investigation, July 21, 2017)

Soil Type	Hydrologic Soil Group
Silty sand with some gravel	C

TABLE OF CURVE NUMBERS (CN's)										
Land Use		Hydrologic Soil Type							Manning's	Source
		A	AB	B	BC	C	CD	D	'n'	
Meadow	"Good"	30	44	58	64.5	71	74.5	78	0.40	MTO
Woodlot	"Fair"	36	48	60	66.5	73	76	79	0.40	MTO
Gravel		76	80.5	85	87	89	90	91	0.30	City
Lawns	"Good"	39	50	61	67.5	74	77	80	0.25	City
Pasture/Range		58	61.5	65	70.5	76	78.5	81	0.17	MTO
Crop		66	70	74	78	82	84	86	0.13	MTO
Fallow (Bare)		77	82	86	89	91	93	94	0.05	MTO
Low Density Residences		57	64.5	72	76.5	81	83.5	86	0.25	Chin
Streets, paved		98	98	98	98	98	98	98	0.01	City

1. MTO Drainage Manual (1997), Design Chart 1.09-Soil/Land Use Curve Numbers
2. Chin (2000), Water-Resources Engineering, Table 6.13-Curve Numbers for Various Urban Land Uses
3. City of Ottawa Sewer Design Guidelines (2012), Table 5.9 CN Values for Various Soil Groups

HYDROLOGIC SOIL TYPE (%) - External Areas								
	Hydrologic Soil Type							
Catchment	A	AB	B	BC	C	CD	D	TOTAL
EX-1					100			100
EX-2					100			100

LAND USE (%) - External Areas									
Catchment	Meadow	Woodlot	Gravel	Lawns	Pasture Range	Crop	Fallow (Bare)	Low Density Residences	Impervious	Total
EX-1		100.0								100.0
EX-2		82.7				17.3				100.0

CURVE NUMBER (CN) - External Areas										
Catchment	Meadow	Woodlot	Gravel	Lawns	Pasture Range	Crop	Fallow (Bare)	Low Density Residences	Impervious	Weighted CN
EX-1	0.0	73.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	73
EX-2	0.0	60.4	0.0	0.0	0.0	14.2	0.0	0.0	0.0	75

** AMC II assumed
** Hydrological Soil Group taken from MTO Drainage Manual for each soil type

160401279: Derry Side Road Subdivision

NRSC (SCS) Modified Curve Number Calculation: Existing Condition Areas

Step	Input Values				
	Subcatchment:			EX-1	EX-2
1	**CN (AMC II):**			**73**	**75**
2	CN (AMC III) =			87	88
3	100 Year Precipitation, P =	106.73	mm	106.73	106.73

$$Q = \frac{(P - Ia)^2}{(P - Ia) + S} \qquad S = \frac{(P - Ia)^2}{Q} - (P - Ia)$$

Q = rainfall excess or runoff, mm
S = potential maximum retention or available storage, mm

$$CN = \frac{25400}{S + 254} \qquad S = \frac{25400}{CN} - 254$$

CN* = modified SCS curve # that better reflects Ia conditions in Ontario

Step	Output Values				
	Subcatchment:			EX-1	EX-2
	S_{III} =		mm	37.95	34.64
	SCS Assumption of 0.2 S = Ia =		mm	7.59	6.93
4	Q_{III} =		mm	71.69	74.09
	Preferred Initial Abstraction, Ia =	1.5	mm	1.5	1.5
5	S^*_{III} =		mm	49.23	44.23
6	CN^*_{III} =		mm	83.77	85.17
	CN^*_{III}=		Rounded	**84**	**85**
7	**CN^*_{II}=**		converted	**69**	**70**
	CN^*_{II}=		0.9 CN^*_{III}	**75.6**	**76.5**

Explanation of Procedure

1 Determine CN based on typical AMC II conditions (from our normal spreadsheet).
2 Convert CN from AMC II to AMC III conditions (standard SCS tables, as shown at
3 Get precipitation depth P for 100 year storm
4 Using CN_{III} with Ia = 0.2S, compute Q_{III} for 100 year precipitation
5 For the same Q_{III}, compute S^*_{III} using Ia=1.5mm (or otherwise determined from stu
6 Compute CN^*_{III} using S^*_{III}
7 Calculate CN^*_{II} using standard SCS conversion table or assume $0.9CN^*_{III}$

A.2 EXISTING CONDITION SWMHYMO MODELING FILES

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

     SSSSS  W   W  M   M  H   H  Y   Y  M   M   OOO        999    999     =========
     S       W W W  MM MM  H   H   Y Y   MM MM  O   O      9   9  9   9
     SSSSS  W W W  M M M  HHHHH    Y    M M M  O   O  ##  9   9  9   9    Ver  4.05
         S   W W   M   M  H   H    Y    M   M  O   O       9999   9999    Sept 2011
     SSSSS   W W   M   M  H   H    Y    M   M   OOO           9      9    =========
                                                          9   9  9   9    # 3824306
          StormWater Management HYdrologic Model           999    999     =========

 *******************************************************************************
 **************************** SWMHYMO Ver/4.05 ******************************
 *********  A single event and continuous hydrologic simulation model  *********
 *********     based on the principles of HYMO and its successors      *********
 *********                OTTHYMO-83 and OTTHYMO-89.                    *********
 *******************************************************************************
 ********* Distributed by:  J.F. Sabourin and Associates Inc.          *********
 *********                  Ottawa,  Ontario: (613) 836-3884            *********
 *********                  Gatineau, Quebec: (819) 243-6858            *********
 *********                  E-Mail: swmhymo@jfsa.Com                    *********
 *******************************************************************************

 +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
 +++++++++ Licensed user: Stantec Consulting Ltd. 604                 +++++++++
 +++++++++       Ottawa                  SERIAL#:3824306              +++++++++
 +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

 *******************************************************************************
 *********            ++++++ PROGRAM ARRAY DIMENSIONS ++++++           *********
 *********            Maximum value for ID numbers  :      10          *********
 *********            Max. number of rainfall points: 105408           *********
 *********            Max. number of flow points    : 105408           *********
 *******************************************************************************

 ***** DESCRIPTION SUMMARY TABLE HEADERS (units depend on METOUT in START) *****
 *****-----------------------------------------------------------------------*****
 *****      ID:  Hydrograph IDentification numbers, (1-10).                *****
 *****    NHYD:  Hydrograph reference numbers, (6 digits or characters).   *****
 *****    AREA:  Drainage area associated with hydrograph, (ac.) or (ha.). *****
 *****   QPEAK:  Peak flow of simulated hydrograph, (ft^3/s) or (m^3/s).   *****
 ***** TpeakDate_hh:mm is the date and time of the peak flow.              *****
 *****    R.V.:  Runoff Volume of simulated hydrograph, (in) or (mm).      *****
 *****    R.C.:  Runoff Coefficient of simulated hydrograph, (ratio).      *****
 *****       *:  see WARNING or NOTE message printed at end of run.        *****
 *****      **:  see  ERROR  message printed at end of run.                *****
 *******************************************************************************
 *******************************************************************************

 ::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

 *******************************************************************************

 **********************    S U M M A R Y    O U T P U T    **********************
 *******************************************************************************
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 *******************************************************************************
 * Input   filename: C:\SWMHYMO\exist.dat                                       *
 * Output  filename: C:\SWMHYMO\exist.out                                       *
 * Summary filename: C:\SWMHYMO\exist.sum                                       *
 * User comments:                                                               *
 * 1:__________________________________________________________________________*
 * 2:__________________________________________________________________________*
 * 3:__________________________________________________________________________*
 *******************************************************************************


#*******************************************************************************
#  Project Name: [Derry Side Road Subdivision]     Project Number: [160401279]
#  Date         : 09-08-2017
#  Modeller     : [AMP]
#  Company      : Stantec Consulting Ltd. 604
#  License #    :  3824306
#*******************************************************************************
   ** END OF RUN :   1

 *******************************************************************************






 RUN:COMMAND#
 002:0001------------------------------------------------------------------------
       START
        [TZERO =    .00 hrs on        0]
        [METOUT=   2    (1=imperial, 2=metric output)]
        [NSTORM=   1 ]
        [NRUN  =   2 ]
#*******************************************************************************
#  Project Name: [Derry Side Road Subdivision]     Project Number: [160401279]
#  Date         : 09-08-2017
#  Modeller     : [AMP]
#  Company      : Stantec Consulting Ltd. 604
#  License #    :  3824306
#*******************************************************************************
 002:0002------------------------------------------------------------------------
       DEFAULT VALUES
        Filename = C:\SWMHYMO\OTTAWA.VAL
        ICASEdv  = 1 (read and print data)
        FileTitle= File comment: [2005 City of Ottawa Sewer Design Guideline]
                   PARAMETERS USED IN THE DESIGN STANDHYD COMMAND FOR OTTAWA.
        Horton's infiltration equation parameters:
        [Fo= 76.20 mm/hr] [Fc=13.20 mm/hr] [DCAY= 4.14 /hr] [F=  .00 mm]
        Parameters for PERVIOUS surfaces in STANDHYD:
        [IAper=   4.67 mm] [LGP=40.00 m] [MNP= .250]
        Parameters for IMPERVIOUS surfaces in STANDHYD:
        [IAimp=   1.57 mm] [CLI= 1.50]   [MNI= .013]
        Parameters used in NASHYD:
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        Comment  =
        [SDT=30.00:SDUR=  12.00:PTOT=  42.34]
#*******************************************************************************
#
#           DERRY SIDE ROAD SUBDIVISION - EXISTING CONDITIONS
#*******************************************************************************
# STORM: 12hr SCS Storms, 3hr Chicago Storms
# City of Ottawa 2004 IDF Parameters
#-------------------------------------------------------------------------------
#  - Average CN values for each catchment were initially calculated on typical
#    AMC II conditions based on hydrologic soil group and land use. CN values
#    were subsequently modified using the SCS Modified Curve Number Calculations
#  - Soils information for the site area was obtained from exp's
#    Geotechnical Investigation dated July 21, 2017.
#  - Land use across the site areas consist mostly of woodlands and a small por
#    of crops as obtained from aerial photographs
#  - Time to peak for each catchment was estimated based on Tp = 0.67*Tc and
#    Tc values were calculated using the Uplands Method
#*******************************************************************************
#                    SITE AREA EX-1
#*******************************************************************************
 002:0004---------------ID:NHYD-----------AREA----QPEAK-TpeakDate_hh:mm----R.V.-
       DESIGN NASHYD      01:EX-1          7.83     .115 No_date    6:24   11.86
        [CN= 75.6: N= 2.00]
        [Tp=  .38:DT= 1.00]
#*******************************************************************************
#                    SITE AREA EX-2
#*******************************************************************************
 002:0005---------------ID:NHYD-----------AREA----QPEAK-TpeakDate_hh:mm----R.V.-
       DESIGN NASHYD      02:EX-2          8.32     .103 No_date    6:37   12.27
        [CN= 76.5: N= 2.00]
        [Tp=  .53:DT= 1.00]
 002:0006---------------ID:NHYD-----------AREA----QPEAK-TpeakDate_hh:mm----R.V.-
       ADD HYD            01:EX-1          7.83     .115 No_date    6:24   11.86
                       +  02:EX-2          8.32     .103 No_date    6:37   12.27
        [DT= 1.00]  SUM=  03:EX-SITE      16.15     .216 No_date    6:31   12.07
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        [TZERO =    .00 hrs on        0]
        [METOUT=   2    (1=imperial, 2=metric output)]
        [NSTORM=   1 ]
        [NRUN  =   5 ]
#*******************************************************************************
#  Project Name: [Derry Side Road Subdivision]     Project Number: [160401279]
#  Date         : 09-08-2017
#  Modeller     : [AMP]
#  Company      : Stantec Consulting Ltd. 604
#  License #    :  3824306
#*******************************************************************************
 005:0002------------------------------------------------------------------------
       DEFAULT VALUES
        Filename = C:\SWMHYMO\OTTAWA.VAL
        ICASEdv  = 1 (read and print data)
        FileTitle= File comment: [2005 City of Ottawa Sewer Design Guideline]
                   PARAMETERS USED IN THE DESIGN STANDHYD COMMAND FOR OTTAWA.
        Horton's infiltration equation parameters:
        [Fo= 76.20 mm/hr] [Fc=13.20 mm/hr] [DCAY= 4.14 /hr] [F=  .00 mm]
        Parameters for PERVIOUS surfaces in STANDHYD:
        [IAper=   4.67 mm] [LGP=40.00 m] [MNP= .250]
        Parameters for IMPERVIOUS surfaces in STANDHYD:
        [IAimp=   1.57 mm] [CLI= 1.50]   [MNI= .013]
        Parameters used in NASHYD:
        [Ia=   4.67 mm] [N= 2.00]
 005:0003------------------------------------------------------------------------
       READ STORM
        Filename = storm.001
        Comment  =
        [SDT=30.00:SDUR=  12.00:PTOT=  56.17]
#*******************************************************************************
#
#           DERRY SIDE ROAD SUBDIVISION - EXISTING CONDITIONS
#*******************************************************************************
# STORM: 12hr SCS Storms, 3hr Chicago Storms
# City of Ottawa 2004 IDF Parameters
#-------------------------------------------------------------------------------
#  - Average CN values for each catchment were initially calculated on typical
#       AMC II conditions based on hydrologic soil group and land use. CN values
#       were subsequently modified using the SCS Modified Curve Number Calculations
#  - Soils information for the site area was obtained from exp's
#       Geotechnical Investigation dated July 21, 2017.
#  - Land use across the site areas consist mostly of woodlands and a small por
#       of crops as obtained from aerial photographs
#  - Time to peak for each catchment was estimated based on Tp = 0.67*Tc and
#       Tc values were calculated using the Uplands Method
#*******************************************************************************
#                    SITE AREA EX-1
#*******************************************************************************
 005:0004---------------ID:NHYD-----------AREA----QPEAK-TpeakDate_hh:mm----R.V.-
       DESIGN NASHYD      01:EX-1          7.83     .197 No_date    6:22   19.87
        [CN= 75.6: N= 2.00]
        [Tp=  .38:DT= 1.00]
#*******************************************************************************
#                    SITE AREA EX-2
#*******************************************************************************
 005:0005---------------ID:NHYD-----------AREA----QPEAK-TpeakDate_hh:mm----R.V.-
       DESIGN NASHYD      02:EX-2          8.32     .176 No_date    6:35   20.48
        [CN= 76.5: N= 2.00]
        [Tp=  .53:DT= 1.00]
 005:0006---------------ID:NHYD-----------AREA----QPEAK-TpeakDate_hh:mm----R.V.-
       ADD HYD            01:EX-1          7.83     .197 No_date    6:22   19.87
                       +  02:EX-2          8.32     .176 No_date    6:35   20.48
        [DT= 1.00]  SUM=  03:EX-SITE      16.15     .369 No_date    6:30   20.18
   ** END OF RUN :  99

 *******************************************************************************






 RUN:COMMAND#
 100:0001------------------------------------------------------------------------
       START
        [TZERO =    .00 hrs on        0]
        [METOUT=   2    (1=imperial, 2=metric output)]
        [NSTORM=   1 ]
        [NRUN  = 100 ]
#*******************************************************************************
#  Project Name: [Derry Side Road Subdivision]     Project Number: [160401279]
#  Date         : 09-08-2017
#  Modeller     : [AMP]
#  Company      : Stantec Consulting Ltd. 604
#  License #    :  3824306
#*******************************************************************************
 100:0002------------------------------------------------------------------------
       DEFAULT VALUES
        Filename = C:\SWMHYMO\OTTAWA.VAL
        ICASEdv  = 1 (read and print data)
        FileTitle= File comment: [2005 City of Ottawa Sewer Design Guideline]
                   PARAMETERS USED IN THE DESIGN STANDHYD COMMAND FOR OTTAWA.
        Horton's infiltration equation parameters:
        [Fo= 76.20 mm/hr] [Fc=13.20 mm/hr] [DCAY= 4.14 /hr] [F=  .00 mm]
        Parameters for PERVIOUS surfaces in STANDHYD:
        [IAper=   4.67 mm] [LGP=40.00 m] [MNP= .250]
        Parameters for IMPERVIOUS surfaces in STANDHYD:
        [IAimp=   1.57 mm] [CLI= 1.50]   [MNI= .013]
        Parameters used in NASHYD:
        [Ia=   4.67 mm] [N= 2.00]
 100:0003------------------------------------------------------------------------
       READ STORM
        Filename = storm.001
        Comment  =
        [SDT=30.00:SDUR=  12.00:PTOT=  96.00]
#*******************************************************************************
#
#           DERRY SIDE ROAD SUBDIVISION - EXISTING CONDITIONS
#*******************************************************************************
# STORM: 12hr SCS Storms, 3hr Chicago Storms
# City of Ottawa 2004 IDF Parameters
```

```
#------------------------------------------------------------------------------
#  - Average CN values for each catchment were initially calculated on typical
#   AMC II conditions based on hydrologic soil group and land use. CN values
#   were subsequently modified using the SCS Modified Curve Number Calculations
#  - Soils information for the site area was obtained from exp's
#   Geotechnical Investigation dated July 21, 2017.
#  - Land use across the site areas consist mostly of woodlands and a small por
#   of crops as obtained from aerial photographs
#  - Time to peak for each catchment was estimated based on Tp = 0.67*Tc and
#   Tc values were calculated using the Uplands Method
#******************************************************************************
#                   SITE AREA EX-1
#******************************************************************************
 100:0004---------------ID:NHYD-----------AREA----QPEAK-TpeakDate_hh:mm----R.V.-
     DESIGN NASHYD      01:EX-1           7.83     .492 No_date    6:19   48.13
       [CN= 75.6: N= 2.00]
       [Tp=  .38:DT= 1.00]
#******************************************************************************
#                   SITE AREA EX-2
#******************************************************************************
 100:0005---------------ID:NHYD-----------AREA----QPEAK-TpeakDate_hh:mm----R.V.-
     DESIGN NASHYD      02:EX-2           8.32     .436 No_date    6:33   49.25
       [CN= 76.5: N= 2.00]
       [Tp=  .53:DT= 1.00]
 100:0006---------------ID:NHYD-----------AREA----QPEAK-TpeakDate_hh:mm----R.V.-
     ADD HYD            01:EX-1           7.83     .492 No_date    6:19   48.13
                    +  02:EX-2            8.32     .436 No_date    6:33   49.25
       [DT= 1.00]  SUM=  03:EX-SITE      16.15     .915 No_date    6:26   48.71
  ** END OF RUN : 101
*******************************************************************************
 RUN:COMMAND#
 102:0001-----------------------------------------------------------------------
     START
       [TZERO =    .00 hrs on       0]
       [METOUT=   2    (1=imperial, 2=metric output)]
       [NSTORM=   1 ]
       [NRUN  = 102 ]
#******************************************************************************
#  Project Name: [Derry Side Road Subdivision]    Project Number: [160401279]
#  Date        : 09-08-2017
#  Modeller    : [AMP]
#  Company     : Stantec Consulting Ltd. 604
#  License #   :  3824306
#******************************************************************************
 102:0002-----------------------------------------------------------------------
     DEFAULT VALUES
       Filename = C:\SWMHYMO\OTTAWA.VAL
       ICASEdv  = 1 (read and print data)
       FileTitle= File comment: [2005 City of Ottawa Sewer Design Guideline]
                  PARAMETERS USED IN THE DESIGN STANDHYD COMMAND FOR OTTAWA.
       Horton's infiltration equation parameters:
       [Fo= 76.20 mm/hr] [Fc=13.20 mm/hr] [DCAY= 4.14 /hr] [F=  .00 mm]
       Parameters for PERVIOUS surfaces in STANDHYD:
       [IAper=   4.67 mm] [LGP=40.00 m] [MNP= .250]
       Parameters for IMPERVIOUS surfaces in STANDHYD:
       [IAimp=   1.57 mm] [CLI= 1.50]   [MNI= .013]
       Parameters used in NASHYD:
       [Ia=   4.67 mm] [N= 2.00]
 102:0003-----------------------------------------------------------------------
     READ STORM
       Filename = storm.001
       Comment  =
       [SDT=10.00:SDUR=   3.00:PTOT=  31.86]
#******************************************************************************
#
#          DERRY SIDE ROAD SUBDIVISION - EXISTING CONDITIONS
#******************************************************************************
# STORM: 12hr SCS Storms, 3hr Chicago Storms
# City of Ottawa 2004 IDF Parameters
#------------------------------------------------------------------------------
#  - Average CN values for each catchment were initially calculated on typical
#   AMC II conditions based on hydrologic soil group and land use. CN values
#   were subsequently modified using the SCS Modified Curve Number Calculations
#  - Soils information for the site area was obtained from exp's
#   Geotechnical Investigation dated July 21, 2017.
#  - Land use across the site areas consist mostly of woodlands and a small por
#   of crops as obtained from aerial photographs
#  - Time to peak for each catchment was estimated based on Tp = 0.67*Tc and
#   Tc values were calculated using the Uplands Method
#******************************************************************************
#                   SITE AREA EX-1
#******************************************************************************
 102:0004---------------ID:NHYD-----------AREA----QPEAK-TpeakDate_hh:mm----R.V.-
     DESIGN NASHYD      01:EX-1           7.83     .086 No_date    1:36    6.77
       [CN= 75.6: N= 2.00]
       [Tp=  .38:DT= 1.00]
#******************************************************************************
#                   SITE AREA EX-2
#******************************************************************************
 102:0005---------------ID:NHYD-----------AREA----QPEAK-TpeakDate_hh:mm----R.V.-
     DESIGN NASHYD      02:EX-2           8.32     .076 No_date    1:50    7.03
       [CN= 76.5: N= 2.00]
       [Tp=  .53:DT= 1.00]
 102:0006---------------ID:NHYD-----------AREA----QPEAK-TpeakDate_hh:mm----R.V.-
     ADD HYD            01:EX-1           7.83     .086 No_date    1:36    6.77
                    +  02:EX-2            8.32     .076 No_date    1:50    7.03
       [DT= 1.00]  SUM=  03:EX-SITE      16.15     .159 No_date    1:42    6.90
  ** END OF RUN : 104
*******************************************************************************
 RUN:COMMAND#
 105:0001-----------------------------------------------------------------------
     START
       [TZERO =    .00 hrs on       0]
       [METOUT=   2    (1=imperial, 2=metric output)]
       [NSTORM=   1 ]
       [NRUN  = 105 ]
#******************************************************************************
#  Project Name: [Derry Side Road Subdivision]    Project Number: [160401279]
#  Date        : 09-08-2017
#  Modeller    : [AMP]
#  Company     : Stantec Consulting Ltd. 604
#  License #   :  3824306
#******************************************************************************
 105:0002-----------------------------------------------------------------------
     DEFAULT VALUES
       Filename = C:\SWMHYMO\OTTAWA.VAL
       ICASEdv  = 1 (read and print data)
       FileTitle= File comment: [2005 City of Ottawa Sewer Design Guideline]
                  PARAMETERS USED IN THE DESIGN STANDHYD COMMAND FOR OTTAWA.
       Horton's infiltration equation parameters:
       [Fo= 76.20 mm/hr] [Fc=13.20 mm/hr] [DCAY= 4.14 /hr] [F=  .00 mm]
       Parameters for PERVIOUS surfaces in STANDHYD:
       [IAper=   4.67 mm] [LGP=40.00 m] [MNP= .250]
       Parameters for IMPERVIOUS surfaces in STANDHYD:
       [IAimp=   1.57 mm] [CLI= 1.50]   [MNI= .013]
       Parameters used in NASHYD:
       [Ia=   4.67 mm] [N= 2.00]
 105:0003-----------------------------------------------------------------------
     READ STORM
       Filename = storm.001
       Comment  =
       [SDT=10.00:SDUR=   3.00:PTOT=  42.51]
#******************************************************************************
#
#          DERRY SIDE ROAD SUBDIVISION - EXISTING CONDITIONS
#******************************************************************************
# STORM: 12hr SCS Storms, 3hr Chicago Storms
# City of Ottawa 2004 IDF Parameters
#------------------------------------------------------------------------------
#  - Average CN values for each catchment were initially calculated on typical
#       AMC II conditions based on hydrologic soil group and land use. CN values
#       were subsequently modified using the SCS Modified Curve Number Calculations
#  - Soils information for the site area was obtained from exp's
#       Geotechnical Investigation dated July 21, 2017.
#  - Land use across the site areas consist mostly of woodlands and a small por
#       of crops as obtained from aerial photographs
#  - Time to peak for each catchment was estimated based on Tp = 0.67*Tc and
#       Tc values were calculated using the Uplands Method
#******************************************************************************
#                   SITE AREA EX-1
#******************************************************************************
 105:0004---------------ID:NHYD-----------AREA----QPEAK-TpeakDate_hh:mm----R.V.-
     DESIGN NASHYD      01:EX-1           7.83     .156 No_date    1:34   11.95
       [CN= 75.6: N= 2.00]
       [Tp=  .38:DT= 1.00]
#******************************************************************************
#                   SITE AREA EX-2
#******************************************************************************
 105:0005---------------ID:NHYD-----------AREA----QPEAK-TpeakDate_hh:mm----R.V.-
     DESIGN NASHYD      02:EX-2           8.32     .137 No_date    1:47   12.36
       [CN= 76.5: N= 2.00]
       [Tp=  .53:DT= 1.00]
 105:0006---------------ID:NHYD-----------AREA----QPEAK-TpeakDate_hh:mm----R.V.-
     ADD HYD            01:EX-1           7.83     .156 No_date    1:34   11.95
                    +  02:EX-2            8.32     .137 No_date    1:47   12.36
       [DT= 1.00]  SUM=  03:EX-SITE      16.15     .289 No_date    1:39   12.16
  ** END OF RUN : 199
*******************************************************************************
 RUN:COMMAND#
 200:0001-----------------------------------------------------------------------
     START
       [TZERO =    .00 hrs on       0]
       [METOUT=   2    (1=imperial, 2=metric output)]
       [NSTORM=   1 ]
       [NRUN  = 200 ]
#******************************************************************************
#  Project Name: [Derry Side Road Subdivision]    Project Number: [160401279]
#  Date        : 09-08-2017
#  Modeller    : [AMP]
#  Company     : Stantec Consulting Ltd. 604
#  License #   :  3824306
#******************************************************************************
 200:0002-----------------------------------------------------------------------
     DEFAULT VALUES
       Filename = C:\SWMHYMO\OTTAWA.VAL
       ICASEdv  = 1 (read and print data)
       FileTitle= File comment: [2005 City of Ottawa Sewer Design Guideline]
                  PARAMETERS USED IN THE DESIGN STANDHYD COMMAND FOR OTTAWA.
       Horton's infiltration equation parameters:
       [Fo= 76.20 mm/hr] [Fc=13.20 mm/hr] [DCAY= 4.14 /hr] [F=  .00 mm]
       Parameters for PERVIOUS surfaces in STANDHYD:
       [IAper=   4.67 mm] [LGP=40.00 m] [MNP= .250]
       Parameters for IMPERVIOUS surfaces in STANDHYD:
       [IAimp=   1.57 mm] [CLI= 1.50]   [MNI= .013]
       Parameters used in NASHYD:
       [Ia=   4.67 mm] [N= 2.00]
 200:0003-----------------------------------------------------------------------
     READ STORM
       Filename = storm.001
       Comment  =
       [SDT=10.00:SDUR=   3.00:PTOT=  71.66]
#******************************************************************************
#
#          DERRY SIDE ROAD SUBDIVISION - EXISTING CONDITIONS
#******************************************************************************
# STORM: 12hr SCS Storms, 3hr Chicago Storms
# City of Ottawa 2004 IDF Parameters
#------------------------------------------------------------------------------
#  - Average CN values for each catchment were initially calculated on typical
#       AMC II conditions based on hydrologic soil group and land use. CN values
#       were subsequently modified using the SCS Modified Curve Number Calculations
#  - Soils information for the site area was obtained from exp's
#       Geotechnical Investigation dated July 21, 2017.
#  - Land use across the site areas consist mostly of woodlands and a small por
#       of crops as obtained from aerial photographs
#  - Time to peak for each catchment was estimated based on Tp = 0.67*Tc and
#       Tc values were calculated using the Uplands Method
#******************************************************************************
#                   SITE AREA EX-1
#******************************************************************************
 200:0004---------------ID:NHYD-----------AREA----QPEAK-TpeakDate_hh:mm----R.V.-
     DESIGN NASHYD      01:EX-1           7.83     .412 No_date    1:31   30.13
       [CN= 75.6: N= 2.00]
       [Tp=  .38:DT= 1.00]
#******************************************************************************
#                   SITE AREA EX-2
#******************************************************************************
 200:0005---------------ID:NHYD-----------AREA----QPEAK-TpeakDate_hh:mm----R.V.-
     DESIGN NASHYD      02:EX-2           8.32     .355 No_date    1:44   30.95
       [CN= 76.5: N= 2.00]
       [Tp=  .53:DT= 1.00]
 200:0006---------------ID:NHYD-----------AREA----QPEAK-TpeakDate_hh:mm----R.V.-
     ADD HYD            01:EX-1           7.83     .412 No_date    1:31   30.13
                    +  02:EX-2            8.32     .355 No_date    1:44   30.95
       [DT= 1.00]  SUM=  03:EX-SITE      16.15     .756 No_date    1:36   30.55
 200:0002-----------------------------------------------------------------------
       FINISH
--------------------------------------------------------------------------------
********************************************************************************
     WARNINGS / ERRORS / NOTES
     -------------------------
   Simulation ended on 2017-09-13     at 13:24:46
================================================================================
```

Appendix B PROPOSED CONDITIONS

A.1 Proposed Condition Parameters

A.2 Proposed Condition SWMHYMO Modeling Files

B.1 PROPOSED CONDITION PARAMETERS

160401279: Derry Side Road Subdivision
Model Input
SWMHYMO Parameter Summary - Proposed Conditions

Model Catchment ID	Description	Area (ha)	Gradient (%)		XIMP (%)	TIMP (%)	Length (m)		Velocity (m/s)		Tc (hrs)	Tp (hrs)	Infiltration Method	CN	CN*	Ia Perv. (mm)	Ia Imp. (mm)	HYD Method
			Overland	Ditch			Overland	Ditch	Overland	Ditch								
A1	Developed (overland/ditch)	1.73	0.4%	0.5%	9.0%	19.4%	50	281	0.15	0.32	0.34	0.23	SCS	78	79.2	4.67	1.57	NASHYD
A2	Developed (overland/ditch)	1.88	0.4%	0.5%	7.0%	11.8%	90	281	0.15	0.32	0.41	0.28	SCS	76	78.3	4.67	1.57	NASHYD
A3	Developed (overland)	1.33	1.0%	0.5%	8.3%	12.9%	35	250	0.20	0.32	0.27	0.18	SCS	77	78.3	4.67	1.57	NASHYD
A4	Developed (overland/ditch)	2.71	0.6%	0.5%	6.2%	11.8%	98	132	0.17	0.32	0.27	0.18	SCS	76	78.3	4.67	1.57	NASHYD
A5	Developed (overland/ditch)	1.43	0.6%	0.5%	9.0%	15.3%	95	250	0.17	0.32	0.37	0.25	SCS	77	78.3	4.67	1.57	NASHYD
UNC-1	Developed (overland/ditch)	0.96	0.5%	-	6.4%	12.6%	110	0	0.13	-	0.24	0.16	SCS	77	78.3	4.67	1.57	NASHYD
UNC-2	Lawns and woodland (Overland/ditch)	1.87	0.5%	-	0.0%	0.0%	104	0	0.10	-	0.29	0.19	SCS	73	75.6	4.67	1.57	NASHYD
UNC-3	Developed (overland/ditch)	0.55	0.4%	1.5%	13.3%	24.2%	50	45	0.15	0.52	0.12	0.08	SCS	74	76.5	4.67	1.57	STANDHYD
UNC-4	woodland (Overland/ditch)	3.65	0.8%	0.2%	0.3%	1.2%	197	232	0.16	0.20	0.66	0.45	SCS	74	76.5	4.67	1.57	NASHYD
	Total Area	16.11			5.2%	9.7%												

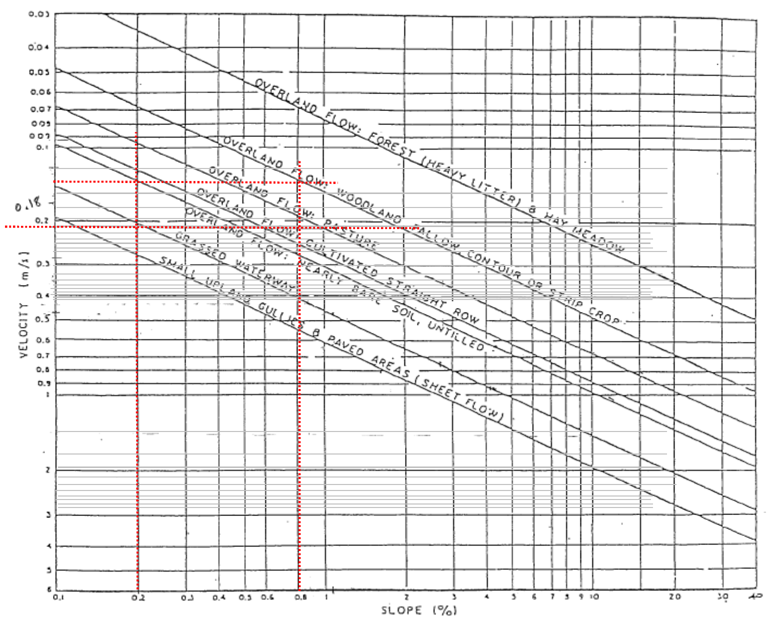
Proposed Conditions

1) Standard City of Ottawa Data for Initial Abstraction Parameters, Tp determination, and Infiltration (CN) values

0.097

OGS-1	3.61	ha	15.5%
OGS-2	5.47	ha	13.0%

Uplands Method Velocity Determination



Source: Upland Method for Estimating Time of Concentration (SCS National Engineering Handbook, 1971)

Land Use Area (ha)										Imperviousness								
woodlot	gravel	lawns	crop	fallow	pasture	meadow	residence	Impervious		Roofs		Half Road		Driveways		Impervious Area	Site Area	Site %Imp
0.60	0.00	0.79	0.00	0.00	0.00	0.00	0.00	0.34	A1	6.0	300	275.0	3.05	120.0	6	0.336	1.73	19.41%
1.31	0.00	0.35	0.00	0.00	0.00	0.00	0.00	0.22	A2	3.0	300	290.0	3.05	73.1	6	0.222	1.88	11.83%
0.50	0.00	0.66	0.00	0.00	0.00	0.00	0.00	0.17	A3	2.0	300	250.0	3.05	58.0	6	0.171	1.33	12.86%
1.00	0.00	1.39	0.00	0.00	0.00	0.00	0.00	0.32	A4	5.0	300	260.0	3.05	149.7	6	0.319	2.71	11.78%
0.50	0.00	0.71	0.00	0.00	0.00	0.00	0.00	0.22	A5	3.0	300	262.0	3.05	82.0	6	0.219	1.43	15.32%
0.37	0.00	0.47	0.00	0.00	0.00	0.00	0.00	0.12	UNC-1	2.0	300	114.0	3.05	44.0	6	0.121	0.96	12.62%
1.40	0.00	0.47	0.00	0.00	0.00	0.00	0.00	0.00	UNC-2	0.0	300	0.0	3.05	0.0	6	0.000	1.87	0.00%
0.07	0.00	0.35	0.00	0.00	0.00	0.00	0.00	0.13	UNC-3	2.0	300	90.0	3.05	76.0	6	0.133	0.55	24.19%
2.45	0.00	1.16	0.00	0.00	0.00	0.00	0.00	0.04	UNC-4	1.0	300	0.0	3.05	21.0	6	0.043	3.65	1.17%
																	16.11	9.71%

Impervious areas included when NASHYD command used

160401279: Derry Side Road Subdivision
NRCS (SCS) Curve Number Determination
Proposed Drainage Areas

Site Soils: (as per exp Geotechnical Investigation, July 21, 2017)

Soil Type	Hydrologic Soil Group
Silty sand with some gravel	C

TABLE OF CURVE NUMBERS (CN's)									
Land Use	Hydrologic Soil Type							Manning's	Source
	A	AB	B	BC	C	CD	D	'n'	
Meadow "Good"	30	44	58	64.5	71	74.5	78	0.40	MTO
Woodlot "Fair"	36	48	60	66.5	73	76	79	0.40	MTO
Gravel	76	80.5	85	87	89	90	91	0.30	City
Lawns "Good"	39	50	61	67.5	74	77	80	0.25	City
Pasture/Range	58	61.5	65	70.5	76	78.5	81	0.17	MTO
Crop	66	70	74	78	82	84	86	0.13	MTO
Fallow (Bare)	77	82	86	89	91	93	94	0.05	MTO
Low Density Residences	57	64.5	72	76.5	81	83.5	86	0.25	Chin
Streets, paved	98	98	98	98	98	98	98	0.01	City

1. MTO Drainage Manual (1997), Design Chart 1.09-Soil/Land Use Curve Numbers
2. Chin (2000), Water-Resources Engineering, Table 6.13-Curve Numbers for Various Urban Land Uses
3. City of Ottawa Sewer Design Guidelines (2004), Table 5.9 CN Values for Various Soil Groups

HYDROLOGIC SOIL TYPE (%)								
	Hydrologic Soil Type							
Catchment	A	AB	B	BC	C	CD	D	TOTAL
A1					100			100
A2					100			100
A3					100			100
A4					100			100
A5					100			100
UNC-1					100			100
UNC-2					100			100
UNC-3					100			100
UNC-4					100			100

LAND USE (%)										
Catchment	Meadow	Woodlot	Gravel	Lawns	Pasture Range	Crop	Fallow (Bare)	Low Density Residences	Impervious	Total
A1		34.7		45.9					19.4	100.0
A2		69.6		18.6					11.8	100.0
A3		37.6		49.5					12.9	100.0
A4		36.9		51.3					11.8	100.0
A5		35.0		49.7					15.3	100.0
UNC-1		38.5		48.8					12.6	100.0
UNC-2		74.9		25.1					0.0	100.0
UNC-3		16.8		83.2					24.2	100.0
UNC-4		67.1		31.7					1.2	100.0

Note: Where STANDHYD command used (shaded), impervious fraction is not considered in CN determination, since %Imp directly input in STANDHYD command

CURVE NUMBER (CN) - External Areas										
Catchment	Meadow	Woodlot	Gravel	Lawns	Pasture Range	Crop	Fallow (Bare)	Low Density Residences	Impervious	Weighted CN
A1	0.0	25.3	0.0	34.0	0.0	0.0	0.0	0.0	19.0	78
A2	0.0	50.8	0.0	13.8	0.0	0.0	0.0	0.0	11.6	76
A3	0.0	27.4	0.0	36.7	0.0	0.0	0.0	0.0	12.6	77
A4	0.0	26.9	0.0	38.0	0.0	0.0	0.0	0.0	11.5	76
A5	0.0	25.5	0.0	36.8	0.0	0.0	0.0	0.0	15.0	77
UNC-1	0.0	28.1	0.0	36.1	0.0	0.0	0.0	0.0	12.4	77
UNC-2	0.0	54.7	0.0	18.6	0.0	0.0	0.0	0.0	0.0	73
UNC-3	0.0	12.3	0.0	61.6	0.0	0.0	0.0	0.0	0.0	74
UNC-4	0.0	49.0	0.0	23.5	0.0	0.0	0.0	0.0	1.1	74

** AMC II assumed
** Hydrological Soil Group taken from MTO Drainage Manual for each soil type

160401279: Derry Side Road Subdivision

NRSC (SCS) Modified Curve Number Calculation: Proposed Condition Areas

Input Values

Step											
	Subcatchment:	A1		A2	A3	A4	A5	UNC-1	UNC-2	UNC-3	UNC-4
1	**CN (AMC II):**	**78**		**76**	**77**	**76**	**77**	**77**	**73**	**74**	**74**
2	CN (AMC III) =	90		89	89	89	89	89	87	88	88
3	100 Year Precipitation, P =	106.73	mm	106.73	106.73	106.73	106.73	106.73	106.73	106.73	106.73
		0									

$$Q = \frac{(P - Ia)^2}{(P - Ia) + S} \qquad S = \frac{(P - Ia)^2}{Q} - (P - Ia)$$

Q = rainfall excess or runoff, mm
S = potential maximum retention or available storage, mm

$$CN = \frac{25400}{S + 254} \qquad S = \frac{25400}{CN} - 254$$

CN* = modified SCS curve # that better reflects Ia conditions in Ontario

Output Values

Step											
	Subcatchment:	A1		A2	A3	A4	A5	UNC-1	UNC-2	UNC-3	UNC-4
	S_{III} =	28.22	mm	31.39	31.39	31.39	31.39	31.39	37.95	34.64	34.64
	SCS Assumption of 0.2 S = Ia =	5.64	mm	6.28	6.28	6.28	6.28	6.28	7.59	6.93	6.93
4	Q_{III} =	79.02	mm	76.53	76.53	76.53	76.53	76.53	71.69	74.09	74.09
	Preferred Initial Abstraction, Ia =	1.5	mm	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
5	S^*_{III} =	34.90	mm	39.46	39.46	39.46	39.46	39.46	49.23	44.23	44.23
6	CN^*_{III} =	87.92	mm	86.55	86.55	86.55	86.55	86.55	83.77	85.17	85.17
	CN^*_{III}=	**88**	Rounded	**87**	**87**	**87**	**87**	**87**	**84**	**85**	**85**
7	**CN^*_{II}=**	**75**	converted	**73**	**73**	**73**	**73**	**73**	**69**	**70**	**70**
	CN^*_{II}=	**79.2**	0.9 CN^*_{III}	**78.3**	**78.3**	**78.3**	**78.3**	**78.3**	**75.6**	**76.5**	**76.5**

Explanation of Procedure

1 Determine CN based on typical AMC II conditions (from our normal spreadsheet).
2 Convert CN from AMC II to AMC III conditions (standard SCS tables, as shown at side)
3 Get precipitation depth P for 100 year storm
4 Using CN_{III} with Ia = 0.2S, compute Q_{III} for 100 year precipitation
5 For the same Q_{III}, compute S^*_{III} using Ia=1.5mm (or otherwise determined from studies)
6 Compute CN^*_{III} using S^*_{III}
7 Calculate CN^*_{II} using standard SCS conversion table or assume $0.9CN^*_{III}$

B.2 PROPOSED CONDITION SWMHYMO MODELING FILES

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

   SSSSS  W   W  M   M  H   H  Y   Y  M   M   OOO        999   999   =========
   S      W W W  MM MM  H   H   Y Y   MM MM  O   O      9   9  9   9
   SSSSS  W W W  M M M  HHHHH    Y    M M M  O   O  ##  9   9  9   9  Ver  4.05
       S   W W   M   M  H   H    Y    M   M  O   O       9999   9999  Sept 2011
   SSSSS   W W   M   M  H   H    Y    M   M   OOO           9      9  =========
                                                        9   9  9   9  # 3824306
        StormWater Management HYdrologic Model           999   999    =========

  ***************************************************************************
  ***************************** SWMHYMO Ver/4.05 ****************************
  *********  A single event and continuous hydrologic simulation model  *********
  *********     based on the principles of HYMO and its successors      *********
  *********                  OTTHYMO-83 and OTTHYMO-89.                 *********
  ***************************************************************************
  ********* Distributed by:  J.F. Sabourin and Associates Inc.          *********
  *********                  Ottawa,  Ontario: (613) 836-3884           *********
  *********                  Gatineau, Quebec: (819) 243-6858           *********
  *********                  E-Mail: swmhymo@jfsa.Com                   *********
  ***************************************************************************

  +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
  +++++++++ Licensed user: Stantec Consulting Ltd. 604                +++++++++
  +++++++++                Ottawa                 SERIAL#:3824306     +++++++++
  +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

  ***************************************************************************
  *********          ++++++ PROGRAM ARRAY DIMENSIONS ++++++              *********
  *********          Maximum value for ID numbers  :     10             *********
  *********          Max. number of rainfall points: 105408             *********
  *********          Max. number of flow points    : 105408             *********
  ***************************************************************************


  *********************   D E T A I L E D   O U T P U T   ********************
  ***************************************************************************
  *         DATE: 2017-09-15     TIME: 09:45:29     RUN COUNTER: 000018          *
  ***************************************************************************
  * Input   filename: C:\SWMHYMO\post.dat                                    *
  * Output  filename: C:\SWMHYMO\post.out                                    *
  * Summary filename: C:\SWMHYMO\post.sum                                    *
  * User comments:                                                           *
  * 1:_______________________________________________________________________*
  * 2:_______________________________________________________________________*
  * 3:_______________________________________________________________________*
  ***************************************************************************

 ----------------------------------------------------------------------------
 001:0001--------------------------------------------------------------------
 *#**************************************************************************
 *#  Project Name: [Derry Side Road Subdivision]    Project Number: [160401279]
 *#  Date        : 09-13-2017
 *#  Modeller    : [AMP]
 *#  Company     : Stantec Consulting Ltd. 604
 *#  License #   :  3824306
 *#**************************************************************************
 --------------------
 | START              |  Project  dir.: C:\SWMHYMO\
 --------------------  Rainfall dir.: C:\SWMHYMO\
     TZERO =   .00 hrs on       0
     METOUT=   2 (output = METRIC)
     NRUN  = 001
     NSTORM=   1
           #  1=O4CH25m.stm
 ----------------------------------------------------------------------------
 001:0002--------------------------------------------------------------------
 ----------------------
 | DEFAULT VALUES     |  Filename: C:\SWMHYMO\OTTAWA.VAL
 ----------------------  ICASEdv = 1 (read and print data)
       FileTitle= File comment: [2005 City of Ottawa Sewer Design Guideline]
                  PARAMETERS USED IN THE DESIGN STANDHYD COMMAND FOR OTTAWA.
       Horton's infiltration equation parameters:
       [Fo= 76.20 mm/hr] [Fc=13.20 mm/hr] [DCAY= 4.14 /hr] [F=  .00 mm]
       Parameters for PERVIOUS surfaces in STANDHYD:
       [IAper=   4.67 mm] [LGP=40.00 m] [MNP= .250]
       Parameters for IMPERVIOUS surfaces in STANDHYD:
       [IAimp=   1.57 mm] [CLI= 1.50]   [MNI= .013]
       Parameters used in NASHYD:
       [Ia=   4.67 mm] [N= 2.00]
 ----------------------------------------------------------------------------
 001:0003--------------------------------------------------------------------
 --------------------
 | READ STORM       |    Filename: 25mm CHICAGO STORM, 4hr, DT=20min
 | Ptotal=  25.00 mm|    Comments: 25mm CHICAGO STORM, 4hr, DT=20min
 --------------------
                   TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
                    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
                    .33   1.809 |   1.33  38.428 |   2.33   3.108 |   3.33   1.665
                    .67   2.746 |   1.67   8.899 |   2.67   2.391 |   3.67   1.455
                   1.00   6.715 |   2.00   4.539 |   3.00   1.957 |   4.00   1.295

 ----------------------------------------------------------------------------
 001:0004--------------------------------------------------------------------
 *#*************************************************************************
 *#
 *#           DERRY SIDE ROAD SUBDIVISION - POST DEVELOPMENT CONDITIONS
 *#**************************************************************************
 *# STORM: 12hr SCS Storms, 3hr Chicago Storms
 *# City of Ottawa 2004 IDF Parameters
 *#--------------------------------------------------------------------------
 *#  - Average CN values for each catchment were initially calculated on typical
 *#  AMC II conditions based on hydrologic soil group and land use. CN values
 *#  were subsequently modified using the SCS Modified Curve Number Calculations
 *#  - Soils information for the site area was obtained from exp's
 *#  Geotechnical Investigation dated July 21, 2017.
 *#  - CN values calculated based on lawns, woodland and impervious areas
 *#  - NASHYD command used for catchments with TIMP<20%
 *#  - Time to peak for each catchment was estimated based on Tp = 0.67*Tc and
 *#  Tc values were calculated using the Uplands Method
 *#**************************************************************************
 *#                     AREA A1 TO SWM 1
 *#**************************************************************************
 ---------------------
 | DESIGN NASHYD      |   Area    (ha)=    1.73   Curve Number   (CN)=79.20
 | 01:A1    DT= 1.00 |   Ia      (mm)=   4.670   # of Linear Res.(N)= 2.00
 ---------------------   U.H. Tp(hrs)=    .230

      Unit Hyd Qpeak  (cms)=     .195

      PEAK FLOW       (cms)=     .016 (i)
      TIME TO PEAK    (hrs)=    1.650
      RUNOFF VOLUME    (mm)=    4.749
      TOTAL RAINFALL   (mm)=   25.002
      RUNOFF COEFFICIENT   =     .190

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

 ----------------------------------------------------------------------------
 001:0005--------------------------------------------------------------------
 *#**************************************************************************
 *#                     AREA A2 TO SWM 1
 *#**************************************************************************
 ---------------------
 | DESIGN NASHYD      |   Area    (ha)=    1.88   Curve Number   (CN)=78.30
 | 02:A2    DT= 1.00 |   Ia      (mm)=   4.670   # of Linear Res.(N)= 2.00
 ---------------------   U.H. Tp(hrs)=    .280

      Unit Hyd Qpeak  (cms)=     .174

      PEAK FLOW       (cms)=     .015 (i)
      TIME TO PEAK    (hrs)=    1.717
      RUNOFF VOLUME    (mm)=    4.556
      TOTAL RAINFALL   (mm)=   25.002
      RUNOFF COEFFICIENT   =     .182

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

 ----------------------------------------------------------------------------
 001:0006--------------------------------------------------------------------
 -----------------------
 | ADD HYD (TOSWM1    ) | ID: NHYD        AREA     QPEAK   TPEAK   R.V.    DWF
 -----------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 01:A1             1.73      .016    1.65   4.75    .000
                    +ID2 02:A2             1.88      .015    1.72   4.56    .000
                     ======================================================
                     SUM 06:TOSWM1         3.61      .031    1.68   4.65    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ----------------------------------------------------------------------------
 001:0007--------------------------------------------------------------------
 --------------------
 | COMPUTE VOLUME   |
 | ID:06  (TOSWM1)  |              DISCHARGE      TIME
 --------------------                (cms)       (hrs)
       *** WARNING: No storage required, RelRate > Inflow Qp.
 ----------------------------------------------------------------------------
 001:0008--------------------------------------------------------------------
 *#**************************************************************************
 *#                     AREA A3 TO SWM 2
 *#**************************************************************************
 ---------------------
 | DESIGN NASHYD      |   Area    (ha)=    1.33   Curve Number   (CN)=78.30
 | 01:A3    DT= 1.00 |   Ia      (mm)=   4.670   # of Linear Res.(N)= 2.00
 ---------------------   U.H. Tp(hrs)=    .180

      Unit Hyd Qpeak  (cms)=     .192

      PEAK FLOW       (cms)=     .014 (i)
      TIME TO PEAK    (hrs)=    1.500
      RUNOFF VOLUME    (mm)=    4.556
      TOTAL RAINFALL   (mm)=   25.002
      RUNOFF COEFFICIENT   =     .182

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

 ----------------------------------------------------------------------------
 001:0009--------------------------------------------------------------------
 *#**************************************************************************
 *#                     AREA A4 TO SWM 2
 *#**************************************************************************
 ---------------------
 | DESIGN NASHYD      |   Area    (ha)=    2.71   Curve Number   (CN)=78.30
 | 02:A4    DT= 1.00 |   Ia      (mm)=   4.670   # of Linear Res.(N)= 2.00
 ---------------------   U.H. Tp(hrs)=    .180

      Unit Hyd Qpeak  (cms)=     .391

      PEAK FLOW       (cms)=     .028 (i)
      TIME TO PEAK    (hrs)=    1.500
      RUNOFF VOLUME    (mm)=    4.557
      TOTAL RAINFALL   (mm)=   25.002
      RUNOFF COEFFICIENT   =     .182

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

 ----------------------------------------------------------------------------
 001:0010--------------------------------------------------------------------
 *#**************************************************************************
 *#                     AREA A5 TO SWM 2
 *#**************************************************************************
 ---------------------
 | DESIGN NASHYD      |   Area    (ha)=    1.43   Curve Number   (CN)=78.30
 | 03:A5    DT= 1.00 |   Ia      (mm)=   4.670   # of Linear Res.(N)= 2.00
 ---------------------   U.H. Tp(hrs)=    .250

      Unit Hyd Qpeak  (cms)=     .148

      PEAK FLOW       (cms)=     .012 (i)
      TIME TO PEAK    (hrs)=    1.683
      RUNOFF VOLUME    (mm)=    4.556
      TOTAL RAINFALL   (mm)=   25.002
      RUNOFF COEFFICIENT   =     .182

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

 ----------------------------------------------------------------------------
 001:0011--------------------------------------------------------------------
 -----------------------
 | ADD HYD (TOSWM2    ) | ID: NHYD        AREA     QPEAK   TPEAK   R.V.    DWF
 -----------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 01:A3             1.33      .014    1.50   4.56    .000
                    +ID2 02:A4             2.71      .028    1.50   4.56    .000
                    +ID3 03:A5             1.43      .012    1.68   4.56    .000
                     ======================================================
                     SUM 05:TOSWM2         5.47      .053    1.53   4.56    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ----------------------------------------------------------------------------
 001:0012--------------------------------------------------------------------
 --------------------
 | COMPUTE VOLUME   |
 | ID:05  (TOSWM2)  |              DISCHARGE      TIME
 --------------------                (cms)       (hrs)
       *** WARNING: No storage required, RelRate > Inflow Qp.
 ----------------------------------------------------------------------------
 001:0013--------------------------------------------------------------------
 *#**************************************************************************
 *#                     UNCONTROLLED AREA UNC-1
 *#**************************************************************************
 ---------------------
 | DESIGN NASHYD      |   Area    (ha)=     .96   Curve Number   (CN)=78.30
 | 10:UNC-1  DT= 1.00 |   Ia      (mm)=   4.670   # of Linear Res.(N)= 2.00
 ---------------------   U.H. Tp(hrs)=    .160

      Unit Hyd Qpeak  (cms)=     .156

      PEAK FLOW       (cms)=     .011 (i)
      TIME TO PEAK    (hrs)=    1.467
      RUNOFF VOLUME    (mm)=    4.556
      TOTAL RAINFALL   (mm)=   25.002
      RUNOFF COEFFICIENT   =     .182

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

 ----------------------------------------------------------------------------
 001:0014--------------------------------------------------------------------
 *#**************************************************************************
```

```
*#                  UNCONTROLLED AREA UNC-2
*#****************************************************************************
---------------------
| DESIGN NASHYD     |   Area    (ha)=    1.87   Curve Number   (CN)=75.60
| 09:UNC-2  DT= 1.00 |  Ia      (mm)=   4.670   # of Linear Res.(N)= 2.00
---------------------   U.H. Tp(hrs)=    .190

     Unit Hyd Qpeak  (cms)=     .255

     PEAK FLOW       (cms)=     .016 (i)
     TIME TO PEAK    (hrs)=    1.533
     RUNOFF VOLUME    (mm)=    4.040
     TOTAL RAINFALL   (mm)=   25.002
     RUNOFF COEFFICIENT   =     .162

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

------------------------------------------------------------------------------
001:0015----------------------------------------------------------------------
*#****************************************************************************
*#                  UNCONTROLLED AREA UNC-3
*#****************************************************************************
---------------------
| DESIGN STANDHYD    |   Area    (ha)=     .55
| 08:UNC-3  DT= 1.00 |   Total Imp(%)=   24.20   Dir. Conn.(%)=   13.30
---------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area      (ha)=        .13          .42
     Dep. Storage      (mm)=       1.57         4.67
     Average Slope      (%)=       1.00         1.00
     Length             (m)=      60.55        40.00
     Mannings n           =        .013         .250

     Max.eff.Inten.(mm/hr)=       38.43         7.65
                over (min)         3.00        27.00
     Storage Coeff.  (min)=        2.77 (ii)   27.07 (ii)
     Unit Hyd. Tpeak (min)=        3.00        27.00
     Unit Hyd. peak  (cms)=         .39          .04
                                                          *TOTALS*
     PEAK FLOW       (cms)=         .01          .00          .008 (iii)
     TIME TO PEAK    (hrs)=        1.33         1.75         1.333
     RUNOFF VOLUME    (mm)=       23.43          .44         3.495
     TOTAL RAINFALL   (mm)=       25.00        25.00        25.002
     RUNOFF COEFFICIENT   =         .94          .02          .140

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20          K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------
001:0016----------------------------------------------------------------------
*#****************************************************************************
*#                  UNCONTROLLED AREA UNC-4
*#****************************************************************************
---------------------
| DESIGN NASHYD     |   Area    (ha)=    3.65   Curve Number   (CN)=76.50
| 07:UNC-4  DT= 1.00 |  Ia      (mm)=   4.670   # of Linear Res.(N)= 2.00
---------------------   U.H. Tp(hrs)=    .450

     Unit Hyd Qpeak  (cms)=     .211

     PEAK FLOW       (cms)=     .020 (i)
     TIME TO PEAK    (hrs)=    2.000
     RUNOFF VOLUME    (mm)=    4.203
     TOTAL RAINFALL   (mm)=   25.002
     RUNOFF COEFFICIENT   =     .168

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

------------------------------------------------------------------------------
001:0017----------------------------------------------------------------------
-----------------------
| ADD HYD (UNC       ) | ID: NHYD        AREA     QPEAK   TPEAK   R.V.    DWF
-----------------------                 (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 10:UNC-1         .96      .011    1.47   4.56    .000
                    +ID2 09:UNC-2        1.87      .016    1.53   4.04    .000
                    +ID3 08:UNC-3         .55      .008    1.33   3.49    .000
                    +ID4 07:UNC-4        3.65      .020    2.00   4.20    .000
                     =========================================================
                     SUM 04:UNC          7.03      .045    1.67   4.15    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------
001:0018----------------------------------------------------------------------
  ** END OF RUN :   1

******************************************************************************





--------------------
| START            |  Project  dir.: C:\SWMHYMO\
--------------------  Rainfall dir.: C:\SWMHYMO\
    TZERO =   .00 hrs on       0
    METOUT=   2 (output = METRIC)
    NRUN  = 002
    NSTORM=   1
          #  1=O12SC2yr.stm
------------------------------------------------------------------------------
002:0002----------------------------------------------------------------------
*#****************************************************************************
*#  Project Name: [Derry Side Road Subdivision]    Project Number: [160401279]
*#  Date        : 09-13-2017
*#  Modeller    : [AMP]
*#  Company     : Stantec Consulting Ltd. 604
*#  License #   :  3824306
*#****************************************************************************
------------------------------------------------------------------------------
002:0002----------------------------------------------------------------------
---------------------
| DEFAULT VALUES     |  Filename: C:\SWMHYMO\OTTAWA.VAL
---------------------   ICASEdv = 1 (read and print data)
      FileTitle= File comment: [2005 City of Ottawa Sewer Design Guideline]
                 PARAMETERS USED IN THE DESIGN STANDHYD COMMAND FOR OTTAWA.
      Horton's infiltration equation parameters:
      [Fo= 76.20 mm/hr] [Fc=13.20 mm/hr] [DCAY= 4.14 /hr] [F=  .00 mm]
      Parameters for PERVIOUS surfaces in STANDHYD:
      [IAper=   4.67 mm] [LGP=40.00 m] [MNP= .250]
      Parameters for IMPERVIOUS surfaces in STANDHYD:
      [IAimp=   1.57 mm] [CLI= 1.50]   [MNI= .013]
      Parameters used in NASHYD:
      [Ia=   4.67 mm] [N= 2.00]
------------------------------------------------------------------------------
002:0003----------------------------------------------------------------------
-------------------
| READ STORM       |     Filename: 2yr,12hr SCS STORM (Ottawa)
| Ptotal=  42.34 mm|     Comments: 2yr,12hr SCS STORM (Ottawa)
-------------------
                TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
                 hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
                 .50   1.270 |   3.50   1.694 |   6.50   9.230 |   9.50   1.270
                1.00    .593 |   4.00   1.694 |   7.00   4.065 |  10.00   1.016
                1.50   1.101 |   4.50   2.286 |   7.50   2.710 |  10.50   1.440
                2.00   1.101 |   5.00   2.879 |   8.00   2.371 |  11.00    .931
                2.50   1.440 |   5.50   4.573 |   8.50   1.863 |  11.50    .847
                3.00   1.270 |   6.00  36.243 |   9.00   1.948 |  12.00    .847

------------------------------------------------------------------------------
002:0004----------------------------------------------------------------------
*#***************************************************************************
*#
*#          DERRY SIDE ROAD SUBDIVISION - POST DEVELOPMENT CONDITIONS
*#****************************************************************************
*# STORM: 12hr SCS Storms, 3hr Chicago Storms
*# City of Ottawa 2004 IDF Parameters
*#----------------------------------------------------------------------------
*#  - Average CN values for each catchment were initially calculated on typical
*#      AMC II conditions based on hydrologic soil group and land use. CN values
*#      were subsequently modified using the SCS Modified Curve Number Calculations
*#  - Soils information for the site area was obtained from exp's
*#      Geotechnical Investigation dated July 21, 2017.
*#  - CN values calculated based on lawns, woodland and impervious areas
*#  - NASHYD command used for catchments with TIMP<20%
*#  - Time to peak for each catchment was estimated based on Tp = 0.67*Tc and
*#      Tc values were calculated using the Uplands Method
*#****************************************************************************
*#                  AREA A1 TO SWM 1
*#****************************************************************************
---------------------
| DESIGN NASHYD      |   Area    (ha)=    1.73   Curve Number   (CN)=79.20
| 01:A1     DT= 1.00 |   Ia      (mm)=   4.670   # of Linear Res.(N)= 2.00
---------------------    U.H. Tp(hrs)=    .230

     Unit Hyd Qpeak  (cms)=     .195

     PEAK FLOW       (cms)=     .040 (i)
     TIME TO PEAK    (hrs)=    6.133
     RUNOFF VOLUME    (mm)=   13.595
     TOTAL RAINFALL   (mm)=   42.340
     RUNOFF COEFFICIENT   =     .321

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

------------------------------------------------------------------------------
002:0005----------------------------------------------------------------------
*#****************************************************************************
*#                  AREA A2 TO SWM 1
*#****************************************************************************
---------------------
| DESIGN NASHYD      |   Area    (ha)=    1.88   Curve Number   (CN)=78.30
| 02:A2     DT= 1.00 |   Ia      (mm)=   4.670   # of Linear Res.(N)= 2.00
---------------------    U.H. Tp(hrs)=    .280

     Unit Hyd Qpeak  (cms)=     .174

     PEAK FLOW       (cms)=     .037 (i)
     TIME TO PEAK    (hrs)=    6.200
     RUNOFF VOLUME    (mm)=   13.131
     TOTAL RAINFALL   (mm)=   42.340
     RUNOFF COEFFICIENT   =     .310

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

------------------------------------------------------------------------------
002:0006----------------------------------------------------------------------
-----------------------
| ADD HYD (TOSWM1    ) | ID: NHYD        AREA     QPEAK   TPEAK   R.V.    DWF
-----------------------                 (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 01:A1           1.73      .040    6.13  13.59    .000
                    +ID2 02:A2           1.88      .037    6.20  13.13    .000
                     =========================================================
                     SUM 06:TOSWM1       3.61      .077    6.17  13.35    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------
002:0007----------------------------------------------------------------------
--------------------
| COMPUTE VOLUME   |
| ID:06  (TOSWM1)  |             DISCHARGE      TIME
--------------------               (cms)       (hrs)
      *** WARNING: No storage required, RelRate > Inflow Qp.
------------------------------------------------------------------------------
002:0008----------------------------------------------------------------------
*#****************************************************************************
*#                  AREA A3 TO SWM 2
*#****************************************************************************
---------------------
| DESIGN NASHYD      |   Area    (ha)=    1.33   Curve Number   (CN)=78.30
| 01:A3     DT= 1.00 |   Ia      (mm)=   4.670   # of Linear Res.(N)= 2.00
---------------------    U.H. Tp(hrs)=    .180

     Unit Hyd Qpeak  (cms)=     .192

     PEAK FLOW       (cms)=     .034 (i)
     TIME TO PEAK    (hrs)=    6.067
     RUNOFF VOLUME    (mm)=   13.131
     TOTAL RAINFALL   (mm)=   42.340
     RUNOFF COEFFICIENT   =     .310

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

------------------------------------------------------------------------------
002:0009----------------------------------------------------------------------
*#****************************************************************************
*#                  AREA A4 TO SWM 2
*#****************************************************************************
---------------------
| DESIGN NASHYD      |   Area    (ha)=    2.71   Curve Number   (CN)=78.30
| 02:A4     DT= 1.00 |   Ia      (mm)=   4.670   # of Linear Res.(N)= 2.00
---------------------    U.H. Tp(hrs)=    .180

     Unit Hyd Qpeak  (cms)=     .391

     PEAK FLOW       (cms)=     .070 (i)
     TIME TO PEAK    (hrs)=    6.067
     RUNOFF VOLUME    (mm)=   13.131
     TOTAL RAINFALL   (mm)=   42.340
     RUNOFF COEFFICIENT   =     .310

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

------------------------------------------------------------------------------
002:0010----------------------------------------------------------------------
*#****************************************************************************
*#                  AREA A5 TO SWM 2
*#****************************************************************************
---------------------
| DESIGN NASHYD      |   Area    (ha)=    1.43   Curve Number   (CN)=78.30
| 03:A5     DT= 1.00 |   Ia      (mm)=   4.670   # of Linear Res.(N)= 2.00
---------------------    U.H. Tp(hrs)=    .250

     Unit Hyd Qpeak  (cms)=     .148

```

```
      PEAK FLOW       (cms)=     .030 (i)
      TIME TO PEAK    (hrs)=    6.150
      RUNOFF VOLUME    (mm)=   13.131
      TOTAL RAINFALL   (mm)=   42.340
      RUNOFF COEFFICIENT   =     .310

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

----------------------------------------------------------------------------
002:0011--------------------------------------------------------------------
-----------------------
| ADD HYD (TOSWM2    ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
-----------------------                   (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 01:A3            1.33      .034    6.07  13.13    .000
                    +ID2 02:A4            2.71      .070    6.07  13.13    .000
                    +ID3 03:A5            1.43      .030    6.15  13.13    .000
                     =======================================================
                     SUM 05:TOSWM2        5.47      .134    6.08  13.13    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

----------------------------------------------------------------------------
002:0012--------------------------------------------------------------------
--------------------
| COMPUTE VOLUME   |
| ID:05  (TOSWM2)  |              DISCHARGE      TIME
--------------------                (cms)       (hrs)
       *** WARNING: No storage required, RelRate > Inflow Qp.
----------------------------------------------------------------------------
002:0013--------------------------------------------------------------------
*#**************************************************************************
*#                   UNCONTROLLED AREA UNC-1
*#**************************************************************************
---------------------
| DESIGN NASHYD      |   Area    (ha)=     .96   Curve Number   (CN)=78.30
| 10:UNC-1  DT= 1.00 |   Ia      (mm)=   4.670   # of Linear Res.(N)= 2.00
---------------------    U.H. Tp(hrs)=    .160

      Unit Hyd Qpeak  (cms)=     .156

      PEAK FLOW       (cms)=     .027 (i)
      TIME TO PEAK    (hrs)=    6.050
      RUNOFF VOLUME    (mm)=   13.131
      TOTAL RAINFALL   (mm)=   42.340
      RUNOFF COEFFICIENT   =     .310

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

----------------------------------------------------------------------------
002:0014--------------------------------------------------------------------
*#**************************************************************************
*#                   UNCONTROLLED AREA UNC-2
*#**************************************************************************
---------------------
| DESIGN NASHYD      |   Area    (ha)=    1.87   Curve Number   (CN)=75.60
| 09:UNC-2  DT= 1.00 |   Ia      (mm)=   4.670   # of Linear Res.(N)= 2.00
---------------------    U.H. Tp(hrs)=    .190

      Unit Hyd Qpeak  (cms)=     .255

      PEAK FLOW       (cms)=     .042 (i)
      TIME TO PEAK    (hrs)=    6.083
      RUNOFF VOLUME    (mm)=   11.860
      TOTAL RAINFALL   (mm)=   42.340
      RUNOFF COEFFICIENT   =     .280

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

----------------------------------------------------------------------------
002:0015--------------------------------------------------------------------
*#**************************************************************************
*#                   UNCONTROLLED AREA UNC-3
*#**************************************************************************
---------------------
| DESIGN STANDHYD    |   Area    (ha)=     .55
| 08:UNC-3  DT= 1.00 |   Total Imp(%)=   24.20   Dir. Conn.(%)=   13.30
---------------------
                            IMPERVIOUS    PERVIOUS (i)
      Surface Area      (ha)=      .13          .42
      Dep. Storage      (mm)=     1.57         4.67
      Average Slope      (%)=     1.00         1.00
      Length             (m)=    60.55        40.00
      Mannings n            =     .013         .250

      Max.eff.Inten.(mm/hr)=     36.24        15.51
                 over (min)       3.00        21.00
      Storage Coeff.  (min)=      2.84 (ii)   21.15 (ii)
      Unit Hyd. Tpeak (min)=      3.00        21.00
      Unit Hyd. peak  (cms)=       .39          .05
                                                           *TOTALS*
      PEAK FLOW       (cms)=       .01          .01          .013 (iii)
      TIME TO PEAK    (hrs)=      6.00         6.23         6.017
      RUNOFF VOLUME    (mm)=     40.77         4.82         9.597
      TOTAL RAINFALL   (mm)=     42.34        42.34        42.340
      RUNOFF COEFFICIENT   =       .96          .11          .227

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo   (mm/hr)= 76.20          K  (1/hr)=  4.14
             Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

----------------------------------------------------------------------------
002:0016--------------------------------------------------------------------
*#**************************************************************************
*#                   UNCONTROLLED AREA UNC-4
*#**************************************************************************
---------------------
| DESIGN NASHYD      |   Area    (ha)=    3.65   Curve Number   (CN)=76.50
| 07:UNC-4  DT= 1.00 |   Ia      (mm)=   4.670   # of Linear Res.(N)= 2.00
---------------------    U.H. Tp(hrs)=    .450

      Unit Hyd Qpeak  (cms)=     .211

      PEAK FLOW       (cms)=     .050 (i)
      TIME TO PEAK    (hrs)=    6.533
      RUNOFF VOLUME    (mm)=   12.265
      TOTAL RAINFALL   (mm)=   42.340
      RUNOFF COEFFICIENT   =     .290

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

----------------------------------------------------------------------------
002:0017--------------------------------------------------------------------
-----------------------
| ADD HYD (UNC       ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
-----------------------                   (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 10:UNC-1          .96      .027    6.05  13.13    .000
                    +ID2 09:UNC-2         1.87      .042    6.08  11.86    .000
                    +ID3 08:UNC-3          .55      .013    6.02   9.60    .000
                    +ID4 07:UNC-4         3.65      .050    6.53  12.26    .000
                     =======================================================
                     SUM 04:UNC           7.03      .119    6.15  12.07    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

----------------------------------------------------------------------------
002:0018--------------------------------------------------------------------
----------------------------------------------------------------------------
002:0002--------------------------------------------------------------------
  ** END OF RUN :    4

***************************************************************************





--------------------
| START             |  Project  dir.: C:\SWMHYMO\
--------------------   Rainfall dir.: C:\SWMHYMO\
    TZERO =   .00 hrs on        0
    METOUT=   2 (output = METRIC)
    NRUN  = 005
    NSTORM=   1
           #  1=O12SC5yr.stm
----------------------------------------------------------------------------
005:0002--------------------------------------------------------------------
*#**************************************************************************
*#  Project Name: [Derry Side Road Subdivision]    Project Number: [160401279]
*#  Date         : 09-13-2017
*#  Modeller     : [AMP]
*#  Company      : Stantec Consulting Ltd. 604
*#  License #    :  3824306
*#**************************************************************************
----------------------------------------------------------------------------
005:0002--------------------------------------------------------------------
----------------------
| DEFAULT VALUES      |  Filename: C:\SWMHYMO\OTTAWA.VAL
----------------------   ICASEdv = 1 (read and print data)
      FileTitle= File comment: [2005 City of Ottawa Sewer Design Guideline]
                 PARAMETERS USED IN THE DESIGN STANDHYD COMMAND FOR OTTAWA.
      Horton's infiltration equation parameters:
      [Fo= 76.20 mm/hr] [Fc=13.20 mm/hr] [DCAY= 4.14 /hr] [F=  .00 mm]
      Parameters for PERVIOUS surfaces in STANDHYD:
      [IAper=   4.67 mm] [LGP=40.00 m] [MNP= .250]
      Parameters for IMPERVIOUS surfaces in STANDHYD:
      [IAimp=   1.57 mm] [CLI= 1.50]   [MNI= .013]
      Parameters used in NASHYD:
      [Ia=   4.67 mm] [N= 2.00]
----------------------------------------------------------------------------
005:0003--------------------------------------------------------------------
--------------------
| READ STORM        |    Filename: 5yr,12hr SCS STORM (Ottawa)
| Ptotal=  56.17 mm|    Comments: 5yr,12hr SCS STORM (Ottawa)
--------------------
              TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
               hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
               .50   1.685 |   3.50   2.247 |   6.50  12.245 |   9.50   1.685
              1.00    .786 |   4.00   2.247 |   7.00   5.392 |  10.00   1.348
              1.50   1.460 |   4.50   3.033 |   7.50   3.595 |  10.50   1.910
              2.00   1.460 |   5.00   3.820 |   8.00   3.146 |  11.00   1.236
              2.50   1.910 |   5.50   6.066 |   8.50   2.471 |  11.50   1.123
              3.00   1.685 |   6.00  48.082 |   9.00   2.584 |  12.00   1.123

----------------------------------------------------------------------------
005:0004--------------------------------------------------------------------
*#*************************************************************************
*#
*#          DERRY SIDE ROAD SUBDIVISION - POST DEVELOPMENT CONDITIONS
*#**************************************************************************
*# STORM: 12hr SCS Storms, 3hr Chicago Storms
*# City of Ottawa 2004 IDF Parameters
*#--------------------------------------------------------------------------
*#  - Average CN values for each catchment were initially calculated on typical
*#      AMC II conditions based on hydrologic soil group and land use. CN values
*#      were subsequently modified using the SCS Modified Curve Number Calculations
*#  - Soils information for the site area was obtained from exp's
*#      Geotechnical Investigation dated July 21, 2017.
*#  - CN values calculated based on lawns, woodland and impervious areas
*#  - NASHYD command used for catchments with TIMP<20%
*#  - Time to peak for each catchment was estimated based on Tp = 0.67*Tc and
*#      Tc values were calculated using the Uplands Method
*#**************************************************************************
*#                    AREA A1 TO SWM 1
*#**************************************************************************
---------------------
| DESIGN NASHYD      |   Area    (ha)=    1.73   Curve Number   (CN)=79.20
| 01:A1     DT= 1.00 |   Ia      (mm)=   4.670   # of Linear Res.(N)= 2.00
---------------------    U.H. Tp(hrs)=    .230

      Unit Hyd Qpeak  (cms)=     .195

      PEAK FLOW       (cms)=     .068 (i)
      TIME TO PEAK    (hrs)=    6.117
      RUNOFF VOLUME    (mm)=   22.437
      TOTAL RAINFALL   (mm)=   56.170
      RUNOFF COEFFICIENT   =     .399

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

----------------------------------------------------------------------------
005:0005--------------------------------------------------------------------
*#**************************************************************************
*#                    AREA A2 TO SWM 1
*#**************************************************************************
---------------------
| DESIGN NASHYD      |   Area    (ha)=    1.88   Curve Number   (CN)=78.30
| 02:A2     DT= 1.00 |   Ia      (mm)=   4.670   # of Linear Res.(N)= 2.00
---------------------    U.H. Tp(hrs)=    .280

      Unit Hyd Qpeak  (cms)=     .174

      PEAK FLOW       (cms)=     .063 (i)
      TIME TO PEAK    (hrs)=    6.183
      RUNOFF VOLUME    (mm)=   21.759
      TOTAL RAINFALL   (mm)=   56.170
      RUNOFF COEFFICIENT   =     .387

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

----------------------------------------------------------------------------
005:0006--------------------------------------------------------------------
-----------------------
| ADD HYD (TOSWM1    ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
-----------------------                   (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 01:A1            1.73      .068    6.12  22.44    .000
                    +ID2 02:A2            1.88      .063    6.18  21.76    .000
                     =======================================================
                     SUM 06:TOSWM1        3.61      .131    6.15  22.08    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

----------------------------------------------------------------------------
005:0007--------------------------------------------------------------------
--------------------
| COMPUTE VOLUME   |
| ID:06  (TOSWM1)  |              DISCHARGE      TIME
--------------------                (cms)       (hrs)
```

```
      *** WARNING: No storage required, RelRate > Inflow Qp.
 ------------------------------------------------------------------------------
 005:0008----------------------------------------------------------------------
 *#****************************************************************************
 *#                   AREA A3 TO SWM 2
 *#****************************************************************************
 ----------------------
 | DESIGN NASHYD      |   Area    (ha)=    1.33   Curve Number   (CN)=78.30
 | 01:A3     DT= 1.00 |   Ia      (mm)=   4.670   # of Linear Res.(N)= 2.00
 ----------------------   U.H. Tp(hrs)=    .180

     Unit Hyd Qpeak  (cms)=     .192

     PEAK FLOW       (cms)=     .059 (i)
     TIME TO PEAK    (hrs)=    6.067
     RUNOFF VOLUME    (mm)=   21.758
     TOTAL RAINFALL   (mm)=   56.170
     RUNOFF COEFFICIENT   =     .387

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

 ------------------------------------------------------------------------------
 005:0009----------------------------------------------------------------------
 *#****************************************************************************
 *#                   AREA A4 TO SWM 2
 *#****************************************************************************
 ----------------------
 | DESIGN NASHYD      |   Area    (ha)=    2.71   Curve Number   (CN)=78.30
 | 02:A4     DT= 1.00 |   Ia      (mm)=   4.670   # of Linear Res.(N)= 2.00
 ----------------------   U.H. Tp(hrs)=    .180

     Unit Hyd Qpeak  (cms)=     .391

     PEAK FLOW       (cms)=     .119 (i)
     TIME TO PEAK    (hrs)=    6.067
     RUNOFF VOLUME    (mm)=   21.759
     TOTAL RAINFALL   (mm)=   56.170
     RUNOFF COEFFICIENT   =     .387

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

 ------------------------------------------------------------------------------
 005:0010----------------------------------------------------------------------
 *#****************************************************************************
 *#                   AREA A5 TO SWM 2
 *#****************************************************************************
 ----------------------
 | DESIGN NASHYD      |   Area    (ha)=    1.43   Curve Number   (CN)=78.30
 | 03:A5     DT= 1.00 |   Ia      (mm)=   4.670   # of Linear Res.(N)= 2.00
 ----------------------   U.H. Tp(hrs)=    .250

     Unit Hyd Qpeak  (cms)=     .148

     PEAK FLOW       (cms)=     .052 (i)
     TIME TO PEAK    (hrs)=    6.150
     RUNOFF VOLUME    (mm)=   21.758
     TOTAL RAINFALL   (mm)=   56.170
     RUNOFF COEFFICIENT   =     .387

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

 ------------------------------------------------------------------------------
 005:0011----------------------------------------------------------------------
 ------------------------
 | ADD HYD (TOSWM2    ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
 ------------------------                 (ha)     (cms)   (hrs)   (mm)   (cms)
                    ID1 01:A3             1.33      .059    6.07  21.76    .000
                   +ID2 02:A4             2.71      .119    6.07  21.76    .000
                   +ID3 03:A5             1.43      .052    6.15  21.76    .000
                    =========================================================
                    SUM 05:TOSWM2         5.47      .228    6.08  21.76    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ------------------------------------------------------------------------------
 005:0012----------------------------------------------------------------------
 -------------------
 | COMPUTE VOLUME   |
 | ID:05  (TOSWM2)  |                DISCHARGE      TIME
 -------------------                   (cms)       (hrs)
           START CONTROLLING AT        .022        5.563
           INFLOW HYD. PEAKS AT        .228        6.083
           STOP  CONTROLLING AT        .185        6.315

           REQUIRED STORAGE VOLUME (ha.m.)=    .0135
           TOTAL HYDROGRAPH VOLUME (ha.m.)=    .1190
           % OF HYDROGRAPH TO STORE       =  11.3729

           NOTE:  Storage was computed to reduce the Inflow
                  peak to     .185  (cms).

 ------------------------------------------------------------------------------
 005:0013----------------------------------------------------------------------
 *#****************************************************************************
 *#                   UNCONTROLLED AREA UNC-1
 *#****************************************************************************
 ----------------------
 | DESIGN NASHYD      |   Area    (ha)=     .96   Curve Number   (CN)=78.30
 | 10:UNC-1  DT= 1.00 |   Ia      (mm)=   4.670   # of Linear Res.(N)= 2.00
 ----------------------   U.H. Tp(hrs)=    .160

     Unit Hyd Qpeak  (cms)=     .156

     PEAK FLOW       (cms)=     .045 (i)
     TIME TO PEAK    (hrs)=    6.050
     RUNOFF VOLUME    (mm)=   21.758
     TOTAL RAINFALL   (mm)=   56.170
     RUNOFF COEFFICIENT   =     .387

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

 ------------------------------------------------------------------------------
 005:0014----------------------------------------------------------------------
 *#****************************************************************************
 *#                   UNCONTROLLED AREA UNC-2
 *#****************************************************************************
 ----------------------
 | DESIGN NASHYD      |   Area    (ha)=    1.87   Curve Number   (CN)=75.60
 | 09:UNC-2  DT= 1.00 |   Ia      (mm)=   4.670   # of Linear Res.(N)= 2.00
 ----------------------   U.H. Tp(hrs)=    .190

     Unit Hyd Qpeak  (cms)=     .255

     PEAK FLOW       (cms)=     .072 (i)
     TIME TO PEAK    (hrs)=    6.083
     RUNOFF VOLUME    (mm)=   19.870
     TOTAL RAINFALL   (mm)=   56.170
     RUNOFF COEFFICIENT   =     .354

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

 ------------------------------------------------------------------------------
 005:0015----------------------------------------------------------------------
 *#****************************************************************************
 *#                   UNCONTROLLED AREA UNC-3
 *#****************************************************************************
 ----------------------
 | DESIGN STANDHYD    |   Area    (ha)=     .55
 | 08:UNC-3  DT= 1.00 |   Total Imp(%)=   24.20   Dir. Conn.(%)=   13.30
 ----------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .13          .42
     Dep. Storage     (mm)=      1.57         4.67
     Average Slope     (%)=      1.00         1.00
     Length            (m)=     60.55        40.00
     Mannings n           =      .013         .250

     Max.eff.Inten.(mm/hr)=     48.08        34.90
               over (min)=      3.00        16.00
     Storage Coeff.  (min)=      2.53 (ii)   15.77 (ii)
     Unit Hyd. Tpeak (min)=      3.00        16.00
     Unit Hyd. peak  (cms)=       .42          .07
                                                          *TOTALS*
     PEAK FLOW       (cms)=       .01          .03           .034 (iii)
     TIME TO PEAK    (hrs)=      5.97         6.10          6.017
     RUNOFF VOLUME    (mm)=     54.60        12.76         18.322
     TOTAL RAINFALL   (mm)=     56.17        56.17         56.170
     RUNOFF COEFFICIENT   =       .97          .23           .326

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo   (mm/hr)= 76.20          K  (1/hr)=  4.14
             Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ------------------------------------------------------------------------------
 005:0016----------------------------------------------------------------------
 *#****************************************************************************
 *#                   UNCONTROLLED AREA UNC-4
 *#****************************************************************************
 ----------------------
 | DESIGN NASHYD      |   Area    (ha)=    3.65   Curve Number   (CN)=76.50
 | 07:UNC-4  DT= 1.00 |   Ia      (mm)=   4.670   # of Linear Res.(N)= 2.00
 ----------------------   U.H. Tp(hrs)=    .450

     Unit Hyd Qpeak  (cms)=     .211

     PEAK FLOW       (cms)=     .086 (i)
     TIME TO PEAK    (hrs)=    6.500
     RUNOFF VOLUME    (mm)=   20.476
     TOTAL RAINFALL   (mm)=   56.170
     RUNOFF COEFFICIENT   =     .365

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

 ------------------------------------------------------------------------------
 005:0017----------------------------------------------------------------------
 ------------------------
 | ADD HYD (UNC       ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
 ------------------------                 (ha)     (cms)   (hrs)   (mm)   (cms)
                    ID1 10:UNC-1           .96      .045    6.05  21.76    .000
                   +ID2 09:UNC-2          1.87      .072    6.08  19.87    .000
                   +ID3 08:UNC-3           .55      .034    6.02  18.32    .000
                   +ID4 07:UNC-4          3.65      .086    6.50  20.48    .000
                    =========================================================
                    SUM 04:UNC            7.03      .216    6.12  20.32    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ------------------------------------------------------------------------------
 005:0018----------------------------------------------------------------------
 ------------------------------------------------------------------------------
 005:0002----------------------------------------------------------------------
 ------------------------------------------------------------------------------
 005:0002----------------------------------------------------------------------
   ** END OF RUN :  99

 ******************************************************************************





 --------------------
 | START            |   Project  dir.: C:\SWMHYMO\
 --------------------   Rainfall dir.: C:\SWMHYMO\
     TZERO =   .00 hrs on        0
     METOUT=   2 (output = METRIC)
     NRUN  = 100
     NSTORM=   1
            #  1=O12SChyr.stm
 ------------------------------------------------------------------------------
 100:0002----------------------------------------------------------------------
 *#****************************************************************************
 *#  Project Name: [Derry Side Road Subdivision]    Project Number: [160401279]
 *#  Date        : 09-13-2017
 *#  Modeller    : [AMP]
 *#  Company     : Stantec Consulting Ltd. 604
 *#  License #   :  3824306
 *#****************************************************************************
 ------------------------------------------------------------------------------
 100:0002----------------------------------------------------------------------
 ----------------------
 | DEFAULT VALUES     |   Filename: C:\SWMHYMO\OTTAWA.VAL
 ----------------------   ICASEdv = 1 (read and print data)
       FileTitle= File comment: [2005 City of Ottawa Sewer Design Guideline]
                  PARAMETERS USED IN THE DESIGN STANDHYD COMMAND FOR OTTAWA.
       Horton's infiltration equation parameters:
       [Fo= 76.20 mm/hr] [Fc=13.20 mm/hr] [DCAY= 4.14 /hr] [F=  .00 mm]
       Parameters for PERVIOUS surfaces in STANDHYD:
       [IAper=   4.67 mm] [LGP=40.00 m] [MNP= .250]
       Parameters for IMPERVIOUS surfaces in STANDHYD:
       [IAimp=   1.57 mm] [CLI= 1.50]   [MNI= .013]
       Parameters used in NASHYD:
       [Ia=   4.67 mm] [N= 2.00]
 ------------------------------------------------------------------------------
 100:0003----------------------------------------------------------------------
 -------------------
 | READ STORM       |    Filename: 100yr,12hr SCS STORM (Ottawa)
 | Ptotal=  96.00 mm|    Comments: 100yr,12hr SCS STORM (Ottawa)
 -------------------
              TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
               hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
               .50   2.880 |   3.50   3.840 |   6.50  20.928 |   9.50   2.880
              1.00   1.344 |   4.00   3.840 |   7.00   9.216 |  10.00   2.304
              1.50   2.496 |   4.50   5.184 |   7.50   6.144 |  10.50   3.264
              2.00   2.496 |   5.00   6.528 |   8.00   5.376 |  11.00   2.112
              2.50   3.264 |   5.50  10.368 |   8.50   4.224 |  11.50   1.920
              3.00   2.880 |   6.00  82.176 |   9.00   4.416 |  12.00   1.920

 ------------------------------------------------------------------------------
 100:0004----------------------------------------------------------------------
 *#***************************************************************************
 *#
 *#            DERRY SIDE ROAD SUBDIVISION - POST DEVELOPMENT CONDITIONS
 *#****************************************************************************
 *# STORM: 12hr SCS Storms, 3hr Chicago Storms
 *# City of Ottawa 2004 IDF Parameters
 *#----------------------------------------------------------------------------
```

```
*#  - Average CN values for each catchment were initially calculated on typical
*#  AMC II conditions based on hydrologic soil group and land use. CN values
*#  were subsequently modified using the SCS Modified Curve Number Calculations
*#  - Soils information for the site area was obtained from exp's
*#  Geotechnical Investigation dated July 21, 2017.
*#  - CN values calculated based on lawns, woodland and impervious areas
*#  - NASHYD command used for catchments with TIMP<20%
*#  - Time to peak for each catchment was estimated based on Tp = 0.67*Tc and
*#  Tc values were calculated using the Uplands Method
*#****************************************************************************
*#                   AREA A1 TO SWM 1
*#****************************************************************************
----------------------
| DESIGN NASHYD      |   Area     (ha)=    1.73   Curve Number   (CN)=79.20
| 01:A1     DT= 1.00 |   Ia       (mm)=   4.670   # of Linear Res.(N)= 2.00
----------------------   U.H. Tp(hrs)=     .230

     Unit Hyd Qpeak  (cms)=     .195

     PEAK FLOW       (cms)=     .166 (i)
     TIME TO PEAK    (hrs)=    6.100
     RUNOFF VOLUME    (mm)=   52.780
     TOTAL RAINFALL   (mm)=   96.000
     RUNOFF COEFFICIENT   =     .550

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

------------------------------------------------------------------------------
100:0005----------------------------------------------------------------------
*#****************************************************************************
*#                   AREA A2 TO SWM 1
*#****************************************************************************
----------------------
| DESIGN NASHYD      |   Area     (ha)=    1.88   Curve Number   (CN)=78.30
| 02:A2     DT= 1.00 |   Ia       (mm)=   4.670   # of Linear Res.(N)= 2.00
----------------------   U.H. Tp(hrs)=     .280

     Unit Hyd Qpeak  (cms)=     .174

     PEAK FLOW       (cms)=     .155 (i)
     TIME TO PEAK    (hrs)=    6.167
     RUNOFF VOLUME    (mm)=   51.577
     TOTAL RAINFALL   (mm)=   96.000
     RUNOFF COEFFICIENT   =     .537

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

------------------------------------------------------------------------------
100:0006----------------------------------------------------------------------
------------------------
| ADD HYD (TOSWM1    ) | ID: NHYD        AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                 (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 01:A1           1.73      .166    6.10  52.78    .000
                    +ID2 02:A2           1.88      .155    6.17  51.58    .000
                     =========================================================
                     SUM 06:TOSWM1       3.61      .320    6.13  52.15    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------
100:0007----------------------------------------------------------------------
--------------------
| COMPUTE VOLUME   |
| ID:06  (TOSWM1)  |             DISCHARGE      TIME
--------------------               (cms)       (hrs)
           START CONTROLLING AT     .028       5.513
           INFLOW HYD. PEAKS AT     .320       6.133
           STOP  CONTROLLING AT     .185       6.738

           REQUIRED STORAGE VOLUME (ha.m.)=    .0494
           TOTAL HYDROGRAPH VOLUME (ha.m.)=    .1883
           % OF HYDROGRAPH TO STORE       =  26.2343

           NOTE:  Storage was computed to reduce the Inflow
                  peak to     .185  (cms).

------------------------------------------------------------------------------
100:0008----------------------------------------------------------------------
*#****************************************************************************
*#                   AREA A3 TO SWM 2
*#****************************************************************************
----------------------
| DESIGN NASHYD      |   Area     (ha)=    1.33   Curve Number   (CN)=78.30
| 01:A3     DT= 1.00 |   Ia       (mm)=   4.670   # of Linear Res.(N)= 2.00
----------------------   U.H. Tp(hrs)=     .180

     Unit Hyd Qpeak  (cms)=     .192

     PEAK FLOW       (cms)=     .143 (i)
     TIME TO PEAK    (hrs)=    6.050
     RUNOFF VOLUME    (mm)=   51.576
     TOTAL RAINFALL   (mm)=   96.000
     RUNOFF COEFFICIENT   =     .537

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

------------------------------------------------------------------------------
100:0009----------------------------------------------------------------------
*#****************************************************************************
*#                   AREA A4 TO SWM 2
*#****************************************************************************
----------------------
| DESIGN NASHYD      |   Area     (ha)=    2.71   Curve Number   (CN)=78.30
| 02:A4     DT= 1.00 |   Ia       (mm)=   4.670   # of Linear Res.(N)= 2.00
----------------------   U.H. Tp(hrs)=     .180

     Unit Hyd Qpeak  (cms)=     .391

     PEAK FLOW       (cms)=     .291 (i)
     TIME TO PEAK    (hrs)=    6.050
     RUNOFF VOLUME    (mm)=   51.577
     TOTAL RAINFALL   (mm)=   96.000
     RUNOFF COEFFICIENT   =     .537

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

------------------------------------------------------------------------------
100:0010----------------------------------------------------------------------
*#****************************************************************************
*#                   AREA A5 TO SWM 2
*#****************************************************************************
----------------------
| DESIGN NASHYD      |   Area     (ha)=    1.43   Curve Number   (CN)=78.30
| 03:A5     DT= 1.00 |   Ia       (mm)=   4.670   # of Linear Res.(N)= 2.00
----------------------   U.H. Tp(hrs)=     .250

     Unit Hyd Qpeak  (cms)=     .148

     PEAK FLOW       (cms)=     .127 (i)
     TIME TO PEAK    (hrs)=    6.133
     RUNOFF VOLUME    (mm)=   51.577
     TOTAL RAINFALL   (mm)=   96.000
     RUNOFF COEFFICIENT   =     .537

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

------------------------------------------------------------------------------
100:0011----------------------------------------------------------------------
------------------------
| ADD HYD (TOSWM2    ) | ID: NHYD        AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                 (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 01:A3           1.33      .143    6.05  51.58    .000
                    +ID2 02:A4           2.71      .291    6.05  51.58    .000
                    +ID3 03:A5           1.43      .127    6.13  51.58    .000
                     =========================================================
                     SUM 05:TOSWM2       5.47      .559    6.07  51.58    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------
100:0012----------------------------------------------------------------------
--------------------
| COMPUTE VOLUME   |
| ID:05  (TOSWM2)  |             DISCHARGE      TIME
--------------------               (cms)       (hrs)
           START CONTROLLING AT     .044       5.502
           INFLOW HYD. PEAKS AT     .559       6.067
           STOP  CONTROLLING AT     .185       6.884

           REQUIRED STORAGE VOLUME (ha.m.)=    .1106
           TOTAL HYDROGRAPH VOLUME (ha.m.)=    .2821
           % OF HYDROGRAPH TO STORE       =  39.2112

           NOTE:  Storage was computed to reduce the Inflow
                  peak to     .185  (cms).

------------------------------------------------------------------------------
100:0013----------------------------------------------------------------------
*#****************************************************************************
*#                   UNCONTROLLED AREA UNC-1
*#****************************************************************************
----------------------
| DESIGN NASHYD      |   Area     (ha)=     .96   Curve Number   (CN)=78.30
| 10:UNC-1  DT= 1.00 |   Ia       (mm)=   4.670   # of Linear Res.(N)= 2.00
----------------------   U.H. Tp(hrs)=     .160

     Unit Hyd Qpeak  (cms)=     .156

     PEAK FLOW       (cms)=     .109 (i)
     TIME TO PEAK    (hrs)=    6.033
     RUNOFF VOLUME    (mm)=   51.576
     TOTAL RAINFALL   (mm)=   96.000
     RUNOFF COEFFICIENT   =     .537

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

------------------------------------------------------------------------------
100:0014----------------------------------------------------------------------
*#****************************************************************************
*#                   UNCONTROLLED AREA UNC-2
*#****************************************************************************
----------------------
| DESIGN NASHYD      |   Area     (ha)=    1.87   Curve Number   (CN)=75.60
| 09:UNC-2  DT= 1.00 |   Ia       (mm)=   4.670   # of Linear Res.(N)= 2.00
----------------------   U.H. Tp(hrs)=     .190

     Unit Hyd Qpeak  (cms)=     .255

     PEAK FLOW       (cms)=     .181 (i)
     TIME TO PEAK    (hrs)=    6.067
     RUNOFF VOLUME    (mm)=   48.129
     TOTAL RAINFALL   (mm)=   96.000
     RUNOFF COEFFICIENT   =     .501

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

------------------------------------------------------------------------------
100:0015----------------------------------------------------------------------
*#****************************************************************************
*#                   UNCONTROLLED AREA UNC-3
*#****************************************************************************
----------------------
| DESIGN STANDHYD    |   Area     (ha)=     .55
| 08:UNC-3  DT= 1.00 |   Total Imp(%)=   24.20   Dir. Conn.(%)=   13.30
----------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .13          .42
     Dep. Storage     (mm)=      1.57         4.67
     Average Slope     (%)=      1.00         1.00
     Length            (m)=     60.55        40.00
     Mannings n           =      .013         .250

     Max.eff.Inten.(mm/hr)=     82.18        79.52
                over (min)       2.00        12.00
     Storage Coeff.  (min)=      2.05 (ii)   11.57 (ii)
     Unit Hyd. Tpeak (min)=      2.00        12.00
     Unit Hyd. peak  (cms)=       .55          .10
                                                           *TOTALS*
     PEAK FLOW       (cms)=       .02          .08           .095 (iii)
     TIME TO PEAK    (hrs)=      5.90         6.03          6.000
     RUNOFF VOLUME    (mm)=     94.43        38.67         46.082
     TOTAL RAINFALL   (mm)=     96.00        96.00         96.000
     RUNOFF COEFFICIENT   =       .98          .40           .480

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo    (mm/hr)= 76.20          K  (1/hr)=  4.14
            Fc    (mm/hr)= 13.20     Cum.Inf.    (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------
100:0016----------------------------------------------------------------------
*#****************************************************************************
*#                   UNCONTROLLED AREA UNC-4
*#****************************************************************************
----------------------
| DESIGN NASHYD      |   Area     (ha)=    3.65   Curve Number   (CN)=76.50
| 07:UNC-4  DT= 1.00 |   Ia       (mm)=   4.670   # of Linear Res.(N)= 2.00
----------------------   U.H. Tp(hrs)=     .450

     Unit Hyd Qpeak  (cms)=     .211

     PEAK FLOW       (cms)=     .212 (i)
     TIME TO PEAK    (hrs)=    6.450
     RUNOFF VOLUME    (mm)=   49.252
     TOTAL RAINFALL   (mm)=   96.000
     RUNOFF COEFFICIENT   =     .513

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

------------------------------------------------------------------------------
100:0017----------------------------------------------------------------------
------------------------
| ADD HYD (UNC       ) | ID: NHYD        AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                 (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 10:UNC-1         .96      .109    6.03  51.58    .000
                    +ID2 09:UNC-2        1.87      .181    6.07  48.13    .000
                    +ID3 08:UNC-3         .55      .095    6.00  46.08    .000
                    +ID4 07:UNC-4        3.65      .212    6.45  49.25    .000
```

```
                    ==========================================================
                    SUM 04:UNC            7.03     .545    6.08  49.02    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
100:0018------------------------------------------------------------------------
--------------------------------------------------------------------------------
100:0002------------------------------------------------------------------------
--------------------------------------------------------------------------------
100:0002------------------------------------------------------------------------
--------------------------------------------------------------------------------
100:0002------------------------------------------------------------------------
  ** END OF RUN : 101

*******************************************************************************






--------------------
| START              |  Project  dir.: C:\SWMHYMO\
--------------------    Rainfall dir.: C:\SWMHYMO\
   TZERO =   .00 hrs on       0
   METOUT=   2 (output = METRIC)
   NRUN  = 102
   NSTORM=   1
          #  1=OT3CH2yr.stm
--------------------------------------------------------------------------------
102:0002------------------------------------------------------------------------
*#******************************************************************************
*#  Project Name: [Derry Side Road Subdivision]    Project Number: [160401279]
*#  Date         : 09-13-2017
*#  Modeller     : [AMP]
*#  Company      : Stantec Consulting Ltd. 604
*#  License #    :  3824306
*#******************************************************************************
--------------------------------------------------------------------------------
102:0002------------------------------------------------------------------------
----------------------
| DEFAULT VALUES     |  Filename: C:\SWMHYMO\OTTAWA.VAL
----------------------    ICASEdv = 1 (read and print data)
     FileTitle= File comment: [2005 City of Ottawa Sewer Design Guideline]
                PARAMETERS USED IN THE DESIGN STANDHYD COMMAND FOR OTTAWA.
     Horton's infiltration equation parameters:
     [Fo= 76.20 mm/hr] [Fc=13.20 mm/hr] [DCAY= 4.14 /hr] [F=  .00 mm]
     Parameters for PERVIOUS surfaces in STANDHYD:
     [IAper=   4.67 mm] [LGP=40.00 m] [MNP= .250]
     Parameters for IMPERVIOUS surfaces in STANDHYD:
     [IAimp=   1.57 mm] [CLI= 1.50]   [MNI= .013]
     Parameters used in NASHYD:
     [Ia=   4.67 mm] [N= 2.00]
--------------------------------------------------------------------------------
102:0003------------------------------------------------------------------------
--------------------
| READ STORM         |    Filename: 2yr CHICAGO STORM, 3hr, DT=10min
| Ptotal=  31.86 mm|    Comments: 2yr CHICAGO STORM, 3hr, DT=10min
--------------------
             TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
              hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
              .17   2.815 |   1.00  76.805 |   1.83   5.095 |   2.67   2.684
              .33   3.498 |   1.17  24.079 |   2.00   4.291 |   2.83   2.463
              .50   4.687 |   1.33  12.364 |   2.17   3.718 |   3.00   2.279
              .67   7.305 |   1.50   8.324 |   2.33   3.288 |
              .83  18.209 |   1.67   6.303 |   2.50   2.953 |

--------------------------------------------------------------------------------
102:0004------------------------------------------------------------------------
*#*****************************************************************************
*#
*#         DERRY SIDE ROAD SUBDIVISION - POST DEVELOPMENT CONDITIONS
*#******************************************************************************
*# STORM: 12hr SCS Storms, 3hr Chicago Storms
*# City of Ottawa 2004 IDF Parameters
*#------------------------------------------------------------------------------
*#  - Average CN values for each catchment were initially calculated on typical
*#  AMC II conditions based on hydrologic soil group and land use. CN values
*#  were subsequently modified using the SCS Modified Curve Number Calculations
*#  - Soils information for the site area was obtained from exp's
*#  Geotechnical Investigation dated July 21, 2017.
*#  - CN values calculated based on lawns, woodland and impervious areas
*#  - NASHYD command used for catchments with TIMP<20%
*#  - Time to peak for each catchment was estimated based on Tp = 0.67*Tc and
*#  Tc values were calculated using the Uplands Method
*#******************************************************************************
*#                   AREA A1 TO SWM 1
*#******************************************************************************
----------------------
| DESIGN NASHYD      |   Area    (ha)=    1.73   Curve Number   (CN)=79.20
| 01:A1     DT= 1.00 |   Ia      (mm)=   4.670   # of Linear Res.(N)= 2.00
----------------------   U.H. Tp(hrs)=    .230

     Unit Hyd Qpeak  (cms)=     .195

     PEAK FLOW       (cms)=     .031 (i)
     TIME TO PEAK    (hrs)=    1.350
     RUNOFF VOLUME    (mm)=    7.873
     TOTAL RAINFALL   (mm)=   31.860
     RUNOFF COEFFICIENT   =     .247

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

--------------------------------------------------------------------------------
102:0005------------------------------------------------------------------------
*#******************************************************************************
*#                   AREA A2 TO SWM 1
*#******************************************************************************
----------------------
| DESIGN NASHYD      |   Area    (ha)=    1.88   Curve Number   (CN)=78.30
| 02:A2     DT= 1.00 |   Ia      (mm)=   4.670   # of Linear Res.(N)= 2.00
----------------------   U.H. Tp(hrs)=    .280

     Unit Hyd Qpeak  (cms)=     .174

     PEAK FLOW       (cms)=     .028 (i)
     TIME TO PEAK    (hrs)=    1.433
     RUNOFF VOLUME    (mm)=    7.576
     TOTAL RAINFALL   (mm)=   31.860
     RUNOFF COEFFICIENT   =     .238

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

--------------------------------------------------------------------------------
102:0006------------------------------------------------------------------------
------------------------
| ADD HYD (TOSWM1    ) | ID: NHYD         AREA     QPEAK   TPEAK    R.V.    DWF
------------------------                  (ha)     (cms)   (hrs)    (mm)   (cms)
                    ID1 01:A1             1.73      .031    1.35    7.87    .000
                   +ID2 02:A2             1.88      .028    1.43    7.58    .000
                    ==========================================================
                    SUM 06:TOSWM1         3.61      .058    1.38    7.72    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
102:0007------------------------------------------------------------------------
--------------------
| COMPUTE VOLUME     |
| ID:06  (TOSWM1)    |              DISCHARGE      TIME
--------------------                  (cms)       (hrs)
      *** WARNING: No storage required, RelRate > Inflow Qp.
--------------------------------------------------------------------------------
102:0008------------------------------------------------------------------------
*#******************************************************************************
*#                   AREA A3 TO SWM 2
*#******************************************************************************
----------------------
| DESIGN NASHYD      |   Area    (ha)=    1.33   Curve Number   (CN)=78.30
| 01:A3     DT= 1.00 |   Ia      (mm)=   4.670   # of Linear Res.(N)= 2.00
----------------------   U.H. Tp(hrs)=    .180

     Unit Hyd Qpeak  (cms)=     .192

     PEAK FLOW       (cms)=     .026 (i)
     TIME TO PEAK    (hrs)=    1.250
     RUNOFF VOLUME    (mm)=    7.576
     TOTAL RAINFALL   (mm)=   31.860
     RUNOFF COEFFICIENT   =     .238

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

--------------------------------------------------------------------------------
102:0009------------------------------------------------------------------------
*#******************************************************************************
*#                   AREA A4 TO SWM 2
*#******************************************************************************
----------------------
| DESIGN NASHYD      |   Area    (ha)=    2.71   Curve Number   (CN)=78.30
| 02:A4     DT= 1.00 |   Ia      (mm)=   4.670   # of Linear Res.(N)= 2.00
----------------------   U.H. Tp(hrs)=    .180

     Unit Hyd Qpeak  (cms)=     .391

     PEAK FLOW       (cms)=     .053 (i)
     TIME TO PEAK    (hrs)=    1.250
     RUNOFF VOLUME    (mm)=    7.576
     TOTAL RAINFALL   (mm)=   31.860
     RUNOFF COEFFICIENT   =     .238

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

--------------------------------------------------------------------------------
102:0010------------------------------------------------------------------------
*#******************************************************************************
*#                   AREA A5 TO SWM 2
*#******************************************************************************
----------------------
| DESIGN NASHYD      |   Area    (ha)=    1.43   Curve Number   (CN)=78.30
| 03:A5     DT= 1.00 |   Ia      (mm)=   4.670   # of Linear Res.(N)= 2.00
----------------------   U.H. Tp(hrs)=    .250

     Unit Hyd Qpeak  (cms)=     .148

     PEAK FLOW       (cms)=     .023 (i)
     TIME TO PEAK    (hrs)=    1.383
     RUNOFF VOLUME    (mm)=    7.576
     TOTAL RAINFALL   (mm)=   31.860
     RUNOFF COEFFICIENT   =     .238

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

--------------------------------------------------------------------------------
102:0011------------------------------------------------------------------------
------------------------
| ADD HYD (TOSWM2    ) | ID: NHYD         AREA     QPEAK   TPEAK    R.V.    DWF
------------------------                  (ha)     (cms)   (hrs)    (mm)   (cms)
                    ID1 01:A3             1.33      .026    1.25    7.58    .000
                   +ID2 02:A4             2.71      .053    1.25    7.58    .000
                   +ID3 03:A5             1.43      .023    1.38    7.58    .000
                    ==========================================================
                    SUM 05:TOSWM2         5.47      .101    1.28    7.58    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
102:0012------------------------------------------------------------------------
--------------------
| COMPUTE VOLUME     |
| ID:05  (TOSWM2)    |              DISCHARGE      TIME
--------------------                  (cms)       (hrs)
      *** WARNING: No storage required, RelRate > Inflow Qp.
--------------------------------------------------------------------------------
102:0013------------------------------------------------------------------------
*#******************************************************************************
*#                   UNCONTROLLED AREA UNC-1
*#******************************************************************************
----------------------
| DESIGN NASHYD      |   Area    (ha)=     .96   Curve Number   (CN)=78.30
| 10:UNC-1  DT= 1.00 |   Ia      (mm)=   4.670   # of Linear Res.(N)= 2.00
----------------------   U.H. Tp(hrs)=    .160

     Unit Hyd Qpeak  (cms)=     .156

     PEAK FLOW       (cms)=     .020 (i)
     TIME TO PEAK    (hrs)=    1.217
     RUNOFF VOLUME    (mm)=    7.576
     TOTAL RAINFALL   (mm)=   31.860
     RUNOFF COEFFICIENT   =     .238

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

--------------------------------------------------------------------------------
102:0014------------------------------------------------------------------------
*#******************************************************************************
*#                   UNCONTROLLED AREA UNC-2
*#******************************************************************************
----------------------
| DESIGN NASHYD      |   Area    (ha)=    1.87   Curve Number   (CN)=75.60
| 09:UNC-2  DT= 1.00 |   Ia      (mm)=   4.670   # of Linear Res.(N)= 2.00
----------------------   U.H. Tp(hrs)=    .190

     Unit Hyd Qpeak  (cms)=     .255

     PEAK FLOW       (cms)=     .031 (i)
     TIME TO PEAK    (hrs)=    1.283
     RUNOFF VOLUME    (mm)=    6.772
     TOTAL RAINFALL   (mm)=   31.860
     RUNOFF COEFFICIENT   =     .213

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

--------------------------------------------------------------------------------
102:0015------------------------------------------------------------------------
*#******************************************************************************
*#                   UNCONTROLLED AREA UNC-3
*#******************************************************************************
----------------------
| DESIGN STANDHYD    |   Area    (ha)=     .55
| 08:UNC-3  DT= 1.00 |   Total Imp(%)=   24.20   Dir. Conn.(%)=   13.30
```

```
---------------------
                                IMPERVIOUS   PERVIOUS (i)
     Surface Area     (ha)=        .13          .42
     Dep. Storage     (mm)=       1.57         4.67
     Average Slope     (%)=       1.00         1.00
     Length            (m)=      60.55        40.00
     Mannings n           =       .013         .250

     Max.eff.Inten.(mm/hr)=      76.80        18.20
                over (min)        2.00        19.00
     Storage Coeff.  (min)=       2.10 (ii)   19.28 (ii)
     Unit Hyd. Tpeak (min)=       2.00        19.00
     Unit Hyd. peak  (cms)=        .54          .06
                                                          *TOTALS*
     PEAK FLOW       (cms)=        .02          .01          .019 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.25         1.000
     RUNOFF VOLUME    (mm)=      30.29         5.04         8.397
     TOTAL RAINFALL   (mm)=      31.86        31.86        31.860
     RUNOFF COEFFICIENT   =        .95          .16          .264

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20          K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
102:0016------------------------------------------------------------------------
*#******************************************************************************
*#                   UNCONTROLLED AREA UNC-4
*#******************************************************************************
---------------------
| DESIGN NASHYD      |   Area    (ha)=    3.65   Curve Number   (CN)=76.50
| 07:UNC-4  DT= 1.00 |   Ia      (mm)=   4.670   # of Linear Res.(N)= 2.00
---------------------    U.H. Tp(hrs)=    .450

     Unit Hyd Qpeak  (cms)=     .211

     PEAK FLOW       (cms)=     .037 (i)
     TIME TO PEAK    (hrs)=    1.700
     RUNOFF VOLUME    (mm)=    7.026
     TOTAL RAINFALL   (mm)=   31.860
     RUNOFF COEFFICIENT   =     .221

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

--------------------------------------------------------------------------------
102:0017------------------------------------------------------------------------
-----------------------
| ADD HYD (UNC       ) | ID: NHYD        AREA     QPEAK   TPEAK   R.V.    DWF
-----------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 10:UNC-1         .96      .020    1.22   7.58    .000
                    +ID2 09:UNC-2        1.87      .031    1.28   6.77    .000
                    +ID3 08:UNC-3         .55      .019    1.00   8.40    .000
                    +ID4 07:UNC-4        3.65      .037    1.70   7.03    .000
                     ===========================================================
                     SUM 04:UNC          7.03      .093    1.30   7.14    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
102:0018------------------------------------------------------------------------
--------------------------------------------------------------------------------
102:0002------------------------------------------------------------------------
--------------------------------------------------------------------------------
102:0002------------------------------------------------------------------------
--------------------------------------------------------------------------------
102:0002------------------------------------------------------------------------
--------------------------------------------------------------------------------
102:0002------------------------------------------------------------------------
  ** END OF RUN : 104

*******************************************************************************





--------------------
| START             |  Project  dir.: C:\SWMHYMO\
--------------------  Rainfall dir.: C:\SWMHYMO\
    TZERO =   .00 hrs on       0
    METOUT=   2 (output = METRIC)
    NRUN  = 105
    NSTORM=   1
           #  1=OT3CH5yr.stm
--------------------------------------------------------------------------------
105:0002------------------------------------------------------------------------
*#******************************************************************************
*#  Project Name: [Derry Side Road Subdivision]    Project Number: [160401279]
*#  Date        : 09-13-2017
*#  Modeller    : [AMP]
*#  Company     : Stantec Consulting Ltd. 604
*#  License #   :  3824306
*#******************************************************************************
--------------------------------------------------------------------------------
105:0002------------------------------------------------------------------------
---------------------
| DEFAULT VALUES     |  Filename: C:\SWMHYMO\OTTAWA.VAL
---------------------  ICASEdv = 1 (read and print data)
      FileTitle= File comment: [2005 City of Ottawa Sewer Design Guideline]
                 PARAMETERS USED IN THE DESIGN STANDHYD COMMAND FOR OTTAWA.
      Horton's infiltration equation parameters:
      [Fo= 76.20 mm/hr] [Fc=13.20 mm/hr] [DCAY= 4.14 /hr] [F=  .00 mm]
      Parameters for PERVIOUS surfaces in STANDHYD:
      [IAper=   4.67 mm] [LGP=40.00 m] [MNP= .250]
      Parameters for IMPERVIOUS surfaces in STANDHYD:
      [IAimp=   1.57 mm] [CLI= 1.50]   [MNI= .013]
      Parameters used in NASHYD:
      [Ia=   4.67 mm] [N= 2.00]
--------------------------------------------------------------------------------
105:0003------------------------------------------------------------------------
--------------------
| READ STORM        |    Filename: 5yr CHICAGO STORM, 3hr, DT=10min
| Ptotal=  42.51 mm|    Comments: 5yr CHICAGO STORM, 3hr, DT=10min
--------------------
              TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
               hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
               .17   3.682 |   1.00 104.193 |   1.83   6.689 |   2.67   3.510
               .33   4.582 |   1.17  32.037 |   2.00   5.628 |   2.83   3.220
               .50   6.151 |   1.33  16.337 |   2.17   4.872 |   3.00   2.978
               .67   9.614 |   1.50  10.965 |   2.33   4.305 |
               .83  24.170 |   1.67   8.287 |   2.50   3.864 |

--------------------------------------------------------------------------------
105:0004------------------------------------------------------------------------
*#****************************************************************************
*#
*#          DERRY SIDE ROAD SUBDIVISION - POST DEVELOPMENT CONDITIONS
*#******************************************************************************
*# STORM: 12hr SCS Storms, 3hr Chicago Storms
*# City of Ottawa 2004 IDF Parameters
*#------------------------------------------------------------------------------
*#  - Average CN values for each catchment were initially calculated on typical
*#      AMC II conditions based on hydrologic soil group and land use. CN values
*#      were subsequently modified using the SCS Modified Curve Number Calculations
*#  - Soils information for the site area was obtained from exp's
*#      Geotechnical Investigation dated July 21, 2017.
*#  - CN values calculated based on lawns, woodland and impervious areas
*#  - NASHYD command used for catchments with TIMP<20%
*#  - Time to peak for each catchment was estimated based on Tp = 0.67*Tc and
*#      Tc values were calculated using the Uplands Method
*#******************************************************************************
*#                   AREA A1 TO SWM 1
*#******************************************************************************
---------------------
| DESIGN NASHYD      |   Area    (ha)=    1.73   Curve Number   (CN)=79.20
| 01:A1     DT= 1.00 |   Ia      (mm)=   4.670   # of Linear Res.(N)= 2.00
---------------------    U.H. Tp(hrs)=    .230

     Unit Hyd Qpeak  (cms)=     .195

     PEAK FLOW       (cms)=     .056 (i)
     TIME TO PEAK    (hrs)=    1.333
     RUNOFF VOLUME    (mm)=   13.698
     TOTAL RAINFALL   (mm)=   42.514
     RUNOFF COEFFICIENT   =     .322

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

--------------------------------------------------------------------------------
105:0005------------------------------------------------------------------------
*#******************************************************************************
*#                   AREA A2 TO SWM 1
*#******************************************************************************
---------------------
| DESIGN NASHYD      |   Area    (ha)=    1.88   Curve Number   (CN)=78.30
| 02:A2     DT= 1.00 |   Ia      (mm)=   4.670   # of Linear Res.(N)= 2.00
---------------------    U.H. Tp(hrs)=    .280

     Unit Hyd Qpeak  (cms)=     .174

     PEAK FLOW       (cms)=     .051 (i)
     TIME TO PEAK    (hrs)=    1.400
     RUNOFF VOLUME    (mm)=   13.232
     TOTAL RAINFALL   (mm)=   42.514
     RUNOFF COEFFICIENT   =     .311

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

--------------------------------------------------------------------------------
105:0006------------------------------------------------------------------------
-----------------------
| ADD HYD (TOSWM1    ) | ID: NHYD        AREA     QPEAK   TPEAK   R.V.    DWF
-----------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 01:A1           1.73      .056    1.33  13.70    .000
                    +ID2 02:A2           1.88      .051    1.40  13.23    .000
                     ===========================================================
                     SUM 06:TOSWM1       3.61      .106    1.35  13.46    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
105:0007------------------------------------------------------------------------
--------------------
| COMPUTE VOLUME    |
| ID:06  (TOSWM1)   |             DISCHARGE      TIME
--------------------                (cms)       (hrs)
      *** WARNING: No storage required, RelRate > Inflow Qp.
--------------------------------------------------------------------------------
105:0008------------------------------------------------------------------------
*#******************************************************************************
*#                   AREA A3 TO SWM 2
*#******************************************************************************
---------------------
| DESIGN NASHYD      |   Area    (ha)=    1.33   Curve Number   (CN)=78.30
| 01:A3     DT= 1.00 |   Ia      (mm)=   4.670   # of Linear Res.(N)= 2.00
---------------------    U.H. Tp(hrs)=    .180

     Unit Hyd Qpeak  (cms)=     .192

     PEAK FLOW       (cms)=     .048 (i)
     TIME TO PEAK    (hrs)=    1.233
     RUNOFF VOLUME    (mm)=   13.232
     TOTAL RAINFALL   (mm)=   42.514
     RUNOFF COEFFICIENT   =     .311

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

--------------------------------------------------------------------------------
105:0009------------------------------------------------------------------------
*#******************************************************************************
*#                   AREA A4 TO SWM 2
*#******************************************************************************
---------------------
| DESIGN NASHYD      |   Area    (ha)=    2.71   Curve Number   (CN)=78.30
| 02:A4     DT= 1.00 |   Ia      (mm)=   4.670   # of Linear Res.(N)= 2.00
---------------------    U.H. Tp(hrs)=    .180

     Unit Hyd Qpeak  (cms)=     .391

     PEAK FLOW       (cms)=     .098 (i)
     TIME TO PEAK    (hrs)=    1.233
     RUNOFF VOLUME    (mm)=   13.232
     TOTAL RAINFALL   (mm)=   42.514
     RUNOFF COEFFICIENT   =     .311

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

--------------------------------------------------------------------------------
105:0010------------------------------------------------------------------------
*#******************************************************************************
*#                   AREA A5 TO SWM 2
*#******************************************************************************
---------------------
| DESIGN NASHYD      |   Area    (ha)=    1.43   Curve Number   (CN)=78.30
| 03:A5     DT= 1.00 |   Ia      (mm)=   4.670   # of Linear Res.(N)= 2.00
---------------------    U.H. Tp(hrs)=    .250

     Unit Hyd Qpeak  (cms)=     .148

     PEAK FLOW       (cms)=     .042 (i)
     TIME TO PEAK    (hrs)=    1.350
     RUNOFF VOLUME    (mm)=   13.232
     TOTAL RAINFALL   (mm)=   42.514
     RUNOFF COEFFICIENT   =     .311

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

--------------------------------------------------------------------------------
105:0011------------------------------------------------------------------------
-----------------------
| ADD HYD (TOSWM2    ) | ID: NHYD        AREA     QPEAK   TPEAK   R.V.    DWF
-----------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 01:A3           1.33      .048    1.23  13.23    .000
                    +ID2 02:A4           2.71      .098    1.23  13.23    .000
                    +ID3 03:A5           1.43      .042    1.35  13.23    .000
                     ===========================================================
                     SUM 05:TOSWM2       5.47      .186    1.25  13.23    .000
```

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

-------------------------------------------------------------------------------
105:0012-----------------------------------------------------------------------
--------------------
| COMPUTE VOLUME   |
| ID:05  (TOSWM2)  |             DISCHARGE      TIME
--------------------               (cms)       (hrs)
          START CONTROLLING AT     .019        .901
          INFLOW HYD. PEAKS AT     .186       1.250
          STOP  CONTROLLING AT     .185       1.286

          REQUIRED STORAGE VOLUME (ha.m.)=    .0040
          TOTAL HYDROGRAPH VOLUME (ha.m.)=    .0724
          % OF HYDROGRAPH TO STORE       =   5.4687

          NOTE:  Storage was computed to reduce the Inflow
                 peak to     .185  (cms).

-------------------------------------------------------------------------------
105:0013-----------------------------------------------------------------------
*#*****************************************************************************
*#                    UNCONTROLLED AREA UNC-1
*#*****************************************************************************
----------------------
| DESIGN NASHYD      |   Area    (ha)=     .96   Curve Number   (CN)=78.30
| 10:UNC-1  DT= 1.00 |   Ia      (mm)=   4.670   # of Linear Res.(N)= 2.00
----------------------   U.H. Tp(hrs)=    .160

     Unit Hyd Qpeak  (cms)=     .156

     PEAK FLOW       (cms)=     .037 (i)
     TIME TO PEAK    (hrs)=    1.200
     RUNOFF VOLUME    (mm)=   13.231
     TOTAL RAINFALL   (mm)=   42.514
     RUNOFF COEFFICIENT   =     .311

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

-------------------------------------------------------------------------------
105:0014-----------------------------------------------------------------------
*#*****************************************************************************
*#                    UNCONTROLLED AREA UNC-2
*#*****************************************************************************
----------------------
| DESIGN NASHYD      |   Area    (ha)=    1.87   Curve Number   (CN)=75.60
| 09:UNC-2  DT= 1.00 |   Ia      (mm)=   4.670   # of Linear Res.(N)= 2.00
----------------------   U.H. Tp(hrs)=    .190

     Unit Hyd Qpeak  (cms)=     .255

     PEAK FLOW       (cms)=     .058 (i)
     TIME TO PEAK    (hrs)=    1.250
     RUNOFF VOLUME    (mm)=   11.952
     TOTAL RAINFALL   (mm)=   42.514
     RUNOFF COEFFICIENT   =     .281

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

-------------------------------------------------------------------------------
105:0015-----------------------------------------------------------------------
*#*****************************************************************************
*#                    UNCONTROLLED AREA UNC-3
*#*****************************************************************************
----------------------
| DESIGN STANDHYD    |   Area    (ha)=     .55
| 08:UNC-3  DT= 1.00 |   Total Imp(%)=   24.20   Dir. Conn.(%)=   13.30
----------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .13          .42
     Dep. Storage     (mm)=      1.57         4.67
     Average Slope     (%)=      1.00         1.00
     Length            (m)=     60.55        40.00
     Mannings n          =       .013         .250

     Max.eff.Inten.(mm/hr)=    104.19        55.23
               over (min)       2.00        13.00
     Storage Coeff.  (min)=      1.86 (ii)   12.88 (ii)
     Unit Hyd. Tpeak (min)=      2.00        13.00
     Unit Hyd. peak  (cms)=       .58          .09
                                                          *TOTALS*
     PEAK FLOW       (cms)=       .02          .04           .043 (iii)
     TIME TO PEAK    (hrs)=      1.00         1.15          1.150
     RUNOFF VOLUME    (mm)=     40.94        11.27         15.217
     TOTAL RAINFALL   (mm)=     42.51        42.51         42.514
     RUNOFF COEFFICIENT   =       .96          .27           .358

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20          K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
105:0016-----------------------------------------------------------------------
*#*****************************************************************************
*#                    UNCONTROLLED AREA UNC-4
*#*****************************************************************************
----------------------
| DESIGN NASHYD      |   Area    (ha)=    3.65   Curve Number   (CN)=76.50
| 07:UNC-4  DT= 1.00 |   Ia      (mm)=   4.670   # of Linear Res.(N)= 2.00
----------------------   U.H. Tp(hrs)=    .450

     Unit Hyd Qpeak  (cms)=     .211

     PEAK FLOW       (cms)=     .067 (i)
     TIME TO PEAK    (hrs)=    1.667
     RUNOFF VOLUME    (mm)=   12.360
     TOTAL RAINFALL   (mm)=   42.514
     RUNOFF COEFFICIENT   =     .291

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

-------------------------------------------------------------------------------
105:0017-----------------------------------------------------------------------
------------------------
| ADD HYD (UNC       ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 10:UNC-1          .96      .037    1.20  13.23    .000
                    +ID2 09:UNC-2         1.87      .058    1.25  11.95    .000
                    +ID3 08:UNC-3          .55      .043    1.15  15.22    .000
                    +ID4 07:UNC-4         3.65      .067    1.67  12.36    .000
                     ==========================================================
                     SUM 04:UNC           7.03      .175    1.20  12.59    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
105:0018-----------------------------------------------------------------------
-------------------------------------------------------------------------------
105:0002-----------------------------------------------------------------------
-------------------------------------------------------------------------------
105:0002-----------------------------------------------------------------------
```

```
-------------------------------------------------------------------------------
105:0002-----------------------------------------------------------------------
-------------------------------------------------------------------------------
105:0002-----------------------------------------------------------------------
-------------------------------------------------------------------------------
105:0002-----------------------------------------------------------------------
 ** END OF RUN : 199

******************************************************************************






--------------------
| START            |  Project  dir.: C:\SWMHYMO\
--------------------  Rainfall dir.: C:\SWMHYMO\
   TZERO =   .00 hrs on       0
   METOUT=   2 (output = METRIC)
   NRUN  = 200
   NSTORM=   1
          #  1=OT3CHhyr.stm
-------------------------------------------------------------------------------
200:0002-----------------------------------------------------------------------
*#*****************************************************************************
*#  Project Name: [Derry Side Road Subdivision]    Project Number: [160401279]
*#  Date        : 09-13-2017
*#  Modeller    : [AMP]
*#  Company     : Stantec Consulting Ltd. 604
*#  License #   :  3824306
*#*****************************************************************************
-------------------------------------------------------------------------------
200:0002-----------------------------------------------------------------------
----------------------
| DEFAULT VALUES     |  Filename: C:\SWMHYMO\OTTAWA.VAL
----------------------  ICASEdv = 1 (read and print data)
     FileTitle= File comment: [2005 City of Ottawa Sewer Design Guideline]
                PARAMETERS USED IN THE DESIGN STANDHYD COMMAND FOR OTTAWA.
     Horton's infiltration equation parameters:
     [Fo= 76.20 mm/hr] [Fc=13.20 mm/hr] [DCAY= 4.14 /hr] [F=  .00 mm]
     Parameters for PERVIOUS surfaces in STANDHYD:
     [IAper=   4.67 mm] [LGP=40.00 m] [MNP= .250]
     Parameters for IMPERVIOUS surfaces in STANDHYD:
     [IAimp=  1.57 mm] [CLI= 1.50]   [MNI= .013]
     Parameters used in NASHYD:
     [Ia=   4.67 mm] [N= 2.00]
-------------------------------------------------------------------------------
200:0003-----------------------------------------------------------------------
--------------------
| READ STORM       |    Filename: 100yr CHICAGO STORM, 3hr, DT=10min
| Ptotal=  71.66 mm|    Comments: 100yr CHICAGO STORM, 3hr, DT=10min
--------------------
              TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
               hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
               .17   6.046 |  1.00 178.559 |  1.83  11.059 |  2.67   5.760
               .33   7.542 |  1.17  54.049 |  2.00   9.285 |  2.83   5.280
               .50  10.159 |  1.33  27.319 |  2.17   8.024 |  3.00   4.879
               .67  15.969 |  1.50  18.240 |  2.33   7.080 |
               .83  40.655 |  1.67  13.737 |  2.50   6.347 |

-------------------------------------------------------------------------------
200:0004-----------------------------------------------------------------------
*#****************************************************************************
*#
*#          DERRY SIDE ROAD SUBDIVISION - POST DEVELOPMENT CONDITIONS
*#*****************************************************************************
*# STORM: 12hr SCS Storms, 3hr Chicago Storms
*# City of Ottawa 2004 IDF Parameters
*#-----------------------------------------------------------------------------
*#  - Average CN values for each catchment were initially calculated on typical
*#      AMC II conditions based on hydrologic soil group and land use. CN values
*#      were subsequently modified using the SCS Modified Curve Number Calculations
*#  - Soils information for the site area was obtained from exp's
*#      Geotechnical Investigation dated July 21, 2017.
*#  - CN values calculated based on lawns, woodland and impervious areas
*#  - NASHYD command used for catchments with TIMP<20%
*#  - Time to peak for each catchment was estimated based on Tp = 0.67*Tc and
*#      Tc values were calculated using the Uplands Method
*#*****************************************************************************
*#                    AREA A1 TO SWM 1
*#*****************************************************************************
----------------------
| DESIGN NASHYD      |   Area    (ha)=    1.73   Curve Number   (CN)=79.20
| 01:A1     DT= 1.00 |   Ia      (mm)=   4.670   # of Linear Res.(N)= 2.00
----------------------   U.H. Tp(hrs)=    .230

     Unit Hyd Qpeak  (cms)=     .195

     PEAK FLOW       (cms)=     .145 (i)
     TIME TO PEAK    (hrs)=    1.283
     RUNOFF VOLUME    (mm)=   33.569
     TOTAL RAINFALL   (mm)=   71.665
     RUNOFF COEFFICIENT   =     .468

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

-------------------------------------------------------------------------------
200:0005-----------------------------------------------------------------------
*#*****************************************************************************
*#                    AREA A2 TO SWM 1
*#*****************************************************************************
----------------------
| DESIGN NASHYD      |   Area    (ha)=    1.88   Curve Number   (CN)=78.30
| 02:A2     DT= 1.00 |   Ia      (mm)=   4.670   # of Linear Res.(N)= 2.00
----------------------   U.H. Tp(hrs)=    .280

     Unit Hyd Qpeak  (cms)=     .174

     PEAK FLOW       (cms)=     .134 (i)
     TIME TO PEAK    (hrs)=    1.367
     RUNOFF VOLUME    (mm)=   32.669
     TOTAL RAINFALL   (mm)=   71.665
     RUNOFF COEFFICIENT   =     .456

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

-------------------------------------------------------------------------------
200:0006-----------------------------------------------------------------------
------------------------
| ADD HYD (TOSWM1    ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 01:A1            1.73      .145    1.28  33.57    .000
                    +ID2 02:A2            1.88      .134    1.37  32.67    .000
                     ==========================================================
                     SUM 06:TOSWM1        3.61      .277    1.33  33.10    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
200:0007-----------------------------------------------------------------------
--------------------
| COMPUTE VOLUME   |
| ID:06  (TOSWM1)  |             DISCHARGE      TIME
--------------------               (cms)       (hrs)
          START CONTROLLING AT     .011        .849
```

```
           INFLOW HYD. PEAKS AT     .277       1.333
           STOP  CONTROLLING AT     .185       1.784

           REQUIRED STORAGE VOLUME (ha.m.)=    .0362
           TOTAL HYDROGRAPH VOLUME (ha.m.)=    .1195
           % OF HYDROGRAPH TO STORE       =  30.2814

           NOTE:  Storage was computed to reduce the Inflow
                  peak to     .185  (cms).

 -----------------------------------------------------------------------------
 200:0008---------------------------------------------------------------------
 *#****************************************************************************
 *#                     AREA A3 TO SWM 2
 *#****************************************************************************
 ---------------------
 | DESIGN NASHYD      |   Area    (ha)=    1.33   Curve Number   (CN)=78.30
 | 01:A3     DT= 1.00 |   Ia      (mm)=   4.670   # of Linear Res.(N)= 2.00
 ---------------------    U.H. Tp(hrs)=    .180

      Unit Hyd Qpeak  (cms)=     .192

      PEAK FLOW       (cms)=     .127 (i)
      TIME TO PEAK    (hrs)=    1.217
      RUNOFF VOLUME    (mm)=   32.669
      TOTAL RAINFALL   (mm)=   71.665
      RUNOFF COEFFICIENT   =     .456

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

 -----------------------------------------------------------------------------
 200:0009---------------------------------------------------------------------
 *#****************************************************************************
 *#                     AREA A4 TO SWM 2
 *#****************************************************************************
 ---------------------
 | DESIGN NASHYD      |   Area    (ha)=    2.71   Curve Number   (CN)=78.30
 | 02:A4     DT= 1.00 |   Ia      (mm)=   4.670   # of Linear Res.(N)= 2.00
 ---------------------    U.H. Tp(hrs)=    .180

      Unit Hyd Qpeak  (cms)=     .391

      PEAK FLOW       (cms)=     .258 (i)
      TIME TO PEAK    (hrs)=    1.217
      RUNOFF VOLUME    (mm)=   32.669
      TOTAL RAINFALL   (mm)=   71.665
      RUNOFF COEFFICIENT   =     .456

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

 -----------------------------------------------------------------------------
 200:0010---------------------------------------------------------------------
 *#****************************************************************************
 *#                     AREA A5 TO SWM 2
 *#****************************************************************************
 ---------------------
 | DESIGN NASHYD      |   Area    (ha)=    1.43   Curve Number   (CN)=78.30
 | 03:A5     DT= 1.00 |   Ia      (mm)=   4.670   # of Linear Res.(N)= 2.00
 ---------------------    U.H. Tp(hrs)=    .250

      Unit Hyd Qpeak  (cms)=     .148

      PEAK FLOW       (cms)=     .110 (i)
      TIME TO PEAK    (hrs)=    1.333
      RUNOFF VOLUME    (mm)=   32.669
      TOTAL RAINFALL   (mm)=   71.665
      RUNOFF COEFFICIENT   =     .456

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

 -----------------------------------------------------------------------------
 200:0011---------------------------------------------------------------------
 -----------------------
 | ADD HYD (TOSWM2    ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
 -----------------------                   (ha)     (cms)   (hrs)   (mm)   (cms)
                      ID1 01:A3            1.33      .127    1.22  32.67    .000
                     +ID2 02:A4            2.71      .258    1.22  32.67    .000
                     +ID3 03:A5            1.43      .110    1.33  32.67    .000
                      =======================================================
                      SUM 05:TOSWM2        5.47      .491    1.23  32.67    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 -----------------------------------------------------------------------------
 200:0012---------------------------------------------------------------------
 -------------------
 | COMPUTE VOLUME    |
 | ID:05  (TOSWM2)  |             DISCHARGE      TIME
 -------------------                (cms)       (hrs)
           START CONTROLLING AT     .011        .791
           INFLOW HYD. PEAKS AT     .491       1.233
           STOP  CONTROLLING AT     .185       1.955

           REQUIRED STORAGE VOLUME (ha.m.)=    .0888
           TOTAL HYDROGRAPH VOLUME (ha.m.)=    .1787
           % OF HYDROGRAPH TO STORE       =  49.6948

           NOTE:  Storage was computed to reduce the Inflow
                  peak to     .185  (cms).

 -----------------------------------------------------------------------------
 200:0013---------------------------------------------------------------------
 *#****************************************************************************
 *#                     UNCONTROLLED AREA UNC-1
 *#****************************************************************************
 ---------------------
 | DESIGN NASHYD      |   Area    (ha)=     .96   Curve Number   (CN)=78.30
 | 10:UNC-1  DT= 1.00 |   Ia      (mm)=   4.670   # of Linear Res.(N)= 2.00
 ---------------------    U.H. Tp(hrs)=    .160

      Unit Hyd Qpeak  (cms)=     .156

      PEAK FLOW       (cms)=     .099 (i)
      TIME TO PEAK    (hrs)=    1.183
      RUNOFF VOLUME    (mm)=   32.668
      TOTAL RAINFALL   (mm)=   71.665
      RUNOFF COEFFICIENT   =     .456

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

 -----------------------------------------------------------------------------
 200:0014---------------------------------------------------------------------
 *#****************************************************************************
 *#                     UNCONTROLLED AREA UNC-2
 *#****************************************************************************
 ---------------------
 | DESIGN NASHYD      |   Area    (ha)=    1.87   Curve Number   (CN)=75.60
 | 09:UNC-2  DT= 1.00 |   Ia      (mm)=   4.670   # of Linear Res.(N)= 2.00
 ---------------------    U.H. Tp(hrs)=    .190

      Unit Hyd Qpeak  (cms)=     .255

      PEAK FLOW       (cms)=     .157 (i)
      TIME TO PEAK    (hrs)=    1.233
      RUNOFF VOLUME    (mm)=   30.128
      TOTAL RAINFALL   (mm)=   71.665
      RUNOFF COEFFICIENT   =     .420

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

 -----------------------------------------------------------------------------
 200:0015---------------------------------------------------------------------
 *#****************************************************************************
 *#                     UNCONTROLLED AREA UNC-3
 *#****************************************************************************
 ---------------------
 | DESIGN STANDHYD    |   Area    (ha)=     .55
 | 08:UNC-3  DT= 1.00 |   Total Imp(%)=   24.20   Dir. Conn.(%)=   13.30
 ---------------------
                                 IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=        .13           .42
      Dep. Storage     (mm)=       1.57          4.67
      Average Slope     (%)=       1.00          1.00
      Length            (m)=      60.55         40.00
      Mannings n          =        .013          .250

      Max.eff.Inten.(mm/hr)=     178.56        170.71
               over (min)          1.00          9.00
      Storage Coeff.  (min)=       1.50 (ii)     8.52 (ii)
      Unit Hyd. Tpeak (min)=       1.00          9.00
      Unit Hyd. peak  (cms)=        .83           .13
                                                              *TOTALS*
      PEAK FLOW       (cms)=        .04           .12           .129 (iii)
      TIME TO PEAK    (hrs)=       1.00          1.08          1.083
      RUNOFF VOLUME    (mm)=      70.09         33.11         38.030
      TOTAL RAINFALL   (mm)=      71.66         71.66         71.665
      RUNOFF COEFFICIENT   =        .98           .46           .531

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
             Fo   (mm/hr)= 76.20           K  (1/hr)=  4.14
             Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=   .00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 -----------------------------------------------------------------------------
 200:0016---------------------------------------------------------------------
 *#****************************************************************************
 *#                     UNCONTROLLED AREA UNC-4
 *#****************************************************************************
 ---------------------
 | DESIGN NASHYD      |   Area    (ha)=    3.65   Curve Number   (CN)=76.50
 | 07:UNC-4  DT= 1.00 |   Ia      (mm)=   4.670   # of Linear Res.(N)= 2.00
 ---------------------    U.H. Tp(hrs)=    .450

      Unit Hyd Qpeak  (cms)=     .211

      PEAK FLOW       (cms)=     .175 (i)
      TIME TO PEAK    (hrs)=    1.617
      RUNOFF VOLUME    (mm)=   30.949
      TOTAL RAINFALL   (mm)=   71.665
      RUNOFF COEFFICIENT   =     .432

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

 -----------------------------------------------------------------------------
 200:0017---------------------------------------------------------------------
 -----------------------
 | ADD HYD (UNC       ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
 -----------------------                   (ha)     (cms)   (hrs)   (mm)   (cms)
                      ID1 10:UNC-1          .96      .099    1.18  32.67    .000
                     +ID2 09:UNC-2         1.87      .157    1.23  30.13    .000
                     +ID3 08:UNC-3          .55      .129    1.08  38.03    .000
                     +ID4 07:UNC-4         3.65      .175    1.62  30.95    .000
                      =======================================================
                      SUM 04:UNC           7.03      .465    1.17  31.52    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 -----------------------------------------------------------------------------
 200:0018---------------------------------------------------------------------
 -----------------------------------------------------------------------------
 200:0002---------------------------------------------------------------------
 -----------------------------------------------------------------------------
 200:0002---------------------------------------------------------------------
 -----------------------------------------------------------------------------
 200:0002---------------------------------------------------------------------
 -----------------------------------------------------------------------------
 200:0002---------------------------------------------------------------------
 -----------------------------------------------------------------------------
 200:0002---------------------------------------------------------------------
 -----------------------------------------------------------------------------
 200:0002---------------------------------------------------------------------
       FINISH
 -----------------------------------------------------------------------------
 ******************************************************************************
      WARNINGS / ERRORS / NOTES
      -------------------------
 001:0007 COMPUTE VOLUME
       *** WARNING: No storage required, RelRate > Inflow Qp.
 001:0012 COMPUTE VOLUME
       *** WARNING: No storage required, RelRate > Inflow Qp.
 002:0007 COMPUTE VOLUME
       *** WARNING: No storage required, RelRate > Inflow Qp.
 002:0012 COMPUTE VOLUME
       *** WARNING: No storage required, RelRate > Inflow Qp.
 005:0007 COMPUTE VOLUME
       *** WARNING: No storage required, RelRate > Inflow Qp.
       *** WARNING: No storage required, RelRate > Inflow Qp.
 102:0012 COMPUTE VOLUME
       *** WARNING: No storage required, RelRate > Inflow Qp.
 105:0007 COMPUTE VOLUME
       *** WARNING: No storage required, RelRate > Inflow Qp.
   Simulation ended on 2017-09-15     at 09:45:32
 ==============================================================================
```

Appendix C PRELIMINARY CDS SIZING

CONTECH ENGINEERED SOLUTIONS

INLINE
HYDRAULIC CALCULATIONS
DERRY SIDE ROAD SUBDIVISION
BECKWITH, ON
570627-10

OGS #1

CDS

DESIGN PARAMETERS

CDS Model No. = CDS3020

Design Treatment Flow = **2.0** cfs

Peak Design Flow = 3.18 cfs

Peak Design Return Interval = 2 year

Rim Elevation @ US Structure 432.41 ft

DETAILED CALCULATIONS

TREATMENT FLOW

Tailwater Condition at Outfall, EL_0

EL_0 = 431.29 ft (invert plus depth of flow at D/S outlet)

Exit Loss from DownStream Pipe, h_1

$h_1 = k * [V^2 / (2*g)]$

where,

k = 1.00

$V = Q / A_F$

= 3.82 fps

h_1 = 0.23 ft

$EGL_1 = EL_0 + h_1$

= 431.51 ft

Head Loss Through Downstream Pipe, h_2

Friction Losses, h_2

$h_2 = S_{EGL} * L$

where,

L = 52.4934 ft

$S_{EGL} = [(Q * n) / (1.49 * A_F * R^{2/3})]^2$

where,

Pipe Characteristics

Dia. = 12 in

S_{PIPE} = 0.0035 ft/ft

n = 0.01

Flow Characteristics

d_F = 0.63 ft

A_F = 0.52 sf

P_W = 1.84 ft

R = 0.28 ft

Head Loss Through Downstream Pipe, h_2 (cont.'d)

S_{EGL} = 0.00351 ft / ft

h_2 = 0.1840 ft

$EGL_2' = EGL_1 + h_2$

= 431.70 ft

Check Entrance Condition for Critical Depth Control

$EL_{CDS\ Inv.}$ = 430.84 ft

d_c = 0.59 ft

$EGL_C = EL_{CDS\ Inv.} + d_c + V_{dc}^2 / (2*g)$

= 431.70 ft

Identify Controling EGL

Friction based EGL controls.

EGL_2 = 431.70 ft

Re-entry Loss into DownStream Pipe, h_3

$h_3 = k * [V^2 / (2*g)]$

where,

k = 0.20

V = Q / A

= 3.82 fps (area based on flow depth)

h_3 = 0.05 ft

$EGL_3' = EGL_2 + h_3$

= 431.74 ft

Oil Baffle Loss, h_4

$h_4 = k * [V^2 / (2*g)]$

where,

k = 1.00

A_{Baffle} = **6.49** sf

V = Q / Abaffle

= 0.31 fps

h_4 = 0.0015 ft

$EGL_4 = EGL_3 + h_4$

= 431.74 ft

Check Standard Weir Elevation

HL_{CDS} = 0.50 ft

$EL_W' = EGL_4 + HL_{CDS}$

= 432.24 ft

$H_W' = EL_W' - EL_{CDS\ INV.}$

= 1.41 ft, or 16.88 in

Std. Weir Height = 17.0 in

Status **OK**

Use H_W = **17** in, or 1.42 ft

$EL_W = EL_{CDS\ INV.} + H_W$

= 432.26 ft

PEAK CONVEYANCE FLOW

Tailwater Condition at Outfall, EL_0

EL_0 = **431.65** ft (invert plus depth of flow at D/S outlet)

Exit Loss from DownStream Pipe, h_1

$h_1 = k * [V^2 / (2*g)]$

where,

k = 1.00

$V = Q / A_F$

= 4.05 fps

h_1 = 0.25 ft

$EGL_1 = EL_0 + h_1$

= 431.91 ft

Head Loss Through Downstream Pipe, h_2

Friction Losses, h_2

$h_2 = S_{EGL} * L$

where,

L = 52.4934 ft

$S_{EGL} = [(Q * n) / (1.49 * A_F * R^{2/3})]^2$

where,

Pipe Characteristics

Dia. = 12 in

S_{PIPE} = 0.0035 ft/ft

n = 0.01

Flow Characteristics

d_n = 1.00 ft

A_F = 0.79 sf

P_W = 3.14 ft

R = 0.25 ft

S_{EGL} = 0.0047 ft / ft

h_2 = 0.25 ft

$EGL_2' = EGL_1 + h_2$

= 432.16 ft

Check Entrance Condition for Critical Depth Control

$EL_{CDS\ Inv.}$ = 430.84 ft

d_c = 0.75 ft

$EGL_C = EL_{CDS\ Inv.} + d_c + V_{dc}^2 / (2*g)$

= 431.98 ft

Identify Controling EGL

Friction based EGL controls.

EGL_2 = 432.16 ft

Re-entry Loss into DownStream Pipe, h_3

$h_3 = k * [V^2 / (2*g)]$

where,

$k =$ 0.20

$V = Q / A_F$

$=$ 4.05 fps (area based on flow depth)

$h_3 =$ 0.05 ft

$EGL_3 = EGL_2 + h_3$

$=$ 432.21 ft

Oil Baffle Loss, h_4

$h_4 = k * [V^2 / (2*g)]$

where,

$k =$ 0.00 (Skirted-baffle model)

$A_{Baffle} =$ 6.49 sf

$V = Q / A_{Baffle}$

$=$ 0.49 fps

$h_4 =$ 0.00 ft

$EGL_4 = EGL_3 + h_4$

$=$ 432.21 ft

$HGL_4 = EGL_4 - [V_P^2 / (2*g)]$

$=$ 431.95 ft

Head over Diversion Weir, h_5

Elevation of Weir

$EL_{Weir} =$ 432.26 ft (established above)

Headloss for Free Discharge Condition

$h_{5a} = [Q / (C * L)]^{2/3}$

where,

$C =$ 3.1

$L =$ 3.00 ft

$h_{5a} =$ 0.49 ft

$EGL_{5a} = EL_{Weir} + h_{5a}$

$=$ 432.75 ft

Headloss for Submerged Condition

$d_{Sub} =$ 0.00 ft (depth of submergence)

$h_{5b} =$ 2.49 ft (separate submerged weir calc.)

$EGL_{5b} = EGL_4 + h_{5b}$

$=$ 434.69 ft

Identify EGL U/S of Weir

The discharge condition is Free, therefore

$EGL_5 =$ 432.75 ft

Expansion Loss from U/S Pipe, h_6

$h_6 = k * [V^2 / (2*g)]$

where,

$k =$ 0.30

$V = Q / A_F$

$=$ 4.05 fps

$h_6 =$ 0.08 ft

$EGL_6 = EGL_5 + h_6$

$=$ 432.82 ft

Head Loss Through Upstream Pipe, h_7

Friction Losses, h_7

$h_7 = S_{EGL} * L$

where,

$L =$ 30.8399 ft

$S_{EGL} = [(Q * n) / (1.49 * A_F * R^{2/3})]^2$

where,

Pipe Characteristics

Dia. = 12 in

$S_{PIPE} =$ 0.0035 ft/ft

$n =$ 0.01

Flow Characteristics

$d_n =$ 1.00 ft

$A_F =$ 0.79 sf

$P_W =$ 3.14 ft

$R =$ 0.25 ft

$S_{EGL} =$ 0.0047 ft / ft

$h_7 =$ 0.14 ft

$EGL_7' = EGL_6 + h_7$

$=$ 432.97 ft

Check Entrance Condition for Critical Depth Control

$EL_{U/S\ Inv.} =$ 430.95 ft

$d_c =$ 0.75 ft

$EGL_C = EL_{CDS\ Inv.} + d_c + V_{dc}^2 / (2*g)$

$=$ 432.09 ft

Identify Controling EGL

Friction based EGL controls.

$EGL_7 =$ 432.97 ft

$HGL_7 = EGL_7 - [V^2 / (2*g)]$

$=$ 432.71 ft

Freeboard = -0.30 ft (at first upstream structure)

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION
BASED ON THE RATIONAL RAINFALL METHOD
BASED ON A FINE PARTICLE SIZE DISTRIBUTION

Project Name:	Derry Side Road Subdivision	**Engineer:**	**Stantec**
Location:	Beckwith, ON	**Contact:**	Ana Paerez, P. Eng.
OGS #:	1	**Report Date:**	14-Sep-17

Area	3.61	ha	**Rainfall Station #**	215	
Weighted C	0.35		**Particle Size Distribution**	FINE	
CDS Model	3020		**CDS Treatment Capacity**	57	l/s

Rainfall Intensity[1] (mm/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (l/s)	Treated Flowrate (l/s)	Operating Rate (%)	Removal Efficiency (%)	Incremental Removal (%)
0.5	9.2%	9.2%	1.8	1.8	3.1	98.0	9.0
1.0	10.6%	19.8%	3.5	3.5	6.2	97.1	10.3
1.5	9.9%	29.7%	5.3	5.3	9.3	96.2	9.5
2.0	8.4%	38.1%	7.0	7.0	12.4	95.3	8.0
2.5	7.7%	45.8%	8.8	8.8	15.5	94.4	7.3
3.0	5.9%	51.7%	10.5	10.5	18.6	93.5	5.6
3.5	4.4%	56.1%	12.3	12.3	21.7	92.6	4.0
4.0	4.7%	60.7%	14.1	14.1	24.8	91.7	4.3
4.5	3.3%	64.0%	15.8	15.8	27.9	90.9	3.0
5.0	3.0%	67.1%	17.6	17.6	31.0	90.0	2.7
6.0	5.4%	72.4%	21.1	21.1	37.2	88.2	4.8
7.0	4.4%	76.8%	24.6	24.6	43.4	86.4	3.8
8.0	3.5%	80.3%	28.1	28.1	49.6	84.6	3.0
9.0	2.8%	83.2%	31.6	31.6	55.8	82.9	2.3
10.0	2.2%	85.3%	35.1	35.1	62.0	81.1	1.8
15.0	7.0%	92.3%	52.7	52.7	93.0	72.2	5.0
20.0	4.5%	96.9%	70.3	56.6	100.0	56.6	2.6
25.0	1.4%	98.3%	87.8	56.6	100.0	45.3	0.7
30.0	0.7%	99.0%	105.4	56.6	100.0	37.7	0.3
35.0	0.5%	99.5%	122.9	56.6	100.0	32.3	0.2
40.0	0.5%	100.0%	140.5	56.6	100.0	28.3	0.2
							88.1

Removal Efficiency Adjustment[2] = 6.5%

Predicted Net Annual Load Removal Efficiency = 81.6%

Predicted % Annual Rainfall Treated = 97.7%

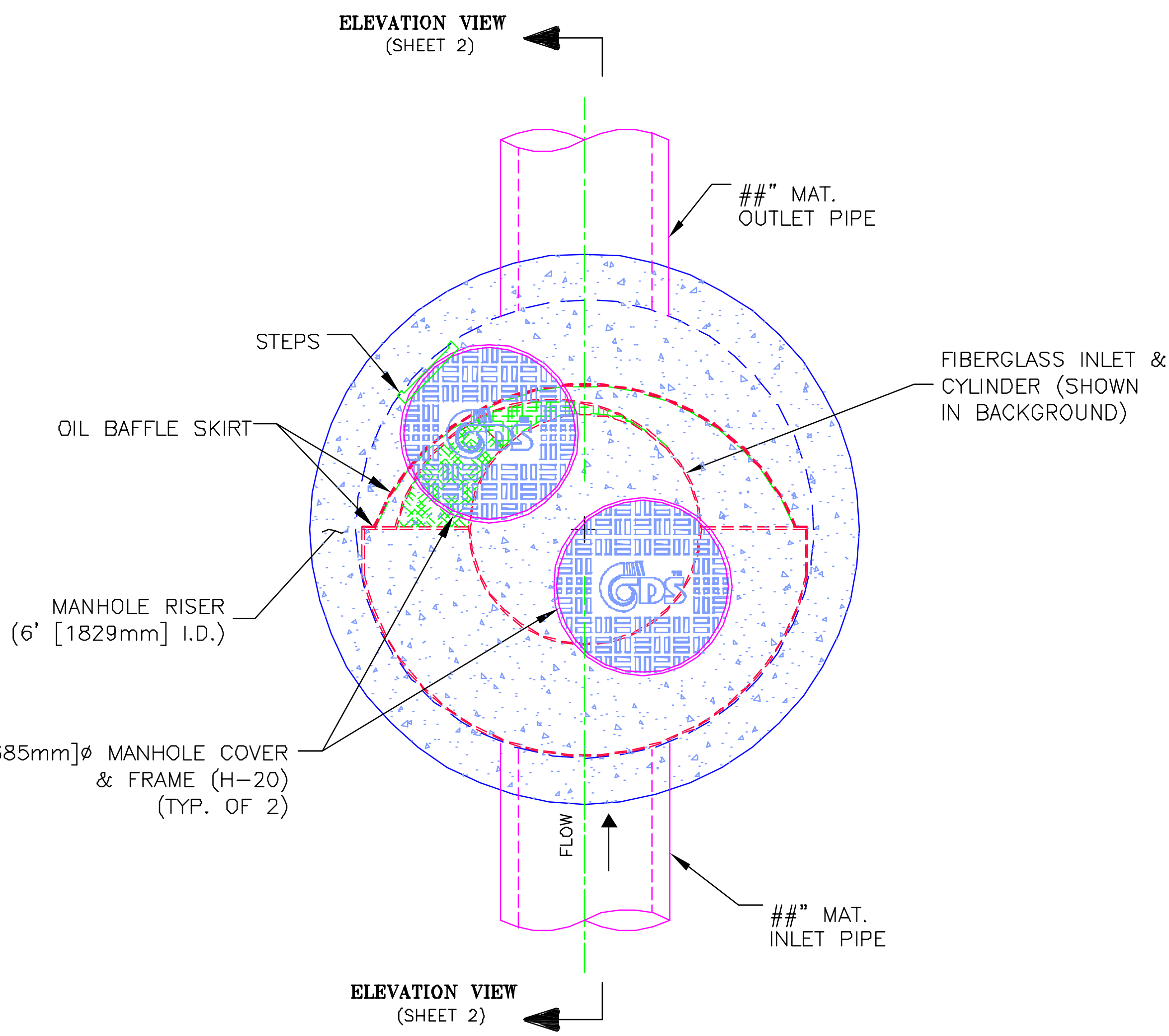
1 - Based on 42 years of hourly rainfall data from Canadian Station 6105976, Ottawa ON

2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

3 - CDS Efficiency based on testing conducted at the University of Central Florida

4 - CDS design flowrate and scaling based on standard manufacturer model & product specifications

PLAN VIEW

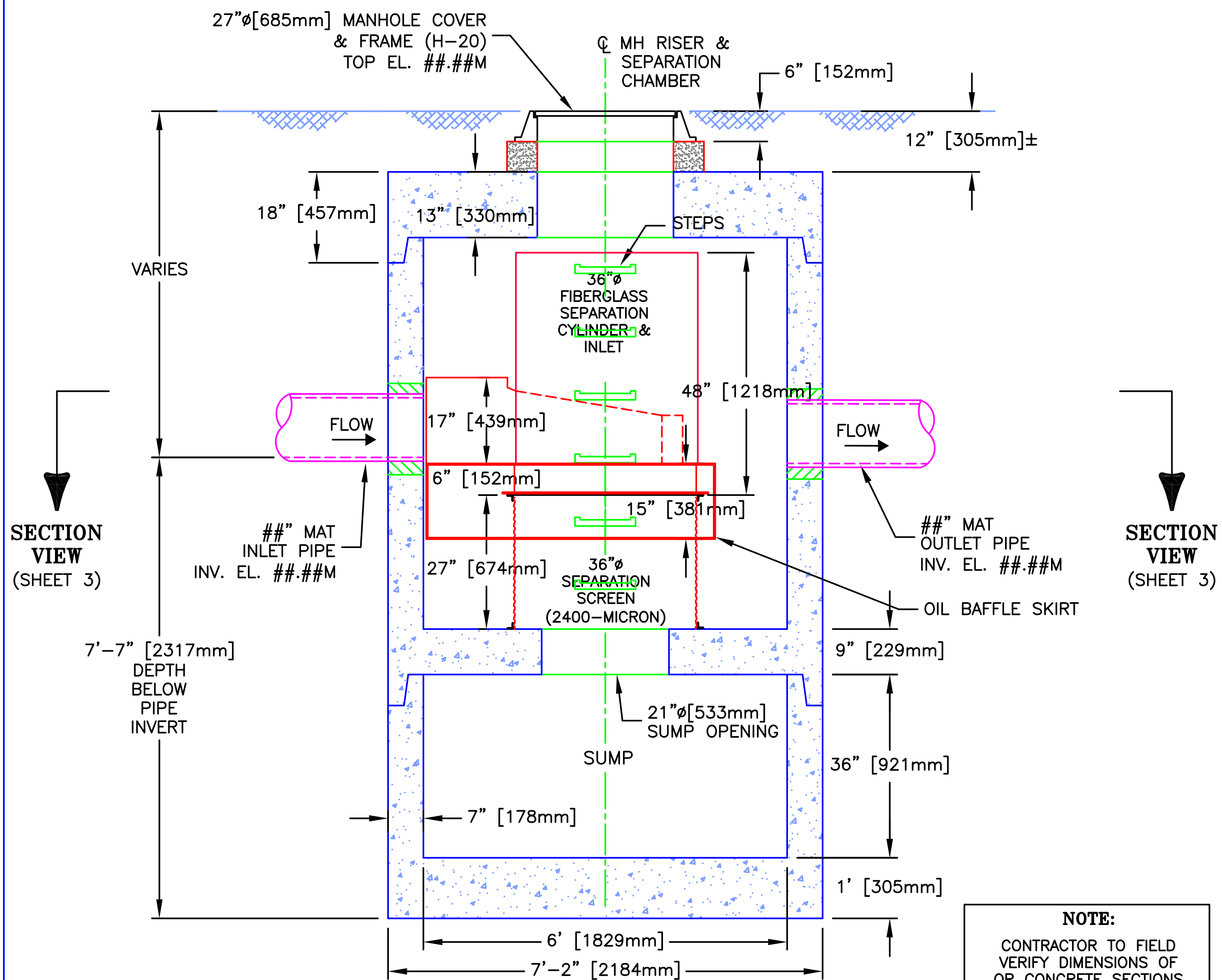


CDS MODEL PMSU30_20m, 2 CFS TREATMENT CAPACITY STORM WATER TREATMENT UNIT

CONTECH STORMWATER SOLUTIONS	PROJECT NAME CITY, STATE	JOB#	CAN-##-###	SCALE 1" = 2.5'
		DATE	##/##/##	SHEET
		DRAWN	INITIALS	1
		APPROV.		

Echelon Environmental 505 Hood Road, Unit 26, Markham, Ontario L3R 5V6 Tel: (905) 948-0000 Fax: (905) 948-0577
CONTECH Stormwater Solutions Inc. 930 Woodcock Road, Suite 101, Orlando, Florida 32803 Tel: (800) 848-9955

ELEVATION VIEW



NOTE:
CONTRACTOR TO FIELD VERIFY DIMENSIONS OF OR CONCRETE SECTIONS

CDS MODEL PMSU30_20m, 2 CFS TREATMENT CAPACITY STORM WATER TREATMENT UNIT

CONTECH STORMWATER SOLUTIONS	PROJECT NAME CITY, STATE	JOB#	CAN-##-###	SCALE 1" = 3'
		DATE	##/##/##	SHEET 2
		DRAWN	INITIALS	
		APPROV.		

Echelon Environmental 505 Hood Road, Unit 26, Markham, Ontario L3R 5V6 Tel: (905) 948-0000 Fax: (905) 948-0577
CONTECH Stormwater Solutions Inc. 930 Woodcock Road, Suite 101, Orlando, Florida 32803 Tel: (800) 848-9955

INLINE
HYDRAULIC CALCULATIONS
DERRY SIDE ROAD SUBDIVISION
BECKWITH, ON
570627-20
OGS #2

DESIGN PARAMETERS

CDS Model No. =	CDS3030	
Design Treatment Flow =	3.0	cfs
Peak Design Flow =	4.45	cfs
Peak Design Return Interval =	2	year
Rim Elevation @ US Structure	432.09	ft

DETAILED CALCULATIONS

<u>TREATMENT FLOW</u>

Tailwater Condition at Outfall, EL_0

EL_0 = 431.29 ft (invert plus depth of flow at D/S outlet)

Exit Loss from DownStream Pipe, h_1

$h_1 = k * [V^2 / (2*g)]$

where,

k = 1.00

$V = Q / A_F$

= 3.82 fps

h_1 = 0.23 ft

$EGL_1 = EL_0 + h_1$

= 431.52 ft

Head Loss Through Downstream Pipe, h_2

Friction Losses, h_2

$h_2 = S_{EGL} * L$

where,

L = 52.4934 ft

$S_{EGL} = [(Q * n) / (1.49 * A_F * R^{2/3})]^2$

where,

Pipe Characteristics

Dia. =	12	in
S_{PIPE} =	0.0035	ft/ft
n =	0.01	

Flow Characteristics

d_F =	1.00	ft
A_F =	0.79	sf
P_W =	3.14	ft
R =	0.25	ft

Head Loss Through Downstream Pipe, h_2 (cont.'d)

S_{EGL} = 0.00418 ft / ft

h_2 = 0.2194 ft

$EGL_2' = EGL_1 + h_2$
= 431.74 ft

Check Entrance Condition for Critical Depth Control

$EL_{CDS\ Inv.}$ = 430.48 ft

d_c = 0.73 ft

$EGL_C = EL_{CDS\ Inv.} + d_c + V_{dc}^2 / (2*g)$
= 431.58 ft

Identify Controling EGL

Friction based EGL controls.
EGL_2 = 431.74 ft

Re-entry Loss into DownStream Pipe, h_3

$h_3 = k * [V^2 / (2*g)]$

where,
k = 0.20
V = Q / A
= 3.82 fps (area based on flow depth)

h_3 = 0.05 ft

$EGL_3' = EGL_2 + h_3$
= 431.79 ft

Oil Baffle Loss, h_4

$h_4 = k * [V^2 / (2*g)]$

where,
k = 1.00
A_{Baffle} = **6.49** sf
V = Q / Abaffle
= 0.46 fps

h_4 = 0.0033 ft
$EGL_4 = EGL_3 + h_4$
= 431.79 ft

Check Standard Weir Elevation

HL_{CDS} = 0.67 ft

$EL_W' = EGL_4 + HL_{CDS}$
= 432.46 ft

$H_W' = EL_W' - EL_{CDS\ INV.}$
= 1.98 ft, or 23.77 in

Std. Weir Height = 21.0 in
Status **Modify Std Height**

Use H_W = **24** in, or 1.98 ft

$EL_W = EL_{CDS\ INV.} + H_W$
= 432.46 ft

PEAK CONVEYANCE FLOW

Tailwater Condition at Outfall, EL_0

EL_0 = **431.29** ft (invert plus depth of flow at D/S outlet)

Exit Loss from DownStream Pipe, h_1

$h_1 = k * [V^2 / (2*g)]$

where,

k = 1.00

$V = Q / A_F$

= 5.67 fps

h_1 = 0.50 ft

$EGL_1 = EL_0 + h_1$

= 431.79 ft

Head Loss Through Downstream Pipe, h_2

Friction Losses, h_2

$h_2 = S_{EGL} * L$

where,

L = 52.4934 ft

$S_{EGL} = [(Q * n) / (1.49 * A_F * R^{2/3})]^2$

where,

Pipe Characteristics

Dia. = 12 in

S_{PIPE} = 0.0035 ft/ft

n = 0.01

Flow Characteristics

d_n = 1.00 ft

A_F = 0.79 sf

P_W = 3.14 ft

R = 0.25 ft

S_{EGL} = 0.0092 ft / ft

h_2 = 0.48 ft

$EGL_2' = EGL_1 + h_2$

= 432.28 ft

Check Entrance Condition for Critical Depth Control

$EL_{CDS\ Inv.}$ = 430.48 ft

d_c = 0.89 ft

$EGL_C = EL_{CDS\ Inv.} + d_c + V_{dc}^2 / (2*g)$

= 431.93 ft

Identify Controling EGL

Friction based EGL controls.

EGL_2 = 432.28 ft

Re-entry Loss into DownStream Pipe, h_3

$h_3 = k * [V^2 / (2*g)]$

where,

$k =$ 0.20

$V = Q / A_F$

$=$ 5.67 fps (area based on flow depth)

$h_3 =$ 0.10 ft

$EGL_3 = EGL_2 + h_3$

$=$ 432.38 ft

Oil Baffle Loss, h_4

$h_4 = k * [V^2 / (2*g)]$

where,

$k =$ 0.00 (Skirted-baffle model)

$A_{Baffle} =$ 6.49 sf

$V = Q / A_{Baffle}$

$=$ 0.69 fps

$h_4 =$ 0.00 ft

$EGL_4 = EGL_3 + h_4$

$=$ 432.38 ft

$HGL_4 = EGL_4 - [V_P^2 / (2*g)]$

$=$ 431.88 ft

Head over Diversion Weir, h_5

Elevation of Weir

$EL_{Weir} =$ 432.46 ft (established above)

Headloss for Free Discharge Condition

$h_{5a} = [Q / (C * L)]^{2/3}$

where,

$C =$ 3.1

$L =$ 3.00 ft

$h_{5a} =$ 0.61 ft

$EGL_{5a} = EL_{Weir} + h_{5a}$

$=$ 433.07 ft

Headloss for Submerged Condition

$d_{Sub} =$ 0.00 ft (depth of submergence)

$h_{5b} =$ 0.61 ft (separate submerged weir calc.)

$EGL_{5b} = EGL_4 + h_{5b}$

$=$ 432.99 ft

Identify EGL U/S of Weir

The discharge condition is Free, therefore

$EGL_5 =$ 433.07 ft

Expansion Loss from U/S Pipe, h_6

$h_6 = k * [V^2 / (2*g)]$

where,

$k = 0.30$

$V = Q / A_F$

$= 5.67$ fps

$h_6 = 0.15$ ft

$EGL_6 = EGL_5 + h_6$

$= 433.22$ ft

Head Loss Through Upstream Pipe, h_7

Friction Losses, h_7

$h_7 = S_{EGL} * L$

where,

$L = 30.1837$ ft

$S_{EGL} = [(Q * n) / (1.49 * A_F * R^{2/3})]^2$

where,

Pipe Characteristics

Dia. = 12 in

$S_{PIPE} = 0.0035$ ft/ft

$n = 0.01$

Flow Characteristics

$d_n = 1.00$ ft

$A_F = 0.79$ sf

$P_W = 3.14$ ft

$R = 0.25$ ft

$S_{EGL} = 0.0092$ ft / ft

$h_7 = 0.28$ ft

$EGL_7' = EGL_6 + h_7$

$= 433.50$ ft

Check Entrance Condition for Critical Depth Control

$EL_{U/S\ Inv.} = 430.58$ ft

$d_c = 0.89$ ft

$EGL_C = EL_{CDS\ Inv.} + d_c + V_{dc}{}^2 / (2*g)$

$= 432.04$ ft

Identify Controling EGL

Friction based EGL controls.

$EGL_7 = 433.50$ ft

$HGL_7 = EGL_7 - [V^2 / (2*g)]$

$= 433.00$ ft

Freeboard = -0.91 ft (at first upstream structure)

CONTECH ENGINEERED SOLUTIONS

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION
BASED ON THE RATIONAL RAINFALL METHOD
BASED ON A FINE PARTICLE SIZE DISTRIBUTION

CDS TECHNOLOGIES

Project Name:	Derry Side Road Subdivision	**Engineer:**	**Stantec**
Location:	Beckwith, ON	**Contact:**	Ana Paerez, P. Eng.
OGS #:	2	**Report Date:**	14-Sep-17

Area	5.47	ha	**Rainfall Station #**	215	
Weighted C	0.33		**Particle Size Distribution**	FINE	
CDS Model	3030		**CDS Treatment Capacity**	85	l/s

Rainfall Intensity[1] (mm/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (l/s)	Treated Flowrate (l/s)	Operating Rate (%)	Removal Efficiency (%)	Incremental Removal (%)
0.5	9.2%	9.2%	2.5	2.5	3.0	98.0	9.0
1.0	10.6%	19.8%	5.0	5.0	5.9	97.2	10.3
1.5	9.9%	29.7%	7.5	7.5	8.9	96.3	9.5
2.0	8.4%	38.1%	10.0	10.0	11.8	95.5	8.0
2.5	7.7%	45.8%	12.5	12.5	14.8	94.6	7.3
3.0	5.9%	51.7%	15.1	15.1	17.7	93.8	5.6
3.5	4.4%	56.1%	17.6	17.6	20.7	92.9	4.0
4.0	4.7%	60.7%	20.1	20.1	23.6	92.1	4.3
4.5	3.3%	64.0%	22.6	22.6	26.6	91.2	3.0
5.0	3.0%	67.1%	25.1	25.1	29.5	90.4	2.7
6.0	5.4%	72.4%	30.1	30.1	35.4	88.7	4.8
7.0	4.4%	76.8%	35.1	35.1	41.3	87.0	3.8
8.0	3.5%	80.3%	40.1	40.1	47.3	85.3	3.0
9.0	2.8%	83.2%	45.2	45.2	53.2	83.6	2.4
10.0	2.2%	85.3%	50.2	50.2	59.1	81.9	1.8
15.0	7.0%	92.3%	75.3	75.3	88.6	73.5	5.1
20.0	4.5%	96.9%	100.4	85.0	100.0	59.4	2.7
25.0	1.4%	98.3%	125.5	85.0	100.0	47.5	0.7
30.0	0.7%	99.0%	150.5	85.0	100.0	39.6	0.3
35.0	0.5%	99.5%	175.6	85.0	100.0	34.0	0.2
40.0	0.5%	100.0%	200.7	85.0	100.0	29.7	0.2
							88.6

Removal Efficiency Adjustment[2] = 6.5%

Predicted Net Annual Load Removal Efficiency = 82.1%

Predicted % Annual Rainfall Treated = 98.0%

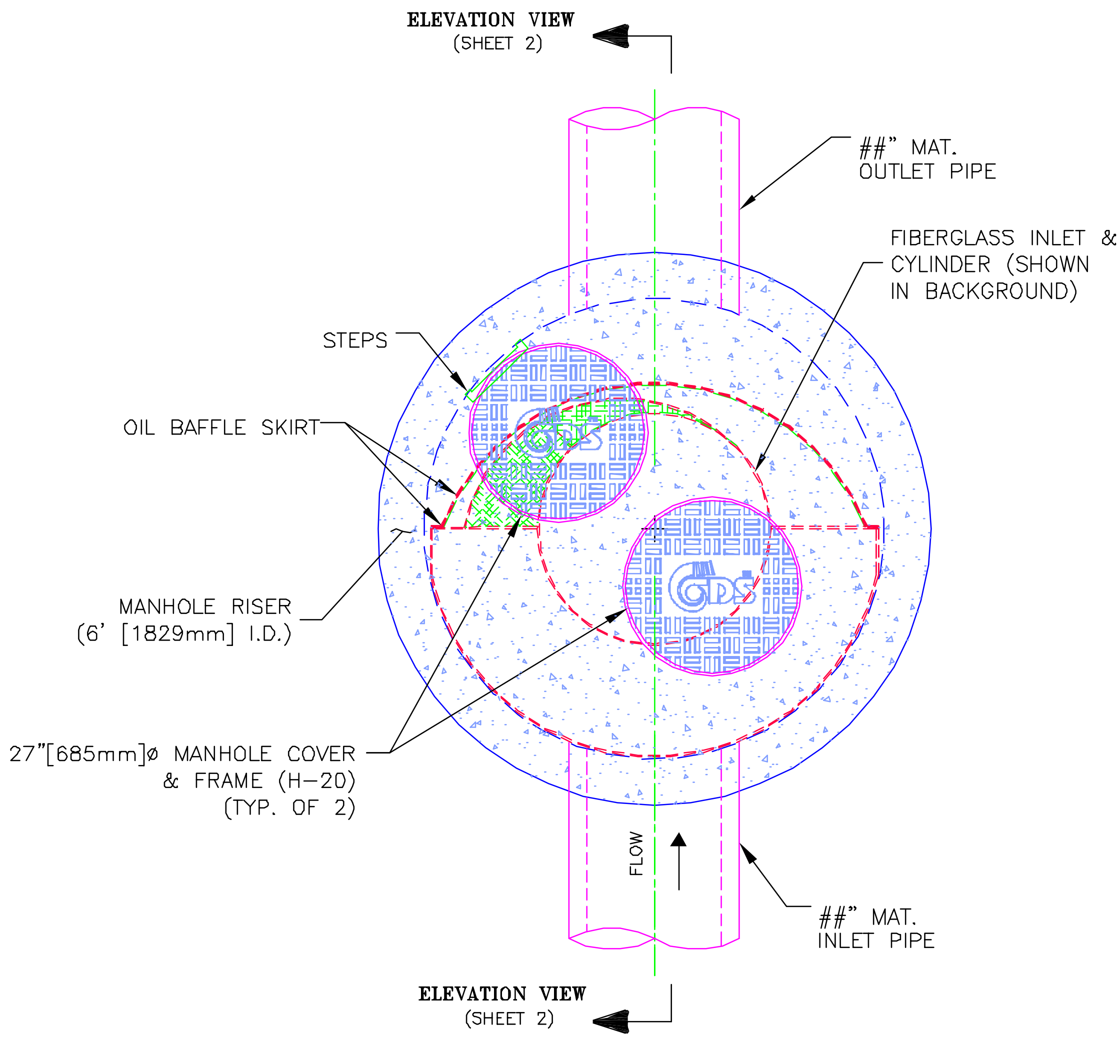
1 - Based on 42 years of hourly rainfall data from Canadian Station 6105976, Ottawa ON

2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

3 - CDS Efficiency based on testing conducted at the University of Central Florida

4 - CDS design flowrate and scaling based on standard manufacturer model & product specifications

PLAN VIEW

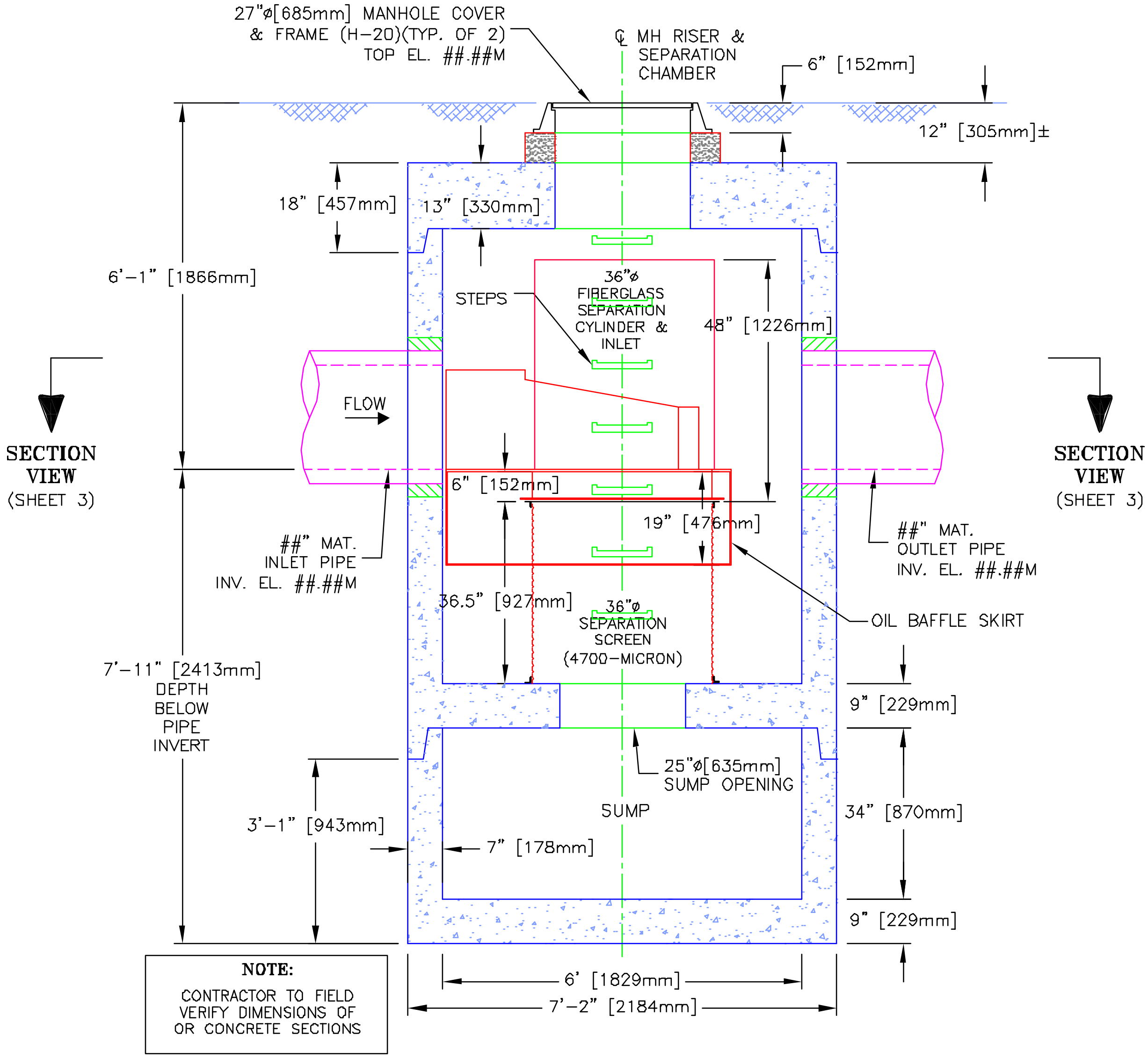


CDS MODEL PMSU30_30m, 3.0 CFS TREATMENT CAPACITY
STORM WATER TREATMENT UNIT

CONTECH STORMWATER SOLUTIONS	PROJECT NAME CITY, STATE	JOB#	CAN-##-###	SCALE 1" = 2.5'
		DATE	##/##/##	SHEET
		DRAWN	INITIALS	1
		APPROV.		

Echelon Environmental 505 Hood Road, Unit 26, Markham, Ontario L3R 5V6 Tel: (905) 948-0000 Fax: (905) 948-0577
CONTECH Stormwater Solutions Inc. 930 Woodcock Road, Suite 101, Orlando, Florida 32803 Tel: (800) 848-9955

ELEVATION VIEW



CDS MODEL PMSU30_30m, 3.0 CFS TREATMENT CAPACITY STORM WATER TREATMENT UNIT

PROJECT NAME CITY, STATE	JOB#	CAN-##-###	SCALE 1" = 3'
	DATE	##/##/##	SHEET
	DRAWN	INITIALS	2
	APPROV.		

Echelon Environmental 505 Hood Road, Unit 26, Markham, Ontario L3R 5V6 Tel: (905) 948-0000 Fax: (905) 948-0577
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Appendix D CONCEPTUAL DRAWINGS