FUNCTIONAL STORMWATER MANAGEMENT REPORT

INFRASTRUCTURE ONTARIO

50 SHERWOOD HEIGHTS DRIVE
Project No.: 2020-0652-10

March 3, 2022

WALTERFEDY
Kitchener | Hamilton | walterfedy.com

INFRASTRUCTURE ONTARIO

FUNCTIONAL STORMWATER MANAGEMENT REPORT
50 Sherwood Heights Drive

Table of Contents

1.0 INTRODUCTION

WalterFedy was retained by Infrastructure Ontario to prepare the following Functional Stormwater Management Report to evaluate a conceptual site development scenario for the lands at 50 Sherwood Heights Drive in the Town of Oakville ("Site") as shown in Figure 1. The Site is proposed on a 7.40 ha undeveloped parcel of land owned by the Ministry of Government and Consumer Services, managed by Infrastructure Ontario. The site is currently vacant with remnants of an approximately 30-car parking lot at the southern end.

A conceptual site plan was prepared to demonstrate the development potential of the subject lands and to provide a framework for the preparation of this study; however, the conceptual site plan is not being submitted for approval. The concept plan was developed for this assessment.

The purpose of this Report is to demonstrate the viability of the presented site layout given recent de-listing of the onsite wet areas and the ability to relocate the drainage channel through the parcel. The concept plan for the Site was developed by GSP Group Ltd. The report presents a potential stormwater management solution to support the development concept.

2.0 EXISTING SITE CONDITIONS

The Site is located close to the Highway 403 and QEW split in Oakville. The site fronts onto Sherwood Heights Drive to the northeast; Kingsway Drive is to the southeast; Ford Drive is to the southwest; and a QEW on-ramp is to the west of the Site. The Ford plant is located on the southern side of Ford Drive. Across from the Site on Sherwood Heights Drive is Kingsford Gardens, which includes a dog park and community garden. Refer to Figure 2 for the existing conditions of the site.

2.1 Existing Topography, Soils, and Hydrogeology

The Site slopes from the northwestern corner to the southeastern corner, with elevations ranging from approximately 143 mamsl near the northwestern corner to 115 mamsl near the southeastern corner. The Site is mostly greenfield, with an approximately 30-car remnant of a parking lot in the southern end fronting Sherwood Heights Drive. Drawing C-100 presents existing conditions at the Site.

A geotechnical investigation for the Site will be completed during detailed design stage if the project progresses. The findings and recommendations of the geotechnical investigation will be incorporated into the detailed design at that time.

The Site is not located in a source water protection area. The Site does not fall within the regulation area of Conservation Halton and, thus, is not within the Conservation Authority's jurisdiction for review.

NRSI identified an unregulated wetland on the site, adjacent to Sherwood Heights Drive and towards the northern portion of the site. Through discussions with the Town of Oakville, Halton Region, and Conservation Halton, it was determined that the area does not meet the minimum threshold requirements to be listed as a wetland.

2.1.1 Storm Servicing

A 600-mm-diameter watermain runs southeasterly on Ford Drive and appears to outlet into a ditch southwest of Ford Drive via a culvert. At the southeastern side of the Site, a natural channel drains surface runoff to a culvert which crosses under Kingsway Drive and outlets into a small stormwater management pond. The pond has an outlet culvert at the southern end.

3.0 SITE GRADING, DRAINAGE, AND STORMWATER MANAGEMENT

3.1 Surface Grading and Drainage

Surface grading would direct stormwater generally from the northwestern end of the site at a higher elevation to the southeastern end of the site at a lower elevation.

Utilizing the Site Plan concept developed by GSP Group, WalterFedy has prepared a conceptual grading design presented on Drawing C-200 . The concept features an opportunity to construct a public green space wetland feature at the western end of the property and provides opportunity to redirect the drainage swale around the development along Sherwood Heights Drive.

It will be necessary to utilize the site's existing outlet as part of any development plan. The culvert under Kingsway Drive should be assessed in detailed design to confirm the size and ensure that the culvert is not failing, blocked, or clogged.

3.2 Stormwater Management

From the Conservation Halton map of the watershed, the site falls within the category of Urban Creeks. The site does not fall within the bounds of a specific subwatershed study and, thus, the constraints for stormwater management are governed by the Town of Oakville *Development Engineering Procedures & Guidelines Manual*.

The Town of Oakville's guidelines are that minor and major drainage need to be controlled to the pre-development conditions. Existing drainage features on the property should be safely convey flows through to an approved outlet without impact to the property itself or surrounding properties, for up to and including the 100-year flows.

There are three stormwater management objectives for the site:

(1) water quality;

(2) water quantity; and

(3) peak flow control

The Town of Oakville typically requires enhanced water quality treatment, in line with the Ministry of the Environment, Conservation and Parks (MECP) requirements. This includes enhanced 80% long-term suspended solids removal.

At a minimum, the site will require that post-development flows are controlled to the pre-development levels for all design storms up to and including the 100-year storm. The site appears to have a single outlet at the southeastern end to a culvert which crosses under Kingsway Drive and outlets to a dry pond. The size of the culvert is not labelled in the information provided by the Town of Oakville. However, this would be the governing factor in determining the peak release rate, as the vast majority of the site is directed to this culvert. The Town of Oakville requires all minor system infrastructure to handle stormwater flows for the 5-year storm event.

The proposed stormwater management approach takes into consideration the amount of fall across the site and utilizes two ponds tiered at different levels across the site. Combined, the ponds provide flow control to attenuate the 100-year, post-development peak flow to less than the pre-development 5-year peak flow. Adequate storage is provided to achieve a 24-hour drawdown time in the ponds prior to discharge from the site. The combined volume of the ponds would feature approximately 3,000 m^3 of active storage volume with an appropriate permanent pool to meet MECP guidelines for Enhanced Water Quality treatment.

The concept provides open space adjacent to buildings which could support placement of infiltration galleries to capture rooftop runoff and then overflow into the storm sewer. It is recommended that detailed design take this opportunity into consideration as the Town has requested in that infiltration be included as part of the strategy to provide stormwater management on site to maintain the site water balance. At a minimum, it is recommended that the infiltration galleries accommodate capture of the first 5 mm of runoff from rooftop areas.

Analysis of the stormwater management system design was completed using Visual OttHymo. Input rainfall parameters for the 2- through 100-year storm events are presented in Table 1. Figure 2 presents the existing conditions drainage area considered to represent the development area within the IO lands at 50 Sherwood Heights. Figure 3 presents the hydrologic model schematic used to represent the existing Site in the model. Input parameters used in the hydrologic model to represent existing conditions are presented in Table 2.

Figure 4 presents the drainage area plan representing proposed conditions. Figure 5 presents the hydrologic model schematic used to represent the Site in the model. Input parameters used in the hydrologic model to represent proposed conditions are presented in Table 2.

Table 3 summarizes the calculated peak flows from each catchment under existing and proposed conditions. Table 4 summarizes the runoff volumes calculated for each catchment under existing and proposed conditions. Table 5 summarizes the routing performance summary of each stormwater management pond under proposed conditions. Design sheets used to calculate the pond volumes and outflow rates are included in Appendix A. Model output is provided in Appendix B.

In general, the stormwater management system incorporates two ponds. The upper pond features an active storage volume of approximately 2,200 cubic metres with an outlet structure comprising an opening 0.2 m by 0.2 m. The lower pond features an active storage volume of approximately 900 cubic metres featuring a staged outlet with a low flow opening 0.1 m by 0.2 m and a high flow outlet 0.2 m by 0.5 m. Combined, the ponds provide a residence time in excess of 24 hours for the 2-year storm event, which is slightly larger than the 25 mm storm event.

3.3 Water Balance

A site water balance was prepared using the methodology provided in the Ministry of the Environment's Stormwater Management Planning and Design Manual (2003). Based on that analysis, it was determined that under existing conditions, the site contributes approximately 7,165 m^3 of groundwater recharge annually. Under proposed conditions, it was determined that the amount of recharge would be reduced to approximately 3,475 m^3. It is commonly required that site development stormwater management plans incorporate infiltration of the first 5 mm of surface runoff. On average, annually in the Oakville region there are 46 unique storm events that have a precipitation accumulation of 5 mm or greater. Capture of the first 5 mm of runoff from the site represents approximately 360 m^3 of available groundwater recharge with each rainfall event. Annually this represents capture and groundwater recharge in excess of 16,000 m^3 of rainfall and, therefore, is able to mitigate for the loss in groundwater recharge resulting from development of the site. A copy of the water balance calculation is provided in Appendix A.

4.0 CONCLUSIONS

Based on the analysis presented in this report, stormwater management for the conceptual layout can be readily achieved to meet municipal and Conservation Authority requirements and outlet to the storm sewer in Ford Drive.

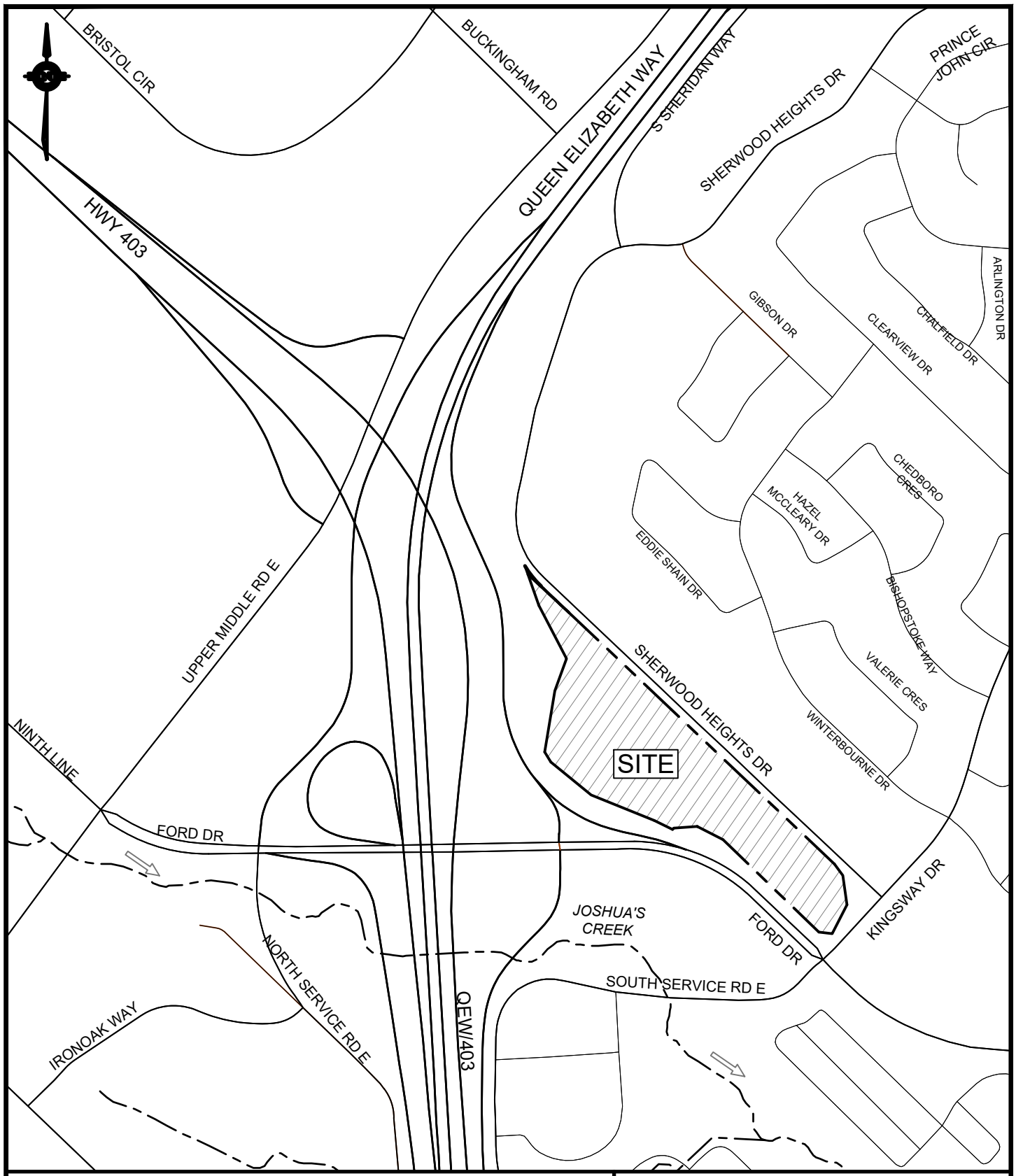
All of which is respectfully submitted,

WALTERFEDY

Brian Verspagen, M.Sc., P.E., P.Eng.
Practice Lead, Water Resources, Civil
Partner

bverspagen@walterfedy.com
519.576.2150 Ext. 331
/ajw

FIGURES



PROJECT:
50 SHERWOOD HEIGHTS DRIVE
OAKVILLE, ON

TITLE:
SITE LOCATION

WALTERFEDY

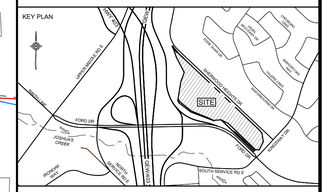
SCALE:	1:8000	DATE:	2021.01.19
DRAWN BY:	K.M.	PROJECT NO.:	2020-0652-10
CHECKED BY:	B.V.	FILE:	2020-0652-10 SITE LOCATION

SHEET NO.:

FIG.1

Ontario
Infrastructure Ontario

KEY PLAN



DATE	ISSUANCE	NO.
2022.01.28	ISSUED FOR PRELIMINARY REVIEW	

LEGEND

EXISTING STORM DRAINAGE AREA

10 — REACH #
0.75 — AREA IN HECTARES
0.2 — RUN OFF COEFFICIENT

CLIENT
INFRASTRUCTURE ONTARIO

PROJECT
DEVELOPMENT CONSTRAINTS ANALYSIS
50 SHERWOOD HEIGHTS DRIVE

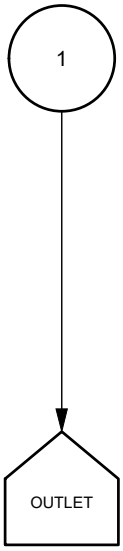
TITLE
EXISTING DRAINAGE AREAS PLAN

WALTERFEDY
KITCHENER HAMILTON 800.685.1378 walterfedy.com

SCALE:	1:1250
DATE:	2022.03.03
PROJECT NO.:	2020-0652-10
CAD FILE:	2020-0652-10 EX AREA
DRAWN BY:	JJ
CHECKED BY:	BV

SHEET NO.:
FIG.2

P:\2020\0652\10\06-DWGS\CIVIL\Working\2020-0652-10 EX AREA, FIG.2, None, Drazen Lepan, 2022-03-03 9:17:05 AM



LEGEND

1234	CATCHMENT
C1234	JUNCTION
ABC	FLOW CONTROL
1000	STORAGE
OUTLET TO LAKE	OUTLET
	CONDUIT
	ROAD

PROJECT:

50 SHERWOOD HEIGHTS DRIVE
DEVELOPMENT CONSTRAINTS ANALYSIS

TITLE:

HYDROLOGIC MODEL SCHEMATIC
EXISTING CONDITIONS

WALTERFEDY

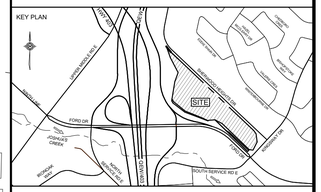
SCALE:	N.T.S.	DATE:	2022.01.28
DRAWN BY:	D.L.	PROJECT NO.:	2020-0652-10
CHECKED BY:	B.V.	FILE:	2020-0652-10 SCH

SHEET NO.:

FIG.3

Ontario
Infrastructure Ontario

KEY PLAN



DATE	ISSUANCE	NO.
2022.01.28	ISSUED FOR PRELIMINARY REVIEW	
2022.02.24	ISSUED FOR ...	

100 — REACH #
0.75 — AREA IN HECTARES
0.2 — RUN OFF COEFFICIENT

DEMONSTRATION PLAN - PRELIMINARY FOR DISCUSSION ONLY

CLIENT
INFRASTRUCTURE ONTARIO

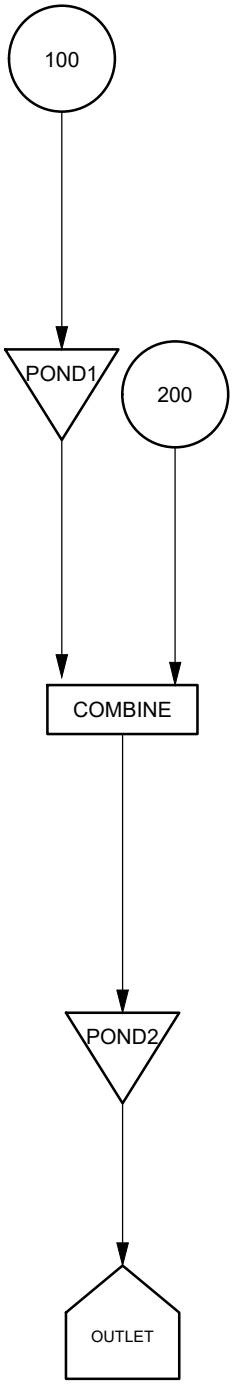
PROJECT
DEVELOPMENT CONSTRAINTS ANALYSIS
50 SHERWOOD HEIGHTS DRIVE

TITLE
PROPOSED DRAINAGE AREA PLAN

WALTERFEDY
KITCHENER HAMILTON 800.685.1378 walterfedy.com

SCALE:	1:1250
DATE:	2022.02.24
PROJECT NO.:	2020-0652-10
CAD FILE:	2020-0652-10 Concept 3-PLT
DRAWN BY:	RN
CHECKED BY:	BV

SHEET NO.:
FIG.4



LEGEND

1234	CATCHMENT
C1234	JUNCTION
ABC	FLOW CONTROL
1000	STORAGE
OUTLET TO LAKE	OUTLET
	CONDUIT
	ROAD

PROJECT:
50 SHERWOOD HEIGHTS DRIVE
DEVELOPMENT CONSTRAINTS ANALYSIS

TITLE:
HYDROLOGIC MODEL SCHEMATIC
PROPOSED CONDITIONS

WALTERFEDY

SCALE:	N.T.S.	DATE:	2022.01.28
DRAWN BY:	D.L.,R.D.	PROJECT NO.:	2020-0652-10
CHECKED BY:	B.V.	FILE:	2020-0652-10 SCH

SHEET NO.:

FIG.5

TABLES

TABLE 1
DESIGN STORM PARAMETERS

INFRASTRUCTURE ONTARIO
SHERWOOD HEIGHTS DRIVE
OAKVILLE, ONTARIO

Design Storm	IDF Storm Parameters			Time to Peak Ratio	Storm Duration	Total Rainfall	Max. Rainfall Intensity
	a	b	c	r	D (hr)	(mm)	(mm/hr)
2-year	725	4.80	0.81	0.33	3	32.1	114.7
5-year	1170	5.80	0.84	0.33	3	42.9	157.4
10-year	1400	5.80	0.85	0.33	3	50.0	186.1
25-year	1680	5.60	0.85	0.33	3	59.1	225.3
50-year	1960	5.80	0.86	0.33	3	65.4	252.6
100-year	2150	5.70	0.86	0.33	3	71.8	279.3

Notes:
(1) Rainfall hyetograph parameters provided in the Town of Oavkille Development Engineering Procedures and Guidelines.

TABLE 2
CATCHMENT PARAMETERS

INFRASTRUCTURE ONTARIO
SHERWOOD HEIGHTS DRIVE
OAKVILLE, ONTARIO

Visual Otthymo Model

Pre-Development Conditions

Subcatchment NHYD	Type	Time Step DT	Area	Curve Number[1]	Intital Abstraction	N hyd	Time to Peak
		(min)	(ha)		(mm)		(hr)
1	NasHyd - 1	10	7.28	80	6.35	3.00	0.2

Post Development Conditions Scenario 1

Subcatchment NHYD	Type	Time Step DT	Area	Impervious Fraction	Curve Number[1]	Loss Methodology	Pervious Slope	Impervious Slope	Pervious Flow Length	Impervious Flow Length
		(min)	(ha)	(-)	(mm)		(%)	(%)	(m)	(m)
100	Urb Hyd	5	5.07	0.60	80	SCS	2.5	2.5	20.0	30.0
200	Urb Hyd	5	2.21	0.40	80	SCS	2.5	2.5	20.0	30.0

Notes
1. Curve number based on pasture, silty-clay/clayey-silt.

TABLE 3
PEAK FLOW COMPARISON

INFRASTRUCTURE ONTARIO
SHERWOOD HEIGHTS DRIVE
OAKVILLE, ONTARIO

Existing Conditions	**Area (Ha)**	**2-Year (m^3/s)**	**5-Year (m^3/s)**	**10-Year (m^3/s)**	**25-Year (m^3/s)**	**50-Year (m^3/s)**	**100-Year (m^3/s)**
Catchments							
1	7.280	0.177	0.368	0.482	0.684	0.835	0.989

Proposed Conditions - Scenario 1	**Area (Ha)**	**2-Year (m^3/s)**	**5-Year (m^3/s)**	**10-Year (m^3/s)**	**25-Year (m^3/s)**	**50-Year (m^3/s)**	**100-Year (m^3/s)**
Catchments							
100	5.070	0.85	1.251	1.494	2.12	2.438	2.756
200	2.210	0.261	0.397	0.477	0.606	0.696	0.786

Outlet	**Area (Ha)**	**2-Year (m^3/s)**	**5-Year (m^3/s)**	**10-Year (m^3/s)**	**25-Year (m^3/s)**	**50-Year (m^3/s)**	**100-Year (m^3/s)**
Existing Conditions	7.280	0.177	0.368	0.482	0.684	0.835	0.989
Proposed Conditions	7.280	0.081	0.118	0.134	0.156	0.172	0.186

TABLE 4
RUNOFF VOLUME COMPARISON

INFRASTRUCTURE ONTARIO
SHERWOOD HEIGHTS DRIVE
OAKVILLE, ONTARIO

Existing Conditions

	Area (Ha)	2-Year (m^3)	5-Year (m^3)	10-Year (m^3)	25-Year (m^3)	50-Year (m^3)	100-Year (m^3)
Catchments							
1	7.280	598	1104	1388	1913	2257	2627

Proposed Conditions - Scenario 1

	Area (Ha)	2-Year (m^3)	5-Year (m^3)	10-Year (m^3)	25-Year (m^3)	50-Year (m^3)	100-Year (m^3)
Catchments							
100	5.070	1180	1702	1970	2439	2734	3045
101	2.210	418	624	732	923	1045	1173

TABLE 5
POND PERFORMANCE SUMMARY

INFRASTRUCTURE ONTARIO
SHERWOOD HEIGHTS DRIVE
OAKVILLE, ONTARIO

Pond Number	Peak Inflow (m^3/s)	Peak Outflow (m^3/s)	Max. Storage Volume (ha m)	Drawdown Time (hr)
Scenario 1 - Pond 1100				
2-Year	0.850	0.087	0.0694	18.5
5-Year	1.251	0.106	0.1077	35.0
10-Year	1.494	0.113	0.1286	44.6
25-Year	2.120	0.125	0.1642	64.4
50-Year	2.438	0.131	0.1885	77.0
100-Year	2.756	0.137	0.2127	90.9
Scenario 1 - Pond 1200				
2-Year	0.314	0.081	0.0664	35.5
5-Year	0.464	0.118	0.0725	35.9
10-Year	0.550	0.134	0.0754	36.0
25-Year	0.691	0.156	0.0842	36.2
50-Year	0.786	0.172	0.0907	36.5
100-Year	0.881	0.186	0.0984	37.1

APPENDIX A

Pond Design Calculations

APPENDIX A
STORMWATER MANAGEMENT POND #1 VO3 INPUTS

INFRASTRUCTURE ONTARIO
SHERWOOD HEIGHTS DRIVE
OAKVILLE, ONTARIO

Stage / Storage

Top of pond = 129
Dead Storage Elevation = 127

Elevation	*Area*	*Depth*	*Total Storage*	*Live Storage*	*Live Storage*
(m)	*(m^2)*	*(m)*	*(m^3)*	*(m^3)*	*(ha·m)*
126.00	256	0.00	0	0	0
127.00	705	1.00	481	0	0.000
127.20	856	1.20	637	156	0.016
127.40	1,006	1.40	823	342	0.034
127.60	1,156	1.60	1,039	558	0.056
127.80	1,306	1.80	1,285	805	0.080
128.00	1,456	2.00	1,561	1,081	0.108
128.20	1,606	2.20	1,868	1,387	0.139
128.40	1,756	2.40	2,204	1,723	0.172
128.60	1,906	2.60	2,570	2,090	0.209
128.80	2,057	2.80	2,967	2,486	0.249
129.00	2,207	3.00	3,393	2,912	0.291

Discharge

Orifice Flow (1)	*Orifice Flow (2)*	*Weir Flow (3)*	*Total Flow from SWMP*	*Total Time to Empty*	*Cumm. Time*	*Cumm. Time*
(m^3/s)	*(m^3/s)*	*(m^3/s)*	*(m^3/s)*	*(hours)*	*(hours)*	*(days)*
0.000	0.000	0.000	0.000			
0.035	0.000	0.000	0.035	2.5	2.5	0.1
0.061	0.000	0.000	0.061	4.0	6.5	0.3
0.079	0.000	0.000	0.079	6.7	13.2	0.6
0.093	0.000	0.000	0.093	9.5	22.7	0.9
0.106	0.000	0.000	0.1059	12.3	34.9	1.5
0.117	0.000	0.000	0.1171	15.2	50.2	2.1
0.127	0.000	0.000	0.1273	18.3	68.5	2.9
0.137	0.000	0.000	0.1367	21.6	90.0	3.8
0.146	0.000	0.000	0.1455	24.9	115.0	4.8
0.154	0.000	0.000	0.1539	28.5	143.4	6.0

Permanent Pool 1,300
Live Storage 2,500

Notes:
Inputs will vary depending on modelling software you choose

*Rectangular Orifice - change cross sectional area calculation for circular orifice

Orifice Flow (1) $Q_{orif} = C \times A \times (2gh_o)^{1/2}$

Height = 0.2 m
Length = 0.2 m
Orifice Invert Elevation = 127.00 m
C = 0.63
A = 0.040 m^2

Orifice Flow (2) $Q_{orif} = C \times A \times (2gh_o)^{1/2}$

Height = 0 m
Length = 0 m
Orifice Invert Elevation = 129.00 m
C = 0.63
A = 0.000 m^2

Weir Flow (3) $Qweir = C \times (2/3)xL \times (2g)^{1/2} xH^{3/2}$

Height = 0.1 m
Length = 0.5 m
Weir Invert Elevation = 129.00 m
C = 1.8

APPENDIX A
STORMWATER MANAGEMENT POND #2 VO3 INPUTS

INFRASTRUCTURE ONTARIO
SHERWOOD HEIGHTS DRIVE
OAKVILLE, ONTARIO

Stage / Storage

Top of pond = 120
Dead Storage Elevation = 119

Elevation	*Area*	*Depth*	*Total Storage*	*Live Storage*	*Live Storage*
(m)	*(m^2)*	*(m)*	*(m^3)*	*(m^3)*	*(ha·m)*
119.00					
119.00	600	0.00	0	0	0.000
119.10	735	0.10	67	67	0.007
119.20	870	0.20	147	147	0.015
119.30	1,005	0.30	241	241	0.024
119.40	1,140	0.40	348	348	0.035
119.50	1,275	0.50	469	469	0.047
119.60	1,410	0.60	603	603	0.060
119.70	1,545	0.70	751	751	0.075
119.80	1,680	0.80	912	912	0.091
119.90	1,815	0.90	1,087	1,087	0.109
120.00	1,950	1.00	1,275	1,275	0.128

Discharge

Orifice Flow (1)	*Orifice Flow (2)*	*Weir Flow (3)*	*Total Flow from SWMP*	*Total Time to Empty*	*Cumm. Time*	*Cumm. Time*
(m^3/s)	*(m^3/s)*	*(m^3/s)*	*(m^3/s)*	*(hours)*	*(hours)*	*(days)*
0.000	0.000	0.000	0.000			
0.012	0.000	0.000	0.012	3.0	3.0	0.1
0.022	0.000	0.000	0.022	4.9	4.9	0.2
0.028	0.000	0.000	0.028	8.3	11.3	0.5
0.033	0.000	0.000	0.033	11.7	16.5	0.7
0.037	0.000	0.000	0.0374	15.2	26.4	1.1
0.041	0.000	0.000	0.0414	18.9	35.4	1.5
0.045	0.088	0.000	0.1332	0.9	36.3	1.5
0.048	0.125	0.000	0.1731	2.2	38.5	1.6
0.051	0.153	0.000	0.2043	3.1	41.7	1.7
0.054	0.176	0.000	0.2309	3.9	45.6	1.9

Permanent Pool	400
Live Storage	1,100

*Rectangular Orifice - change cross sectional area calculation for circular orifice

Orifice Flow (1) $Q_{orif} = C \times A \times (2gh_o)^{1/2}$

Height =	0.1	m
Length =	0.2	m
Orifice Invert Elevation =	119.00	m
C =	0.63	
A =	0.020	m^2

Orifice Flow (2) $Q_{orif} = C \times A \times (2gh_o)^{1/2}$

Height =	0.2	m
Length =	0.5	m
Orifice Invert Elevation =	119.50	m
C =	0.63	
A =	0.100	m^2

Weir Flow (3) $Qweir = C \times (2/3) \times L \times (2g)^{1/2} \times H^{3/2}$

Height =	0.1	m
Length =	0.5	m
Weir Invert Elevation =	120.00	m
C =	1.8	

Notes:
Inputs will vary depending on modelling software you choose

APPENDIX A
WATER BALANCE

INFRASTRUCTURE ONTARIO
SHERWOOD HEIGHTS DRIVE
OAKVILLE, ONTARIO

CATCHMENT INFORMATION

Number	Description	Area (ha)	Percent Impervious	Imperv. Area (ha)
1	Pre-development	7.280	5%	0.364
100	Post-development - Scenario 1	5.070	60%	3.042
200	Post-development - Scenario 1	2.210	40%	0.884

WATER BALANCE SUMMARY - ANNUAL

Pre Development Catchment Water Balance				Infiltration Factor					Average Annual Depth		Output				
Catchment	Land Type	Area (ha)	Soil Type	Soil Group	Topography[1]	Soils[2]	Land Use[3]	Total	Precipitation[4] (mm)	Evapotranspiration[4] (mm)	Average Annual Rainfall (m^3)	Evapotranspiration (m^3)	Precipitation Surplus (m^3)	Groundwater Recharge (m^3)	Annual Runoff Volume (m^3)
1	Pervious	6.9160	Silty Clay	CD	0.2	0.15	0.05	0.4	785	526	54,291	36,378	17,912	7,165	10,747
1	Impervious	0.3640	Silty Clay	CD	0	0	0	0	785	0	2,857	0	2,857	0	2,857
	Total	7.280								**Total**	**57,148**	**36,378**	**20,770**	**7,165**	**13,605**

Post Development Catchment Water Balance				Infiltration Factor					Average Annual Depth		Output				
Catchment	Land Type	Area (ha)	Soil Type	Soil Group	Topography[1]	Soils[2]	Land Use[3]	Total	Precipitation[4] (mm)	Evapotranspiration[4] (mm)	Average Annual Rainfall (m^3)	Evapotranspiration (m^3)	Precipitation Surplus (m^3)	Groundwater Recharge (m^3)	Annual Runoff Volume (m^3)
100	Pervious	2.0280	Silty Clay	CD	0.2	0.15	0.05	0.4	785	526	15,920	10,667	5,253	2,101	3,152
200	Pervious	1.3260	Silty Clay	CD	0.2	0.15	0.05	0.4	785	526	10,409	6,975	3,434	1,374	2,061
100	Impervious	3.0420	Silty Clay	CD	0	0	0	0	785	0	23,880	0	23,880	0	23,880
200	Impervious	0.8840	Silty Clay	CD	0	0	0	0	785	0	6,939	0	6,939	0	6,939
Total Scenario 1		7.280								**Total**	**57,148**	**17,642**	**39,506**	**3,475**	**36,031**

[1] *Values for Pasture and Shrubs*
[2] *Rolling Land, average slope 2.8m to 3.8m/km*
[3] *Light Cover, less than cultivated land (MOE SWM Planning and Design Manual)*
[4] *Mean annual water balance values from NOCSS Table 5.4.2*

Water Balance Mitigation

Number of Days of Rainfall annually with a rainfall event of at least 5mm 46

Mitigation Infiltration Volume (m^3) Scenario 1 3,690
Scenario 2 7,165

Scenario	Site Area (ha)	Pre Infiltration Volume (m^3)	Post Infiltration Volume (m^3)	Required Compensation Volume (m^3)	Capture of 5mm across site (m^3)	Annual Capture of 46 Storms (m^3)
1	7.280	7,165	3,475	3,690	364	16,744

APPENDIX B

Hydrologic Model

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

       V    V   I    SSSSS  U   U    A    L
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
Developed and Distributed by Civica Infrastructure
Copyright 2007 - 2013 Civica Infrastructure
All rights reserved.


                  *****  D E T A I L E D   O U T P U T *****


  Input   filename: C:\Program Files\VO Suite 3.0\VO2\voin.dat

  Output  filename:
C:\Users\bverspagen\AppData\Local\Temp\a87ef0a1-5c36-4da7-a2bb-447f96a8e2
4d\Scenario.out
  Summary filename:
C:\Users\bverspagen\AppData\Local\Temp\a87ef0a1-5c36-4da7-a2bb-447f96a8e2
4d\Scenario.sum


DATE: 02-24-2022                          TIME: 01:50:11

USER:



COMMENTS: ________________________________________________________________


--------------------------------------------------------------------------
---------------------------------
  ****************************
  ** SIMULATION NUMBER:   1 **
  ****************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 725.000
| Ptotal= 33.68 mm |                          B=   4.800
```

```
--------------------                              C=   0.810
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  =  4.00 hrs
                        Storm time step    =  5.00 min
                        Time to peak ratio =  0.33

                  TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME
RAIN
                   hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs
mm/hr
                  0.08    1.85 |  1.08    8.77 |  2.08    5.42 |  3.08
2.50
                  0.17    1.97 |  1.17   13.83 |  2.17    4.91 |  3.17
2.40
                  0.25    2.10 |  1.25   33.68 |  2.25    4.49 |  3.25
2.30
                  0.33    2.26 |  1.33  114.14 |  2.33    4.15 |  3.33
2.22
                  0.42    2.44 |  1.42   43.96 |  2.42    3.85 |  3.42
2.14
                  0.50    2.67 |  1.50   23.44 |  2.50    3.60 |  3.50
2.07
                  0.58    2.94 |  1.58   15.80 |  2.58    3.38 |  3.58
2.00
                  0.67    3.28 |  1.67   11.90 |  2.67    3.19 |  3.67
1.94
                  0.75    3.72 |  1.75    9.56 |  2.75    3.02 |  3.75
1.88
                  0.83    4.31 |  1.83    8.00 |  2.83    2.87 |  3.83
1.83
                  0.92    5.16 |  1.92    6.89 |  2.92    2.73 |  3.92
1.78
                  1.00    6.47 |  2.00    6.07 |  3.00    2.61 |  4.00
1.73


------------------------------------------------------------------------
------
--------------------
| CALIB            |
| NASHYD    (0001) |   Area    (ha)=   7.28   Curve Number   (CN)= 80.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   6.35   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.20

     Unit Hyd Qpeak  (cms)=   1.390

     PEAK FLOW       (cms)=   0.177 (i)
     TIME TO PEAK    (hrs)=   1.583
```

```
     RUNOFF VOLUME    (mm)=   8.210
     TOTAL RAINFALL   (mm)=  33.684
     RUNOFF COEFFICIENT   =   0.244

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

-------------------------------------------------------------------------
------
--------------------
| CALIB            |
| STANDHYD  (0100) |   Area    (ha)=   5.07
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  55.00
--------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       3.04         2.03
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       2.50         2.50
     Length            (m)=     183.85        20.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=     114.14        30.01
               over (min)         5.00        10.00
     Storage Coeff.  (min)=       2.65 (ii)    6.29 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.29         0.15
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.79         0.13          0.850 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.42           1.33
     RUNOFF VOLUME    (mm)=      32.68        11.79          23.28
     TOTAL RAINFALL   (mm)=      33.68        33.68          33.68
     RUNOFF COEFFICIENT   =       0.97         0.35           0.69

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------
------
--------------------
| RESERVOIR (1100) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.1059      0.1080
                          0.0353     0.0160   |   0.1171      0.1390
```

```
                          0.0611     0.0340   |   0.1273      0.1720
                          0.0789     0.0560   |   0.1367      0.2090
                          0.0934     0.0800   |   0.1455      0.2490

                                    AREA     QPEAK     TPEAK       R.V.
                                    (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0100)      5.070      0.850      1.33      23.28
     OUTFLOW: ID= 1 (1100)      5.070      0.087      1.92      23.26

                    PEAK   FLOW   REDUCTION [Qout/Qin](%)= 10.23
                    TIME SHIFT OF PEAK FLOW         (min)= 35.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=  0.0694

--------------------------------------------------------------------------
------
--------------------
| CALIB            |
| STANDHYD  (0200) |   Area    (ha)=   2.21
|ID= 1 DT= 5.0 min |   Total Imp(%)=  40.00   Dir. Conn.(%)=  35.00
--------------------
                                IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.88         1.33
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       2.50         2.50
     Length            (m)=     121.38        20.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=     114.14        28.04
               over (min)         5.00        10.00
     Storage Coeff.  (min)=       2.07 (ii)    9.31 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.31         0.12
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.23         0.06          0.261 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.42           1.33
     RUNOFF VOLUME    (mm)=      32.68        11.48          18.90
     TOTAL RAINFALL   (mm)=      33.68        33.68          33.68
     RUNOFF COEFFICIENT   =       0.97         0.34           0.56

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------
------
```

```
--------------------
| ADD HYD   (0011) |
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (1100):     5.07   0.087     1.92    23.26
        + ID2= 2 (0200):     2.21   0.261     1.33    18.90
          ================================================
          ID = 3 (0011):     7.28   0.314     1.33    21.93

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------
------
--------------------
| RESERVOIR (1200) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)    |   (cms)     (ha.m.)
     **** WARNING : FIRST OUTFLOW IS NOT ZERO.
                           0.0125     0.0070    |   0.0414      0.0600
                           0.0216     0.0150    |   0.1332      0.0750
                           0.0279     0.0240    |   0.1731      0.0910
                           0.0330     0.0350    |   0.2043      0.1090
                           0.0374     0.0470    |   0.2309      0.1280

                                    AREA     QPEAK     TPEAK       R.V.
                                    (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0011)      7.280      0.314      1.33      21.93
     OUTFLOW: ID= 1 (1200)      7.280      0.081      3.50      21.92

                    PEAK   FLOW   REDUCTION [Qout/Qin](%)= 25.73
                    TIME SHIFT OF PEAK FLOW         (min)=130.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=  0.0664

------------------------------------------------------------------------
------
  ***************************
  ** SIMULATION NUMBER:   2 **
  ***************************


--------------------
| CHICAGO STORM    |    IDF curve parameters: A=1170.000
| Ptotal= 45.93 mm |                          B=   5.800
--------------------                          C=   0.840
                         used in:   INTENSITY =  A / (t + B)^C

                         Duration of storm  =  4.00 hrs
                         Storm time step    =  5.00 min
```

Time to peak ratio = 0.33

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.08	2.21	1.08	11.88	2.08	7.06	3.08	3.05
0.17	2.36	1.17	19.39	2.17	6.34	3.17	2.92
0.25	2.54	1.25	48.84	2.25	5.76	3.25	2.80
0.33	2.74	1.33	158.53	2.33	5.27	3.33	2.69
0.42	2.98	1.42	63.98	2.42	4.87	3.42	2.59
0.50	3.27	1.50	33.77	2.50	4.52	3.50	2.49
0.58	3.63	1.58	22.33	2.58	4.23	3.58	2.41
0.67	4.09	1.67	16.51	2.67	3.97	3.67	2.33
0.75	4.69	1.75	13.04	2.75	3.74	3.75	2.25
0.83	5.51	1.83	10.76	2.83	3.54	3.83	2.18
0.92	6.69	1.92	9.16	2.92	3.36	3.92	2.12
1.00	8.55	2.00	7.97	3.00	3.20	4.00	2.06

CALIB					
NASHYD (0001)	Area (ha)=	7.28	Curve Number (CN)=	80.0	
ID= 1 DT= 5.0 min	Ia (mm)=	6.35	# of Linear Res.(N)=	3.00	
	U.H. Tp(hrs)=	0.20			

Unit Hyd Qpeak (cms)= 1.390

PEAK FLOW (cms)= 0.368 (i)
TIME TO PEAK (hrs)= 1.583
RUNOFF VOLUME (mm)= 15.171
TOTAL RAINFALL (mm)= 45.933
RUNOFF COEFFICIENT = 0.330

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

```
--------------------------------------------------------------------------
------
--------------------
| CALIB            |
| STANDHYD  (0100) |   Area    (ha)=   5.07
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  55.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       3.04         2.03
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       2.50         2.50
     Length            (m)=     183.85        20.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=     158.53        53.49
               over (min)         5.00        10.00
     Storage Coeff.  (min)=       2.33 (ii)    5.51 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.30         0.16
                                                          *TOTALS*
     PEAK FLOW       (cms)=       1.13         0.24          1.251 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.42           1.33
     RUNOFF VOLUME    (mm)=      44.93        19.69          33.57
     TOTAL RAINFALL   (mm)=      45.93        45.93          45.93
     RUNOFF COEFFICIENT   =       0.98         0.43           0.73

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------
------
--------------------
| RESERVOIR (1100) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.1059      0.1080
                          0.0353     0.0160   |   0.1171      0.1390
                          0.0611     0.0340   |   0.1273      0.1720
                          0.0789     0.0560   |   0.1367      0.2090
                          0.0934     0.0800   |   0.1455      0.2490

                                AREA     QPEAK     TPEAK       R.V.
```

```
                                (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0100)      5.070      1.251      1.33      33.57
     OUTFLOW: ID= 1 (1100)      5.070      0.106      2.00      33.55

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  8.46
                  TIME SHIFT OF PEAK FLOW         (min)= 40.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  0.1077

--------------------------------------------------------------------------
------
--------------------
| CALIB            |
| STANDHYD  (0200) |   Area    (ha)=   2.21
|ID= 1 DT= 5.0 min |   Total Imp(%)=  40.00   Dir. Conn.(%)=  35.00
--------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.88         1.33
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       2.50         2.50
     Length            (m)=     121.38        20.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=     158.53      Infinit
               over (min)         5.00        10.00
     Storage Coeff.  (min)=       1.81 (ii)    6.31 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.32         0.15
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.33         0.14          0.397 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.42           1.33
     RUNOFF VOLUME    (mm)=      44.93        19.24          28.23
     TOTAL RAINFALL   (mm)=      45.93        45.93          45.93
     RUNOFF COEFFICIENT   =       0.98         0.42           0.61

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------
------

--------------------
| ADD HYD   (0011) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
```

```
          ID1= 1 (1100):     5.07   0.106     2.00    33.55
        + ID2= 2 (0200):     2.21   0.397     1.33    28.23
          ================================================
          ID = 3 (0011):     7.28   0.464     1.33    31.93

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------
------
--------------------
| RESERVOIR (1200) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
     **** WARNING : FIRST OUTFLOW IS NOT ZERO.
                           0.0125     0.0070   |   0.0414      0.0600
                           0.0216     0.0150   |   0.1332      0.0750
                           0.0279     0.0240   |   0.1731      0.0910
                           0.0330     0.0350   |   0.2043      0.1090
                           0.0374     0.0470   |   0.2309      0.1280

                                    AREA     QPEAK     TPEAK       R.V.
                                    (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0011)      7.280      0.464      1.33      31.93
     OUTFLOW: ID= 1 (1200)      7.280      0.118      2.83      31.92

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 25.44
                   TIME SHIFT OF PEAK FLOW        (min)= 90.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  0.0725

--------------------------------------------------------------------------
------
  ***************************
  ** SIMULATION NUMBER:   3 **
  ***************************


--------------------
| CHICAGO STORM    |    IDF curve parameters: A=1400.000
| Ptotal= 52.02 mm |                          B=   5.800
--------------------                          C=   0.850
                         used in:   INTENSITY =  A / (t + B)^C

                         Duration of storm  =  4.00 hrs
                         Storm time step    =  5.00 min
                         Time to peak ratio =  0.33

                  TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME
RAIN
                   hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs
```

```
mm/hr
                0.08    2.37 |  1.08   13.22 |  2.08    7.76 |  3.08
3.29
                0.17    2.54 |  1.17   21.82 |  2.17    6.95 |  3.17
3.15
                0.25    2.73 |  1.25   56.04 |  2.25    6.30 |  3.25
3.02
                0.33    2.95 |  1.33  185.23 |  2.33    5.76 |  3.33
2.89
                0.42    3.22 |  1.42   73.72 |  2.42    5.31 |  3.42
2.78
                0.50    3.54 |  1.50   38.44 |  2.50    4.92 |  3.50
2.68
                0.58    3.94 |  1.58   25.20 |  2.58    4.59 |  3.58
2.59
                0.67    4.44 |  1.67   18.50 |  2.67    4.31 |  3.67
2.50
                0.75    5.11 |  1.75   14.54 |  2.75    4.05 |  3.75
2.42
                0.83    6.02 |  1.83   11.94 |  2.83    3.83 |  3.83
2.34
                0.92    7.35 |  1.92   10.13 |  2.92    3.63 |  3.92
2.27
                1.00    9.44 |  2.00    8.79 |  3.00    3.45 |  4.00
2.20


------------------------------------------------------------------------
------
--------------------
| CALIB            |
| NASHYD    (0001) |   Area    (ha)=   7.28   Curve Number   (CN)= 80.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   6.35   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.20

     Unit Hyd Qpeak  (cms)=   1.390

     PEAK FLOW       (cms)=   0.482 (i)
     TIME TO PEAK    (hrs)=   1.583
     RUNOFF VOLUME    (mm)=  19.069
     TOTAL RAINFALL   (mm)=  52.019
     RUNOFF COEFFICIENT   =   0.367

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

------------------------------------------------------------------------
------
--------------------
| CALIB            |
```

```
| STANDHYD  (0100) |   Area    (ha)=   5.07
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  55.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       3.04         2.03
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       2.50         2.50
     Length            (m)=     183.85        20.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=     185.23        67.82
               over (min)         5.00        10.00
     Storage Coeff.  (min)=       2.19 (ii)    5.18 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.31         0.16
                                                          *TOTALS*
     PEAK FLOW       (cms)=       1.33         0.32          1.494 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.42           1.33
     RUNOFF VOLUME    (mm)=      51.02        23.98          38.85
     TOTAL RAINFALL   (mm)=      52.02        52.02          52.02
     RUNOFF COEFFICIENT   =       0.98         0.46           0.75

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------
------
--------------------
| RESERVOIR (1100) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.1059      0.1080
                          0.0353     0.0160   |   0.1171      0.1390
                          0.0611     0.0340   |   0.1273      0.1720
                          0.0789     0.0560   |   0.1367      0.2090
                          0.0934     0.0800   |   0.1455      0.2490

                                  AREA     QPEAK     TPEAK       R.V.
                                  (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0100)      5.070      1.494      1.33       38.85
     OUTFLOW: ID= 1 (1100)      5.070      0.113      2.00       38.83

                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=  7.59
```

```
                    TIME SHIFT OF PEAK FLOW          (min)= 40.00
                    MAXIMUM  STORAGE   USED        (ha.m.)=  0.1286

--------------------------------------------------------------------------
------
--------------------
| CALIB            |
| STANDHYD  (0200) |   Area    (ha)=   2.21
|ID= 1 DT= 5.0 min |   Total Imp(%)=  40.00   Dir. Conn.(%)=  35.00
--------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.88          1.33
     Dep. Storage     (mm)=       1.00          1.50
     Average Slope     (%)=       2.50          2.50
     Length            (m)=     121.38         20.00
     Mannings n           =      0.013         0.250

     Max.Eff.Inten.(mm/hr)=     185.23       Infinit
               over (min)         5.00         10.00
     Storage Coeff.  (min)=       1.70 (ii)     5.93 (ii)
     Unit Hyd. Tpeak (min)=       5.00         10.00
     Unit Hyd. peak  (cms)=       0.32          0.15
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.38          0.18          0.477 (iii)
     TIME TO PEAK    (hrs)=       1.33          1.42           1.33
     RUNOFF VOLUME    (mm)=      51.02         23.47          33.11
     TOTAL RAINFALL   (mm)=      52.02         52.02          52.02
     RUNOFF COEFFICIENT   =       0.98          0.45           0.64

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------
------

--------------------
| ADD HYD   (0011) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (1100):     5.07   0.113     2.00    38.83
        + ID2= 2 (0200):     2.21   0.477     1.33    33.11
          ================================================
          ID = 3 (0011):     7.28   0.550     1.33    37.09
```

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

------------------------------------------------------------------------
------
--------------------
| RESERVOIR (1200) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
     **** WARNING : FIRST OUTFLOW IS NOT ZERO.
                          0.0125     0.0070   |   0.0414      0.0600
                          0.0216     0.0150   |   0.1332      0.0750
                          0.0279     0.0240   |   0.1731      0.0910
                          0.0330     0.0350   |   0.2043      0.1090
                          0.0374     0.0470   |   0.2309      0.1280

                                    AREA     QPEAK     TPEAK       R.V.
                                    (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0011)      7.280      0.550      1.33      37.09
     OUTFLOW: ID= 1 (1200)      7.280      0.134      2.58      37.07

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 24.43
                  TIME SHIFT OF PEAK FLOW         (min)= 75.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  0.0754

------------------------------------------------------------------------
------
  ****************************
  ** SIMULATION NUMBER:   4 **
  ****************************


--------------------
| CHICAGO STORM    |    IDF curve parameters: A=1680.000
| Ptotal= 62.47 mm |                          B=   5.600
--------------------                          C=   0.850
                       used in:   INTENSITY =  A / (t + B)^C

                       Duration of storm  =  4.00 hrs
                       Storm time step    =  5.00 min
                       Time to peak ratio =  0.33

                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME
RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs
mm/hr
                0.08    2.84 |  1.08   15.73 |  2.08    9.24 |  3.08
3.94
                0.17    3.04 |  1.17   25.95 |  2.17    8.28 |  3.17
3.76
```

```
                0.25    3.26 |  1.25   67.00 |  2.25    7.51 |  3.25
3.60
                0.33    3.53 |  1.33  225.84 |  2.33    6.87 |  3.33
3.46
                0.42    3.84 |  1.42   88.31 |  2.42    6.33 |  3.42
3.33
                0.50    4.23 |  1.50   45.79 |  2.50    5.87 |  3.50
3.20
                0.58    4.70 |  1.58   29.96 |  2.58    5.48 |  3.58
3.09
                0.67    5.30 |  1.67   22.00 |  2.67    5.14 |  3.67
2.99
                0.75    6.09 |  1.75   17.29 |  2.75    4.84 |  3.75
2.89
                0.83    7.18 |  1.83   14.21 |  2.83    4.57 |  3.83
2.80
                0.92    8.75 |  1.92   12.05 |  2.92    4.34 |  3.92
2.71
                1.00   11.24 |  2.00   10.46 |  3.00    4.13 |  4.00
2.63


------------------------------------------------------------------------
------
--------------------
| CALIB            |
| NASHYD    (0001) |   Area    (ha)=   7.28   Curve Number   (CN)= 80.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   6.35   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.20

     Unit Hyd Qpeak  (cms)=   1.390

     PEAK FLOW       (cms)=   0.684 (i)
     TIME TO PEAK    (hrs)=   1.500
     RUNOFF VOLUME    (mm)=  26.276
     TOTAL RAINFALL   (mm)=  62.466
     RUNOFF COEFFICIENT   =   0.421

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

------------------------------------------------------------------------
------
--------------------
| CALIB            |
| STANDHYD  (0100) |   Area    (ha)=   5.07
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  55.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       3.04         2.03
```

```
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       2.50         2.50
     Length            (m)=     183.85        20.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=     225.84        92.05
               over (min)         5.00         5.00
     Storage Coeff.  (min)=       2.02 (ii)    4.79 (ii)
     Unit Hyd. Tpeak (min)=       5.00         5.00
     Unit Hyd. peak  (cms)=       0.31         0.22
                                                          *TOTALS*
     PEAK FLOW       (cms)=       1.64         0.48          2.120 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.33           1.33
     RUNOFF VOLUME    (mm)=      61.47        31.79          48.11
     TOTAL RAINFALL   (mm)=      62.47        62.47          62.47
     RUNOFF COEFFICIENT   =       0.98         0.51           0.77

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------
------
--------------------
| RESERVOIR (1100) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.1059      0.1080
                          0.0353     0.0160   |   0.1171      0.1390
                          0.0611     0.0340   |   0.1273      0.1720
                          0.0789     0.0560   |   0.1367      0.2090
                          0.0934     0.0800   |   0.1455      0.2490

                                  AREA     QPEAK     TPEAK       R.V.
                                  (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0100)      5.070      2.120      1.33       48.11
     OUTFLOW: ID= 1 (1100)      5.070      0.125      2.08       48.09

                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=  5.89
                    TIME SHIFT OF PEAK FLOW         (min)= 45.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=  0.1642

--------------------------------------------------------------------------
------
```

```
--------------------
| CALIB            |
| STANDHYD  (0200) |   Area    (ha)=   2.21
|ID= 1 DT= 5.0 min |   Total Imp(%)=  40.00   Dir. Conn.(%)=  35.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.88         1.33
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       2.50         2.50
     Length            (m)=     121.38        20.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=     225.84      Infinit
               over (min)          5.00        10.00
     Storage Coeff.  (min)=       1.57 (ii)    5.47 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.33         0.16
                                                        *TOTALS*
     PEAK FLOW       (cms)=       0.47         0.26          0.606 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.42           1.33
     RUNOFF VOLUME    (mm)=      61.47        31.17          41.77
     TOTAL RAINFALL   (mm)=      62.47        62.47          62.47
     RUNOFF COEFFICIENT   =       0.98         0.50           0.67

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------
------

--------------------
| ADD HYD   (0011) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (1100):     5.07   0.125     2.08    48.09
        + ID2= 2 (0200):     2.21   0.606     1.33    41.77
          ================================================
          ID = 3 (0011):     7.28   0.691     1.33    46.17

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------
------
--------------------
```

```
| RESERVOIR (1200) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)    |   (cms)     (ha.m.)
     **** WARNING : FIRST OUTFLOW IS NOT ZERO.
                          0.0125     0.0070    |   0.0414      0.0600
                          0.0216     0.0150    |   0.1332      0.0750
                          0.0279     0.0240    |   0.1731      0.0910
                          0.0330     0.0350    |   0.2043      0.1090
                          0.0374     0.0470    |   0.2309      0.1280

                                    AREA     QPEAK     TPEAK       R.V.
                                    (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0011)      7.280      0.691      1.33      46.17
     OUTFLOW: ID= 1 (1200)      7.280      0.156      2.50      46.15

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 22.61
                  TIME SHIFT OF PEAK FLOW         (min)= 70.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  0.0842

--------------------------------------------------------------------------
------
  ***************************
  ** SIMULATION NUMBER:   5 **
  ***************************


--------------------
| CHICAGO STORM    |    IDF curve parameters: A=1960.000
| Ptotal= 68.93 mm |                          B=   5.800
--------------------                          C=   0.860
                       used in:   INTENSITY =  A / (t + B)^C

                       Duration of storm  =  4.00 hrs
                       Storm time step    =  5.00 min
                       Time to peak ratio =  0.33

                  TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME
RAIN
                   hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs
mm/hr
                  0.08    2.97 |  1.08   17.19 |  2.08    9.96 |  3.08
4.15
                  0.17    3.18 |  1.17   28.70 |  2.17    8.90 |  3.17
3.96
                  0.25    3.42 |  1.25   75.22 |  2.25    8.05 |  3.25
3.79
                  0.33    3.71 |  1.33  253.23 |  2.33    7.34 |  3.33
3.63
                  0.42    4.05 |  1.42   99.36 |  2.42    6.75 |  3.42
```

```
3.49
                0.50    4.46 |  1.50   51.18 |  2.50    6.25 |  3.50
3.36
                0.58    4.98 |  1.58   33.24 |  2.58    5.83 |  3.58
3.24
                0.67    5.63 |  1.67   24.24 |  2.67    5.45 |  3.67
3.13
                0.75    6.49 |  1.75   18.94 |  2.75    5.13 |  3.75
3.02
                0.83    7.68 |  1.83   15.49 |  2.83    4.84 |  3.83
2.93
                0.92    9.42 |  1.92   13.08 |  2.92    4.58 |  3.92
2.84
                1.00   12.18 |  2.00   11.31 |  3.00    4.35 |  4.00
2.75


------------------------------------------------------------------------
------
--------------------
| CALIB            |
| NASHYD    (0001) |   Area    (ha)=   7.28   Curve Number   (CN)= 80.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   6.35   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.20

     Unit Hyd Qpeak  (cms)=   1.390

     PEAK FLOW       (cms)=   0.835 (i)
     TIME TO PEAK    (hrs)=   1.500
     RUNOFF VOLUME    (mm)=  31.000
     TOTAL RAINFALL   (mm)=  68.927
     RUNOFF COEFFICIENT   =   0.450

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

------------------------------------------------------------------------
------
--------------------
| CALIB            |
| STANDHYD  (0100) |   Area    (ha)=   5.07
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  55.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       3.04         2.03
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       2.50         2.50
     Length            (m)=     183.85        20.00
     Mannings n           =      0.013        0.250
```

```
     Max.Eff.Inten.(mm/hr)=     253.23       109.43
               over (min)         5.00         5.00
     Storage Coeff.  (min)=       1.93 (ii)    4.57 (ii)
     Unit Hyd. Tpeak (min)=       5.00         5.00
     Unit Hyd. peak  (cms)=       0.31         0.23
                                                          *TOTALS*
     PEAK FLOW       (cms)=       1.86         0.58          2.438 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.33           1.33
     RUNOFF VOLUME    (mm)=      67.93        36.83          53.93
     TOTAL RAINFALL   (mm)=      68.93        68.93          68.93
     RUNOFF COEFFICIENT   =       0.99         0.53           0.78

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------
------
--------------------
| RESERVOIR (1100) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.1059      0.1080
                          0.0353     0.0160   |   0.1171      0.1390
                          0.0611     0.0340   |   0.1273      0.1720
                          0.0789     0.0560   |   0.1367      0.2090
                          0.0934     0.0800   |   0.1455      0.2490

                                  AREA     QPEAK     TPEAK       R.V.
                                  (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0100)      5.070      2.438      1.33       53.93
     OUTFLOW: ID= 1 (1100)      5.070      0.131      2.08       53.91

                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=  5.39
                    TIME SHIFT OF PEAK FLOW         (min)= 45.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=  0.1885

--------------------------------------------------------------------------
------
--------------------
| CALIB            |
| STANDHYD  (0200) |   Area    (ha)=   2.21
|ID= 1 DT= 5.0 min |   Total Imp(%)=  40.00   Dir. Conn.(%)=  35.00
--------------------
```

		IMPERVIOUS	PERVIOUS (i)	
Surface Area	(ha)=	0.88	1.33	
Dep. Storage	(mm)=	1.00	1.50	
Average Slope	(%)=	2.50	2.50	
Length	(m)=	121.38	20.00	
Mannings n	=	0.013	0.250	
Max.Eff.Inten.(mm/hr)	=	253.23	Infinit	
over	(min)	5.00	10.00	
Storage Coeff.	(min)=	1.50 (ii)	5.23 (ii)	
Unit Hyd. Tpeak	(min)=	5.00	10.00	
Unit Hyd. peak	(cms)=	0.33	0.16	
				TOTALS
PEAK FLOW	(cms)=	0.53	0.32	0.696 (iii)
TIME TO PEAK	(hrs)=	1.33	1.42	1.33
RUNOFF VOLUME	(mm)=	67.93	36.16	47.28
TOTAL RAINFALL	(mm)=	68.93	68.93	68.93
RUNOFF COEFFICIENT	=	0.99	0.52	0.69

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 80.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

ADD HYD (0011)		AREA	QPEAK	TPEAK	R.V.
1 + 2 = 3		(ha)	(cms)	(hrs)	(mm)
	ID1= 1 (1100):	5.07	0.131	2.08	53.91
	+ ID2= 2 (0200):	2.21	0.696	1.33	47.28
	==========	==========	==========	==========	==========
	ID = 3 (0011):	7.28	0.786	1.33	51.90

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

RESERVOIR (1200)					
IN= 2---> OUT= 1					
DT= 5.0 min		OUTFLOW	STORAGE	OUTFLOW	STORAGE
		(cms)	(ha.m.)	(cms)	(ha.m.)

**** WARNING : FIRST OUTFLOW IS NOT ZERO.

```
                          0.0125     0.0070   |   0.0414      0.0600
                          0.0216     0.0150   |   0.1332      0.0750
                          0.0279     0.0240   |   0.1731      0.0910
                          0.0330     0.0350   |   0.2043      0.1090
                          0.0374     0.0470   |   0.2309      0.1280

                                    AREA     QPEAK     TPEAK       R.V.
                                    (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0011)      7.280      0.786      1.33      51.90
     OUTFLOW: ID= 1 (1200)      7.280      0.172      2.33      51.88

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 21.94
                   TIME SHIFT OF PEAK FLOW         (min)= 60.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  0.0907

------------------------------------------------------------------------
------
  ***************************
  ** SIMULATION NUMBER:   6 **
  ***************************


--------------------
| CHICAGO STORM    |    IDF curve parameters: A=2150.000
| Ptotal= 75.63 mm |                          B=   5.700
--------------------                          C=   0.860
                       used in:   INTENSITY =  A / (t + B)^C

                       Duration of storm  =  4.00 hrs
                       Storm time step    =  5.00 min
                       Time to peak ratio =  0.33

                  TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME
RAIN
                   hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs
mm/hr
                  0.08    3.25 |  1.08   18.77 |  2.08   10.89 |  3.08
4.54
                  0.17    3.48 |  1.17   31.34 |  2.17    9.73 |  3.17
4.33
                  0.25    3.75 |  1.25   82.35 |  2.25    8.79 |  3.25
4.15
                  0.33    4.06 |  1.33  280.01 |  2.33    8.03 |  3.33
3.98
                  0.42    4.43 |  1.42  108.89 |  2.42    7.38 |  3.42
3.82
                  0.50    4.88 |  1.50   55.93 |  2.50    6.84 |  3.50
3.68
                  0.58    5.44 |  1.58   36.30 |  2.58    6.37 |  3.58
3.55
```

```
                0.67    6.16 |  1.67   26.47 |  2.67    5.96 |  3.67
3.42
                0.75    7.10 |  1.75   20.68 |  2.75    5.61 |  3.75
3.31
                0.83    8.40 |  1.83   16.92 |  2.83    5.29 |  3.83
3.20
                0.92   10.29 |  1.92   14.29 |  2.92    5.01 |  3.92
3.10
                1.00   13.30 |  2.00   12.36 |  3.00    4.76 |  4.00
3.01


------------------------------------------------------------------------
------
--------------------
| CALIB            |
| NASHYD    (0001) |   Area    (ha)=   7.28   Curve Number   (CN)= 80.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   6.35   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.20

     Unit Hyd Qpeak  (cms)=   1.390

     PEAK FLOW       (cms)=   0.989 (i)
     TIME TO PEAK    (hrs)=   1.500
     RUNOFF VOLUME    (mm)=  36.083
     TOTAL RAINFALL   (mm)=  75.635
     RUNOFF COEFFICIENT   =   0.477

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

------------------------------------------------------------------------
------
--------------------
| CALIB            |
| STANDHYD  (0100) |   Area    (ha)=   5.07
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  55.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       3.04         2.03
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       2.50         2.50
     Length            (m)=     183.85        20.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=     280.01       126.83
               over (min)        5.00         5.00
     Storage Coeff.  (min)=       1.85 (ii)    4.39 (ii)
     Unit Hyd. Tpeak (min)=       5.00         5.00
     Unit Hyd. peak  (cms)=       0.32         0.23
```

```
                                                          *TOTALS*
     PEAK FLOW       (cms)=       2.06         0.69          2.756 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.33           1.33
     RUNOFF VOLUME    (mm)=      74.63        42.22          60.05
     TOTAL RAINFALL   (mm)=      75.63        75.63          75.63
     RUNOFF COEFFICIENT   =       0.99         0.56           0.79

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------
------
--------------------
| RESERVOIR (1100) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.1059      0.1080
                          0.0353     0.0160   |   0.1171      0.1390
                          0.0611     0.0340   |   0.1273      0.1720
                          0.0789     0.0560   |   0.1367      0.2090
                          0.0934     0.0800   |   0.1455      0.2490

                                  AREA     QPEAK     TPEAK       R.V.
                                  (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0100)       5.070      2.756      1.33       60.05
     OUTFLOW: ID= 1 (1100)       5.070      0.137      2.08       60.03

                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=  4.99
                    TIME SHIFT OF PEAK FLOW         (min)= 45.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=  0.2127

--------------------------------------------------------------------------
------
--------------------
| CALIB            |
| STANDHYD  (0200) |   Area    (ha)=   2.21
|ID= 1 DT= 5.0 min |   Total Imp(%)=  40.00   Dir. Conn.(%)=  35.00
--------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.88         1.33
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       2.50         2.50
     Length            (m)=     121.38        20.00
```

```
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=     280.01       Infinit
               over (min)         5.00         10.00
     Storage Coeff.  (min)=       1.44 (ii)    5.02 (ii)
     Unit Hyd. Tpeak (min)=       5.00         10.00
     Unit Hyd. peak  (cms)=       0.33          0.16
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.59          0.37          0.786 (iii)
     TIME TO PEAK    (hrs)=       1.33          1.42           1.33
     RUNOFF VOLUME    (mm)=      74.63         41.49          53.09
     TOTAL RAINFALL   (mm)=      75.63         75.63          75.63
     RUNOFF COEFFICIENT   =       0.99          0.55           0.70

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------
------

--------------------
| ADD HYD   (0011) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (1100):     5.07   0.137     2.08    60.03
        + ID2= 2 (0200):     2.21   0.786     1.33    53.09
          ================================================
          ID = 3 (0011):     7.28   0.881     1.33    57.92

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------
------
--------------------
| RESERVOIR (1200) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)    |   (cms)     (ha.m.)
     **** WARNING : FIRST OUTFLOW IS NOT ZERO.
                           0.0125     0.0070    |   0.0414      0.0600
                           0.0216     0.0150    |   0.1332      0.0750
                           0.0279     0.0240    |   0.1731      0.0910
                           0.0330     0.0350    |   0.2043      0.1090
                           0.0374     0.0470    |   0.2309      0.1280
```

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0011)	7.280	0.881	1.33	57.92
OUTFLOW: ID= 1 (1200)	7.280	0.186	2.25	57.90

PEAK FLOW REDUCTION [Qout/Qin](%)= 21.10
TIME SHIFT OF PEAK FLOW (min)= 55.00
MAXIMUM STORAGE USED (ha.m.)= 0.0984

FINISH

==========