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STORMWATER MANAGEMENT REPORT

PROPOSED ROADWAY EXTENSION
LOWE ROAD ALONG FRONTAGE OF
308 LOWE ROAD, OTTAWA

Prepared For:
Aaron Wolf
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Stittsville, Ontario
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PROJECT #: 200143

DISTRIBUTION
4 copies – City of Ottawa
1 copy – Aaron Wolf.
1 copy – Kollaard Associates Inc.

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200143 – PP – Plan and Profile

1 INTRODUCTION

Kollaard Associates was retained by Aaron Wolf to complete a Stormwater Management Report in support of the proposed Lowe Road extension in the City of Ottawa, Ontario. It is understood that Mr. Aaron Wolf (the client) wishes to extend the existing road about 80 metres northwest along the unopened road allowance in order to provide access to the property known as 340 Lowe Road.

Lowe Road is located north of Highway 7 and west of Dwyer Hill Road within the West Carleton-March ward. The existing opened or developed portion of Lowe road currently extends northwest from McArton Road for a distance of about 1.2 km. The existing opened road ends about 7 metres northwest of the access driveway to the property known as 308 Lowe Road. The Lowe Road allowance extends about 1.65 kilometres northwest beyond the existing road end to John Kennedy Way. The road allowance is currently occupied by an unmaintained trail.

1.1 Stormwater Management Criteria

The report shall summarize the existing conditions along both the existing portion of Lowe Road as well as along the portion of the unopened road allowance on which the proposed extension will be located. The report will address additional stormwater flows arising from the proposed extension and will discuss the effect to the surrounding area of the additional stormwater flows resulting from the proposed extension. The report will also describe any measures to be taken during construction to minimize erosion and sedimentation.

The design criteria is as follows:

- Maintain quality control during construction to minimize the effects of the construction by implementing sediment and erosion control measures;
- Ensure a long term enhanced level of treatment for the roadway along the road allowance;
- Demonstrate that the proposed construction will not have a significant effect on the overall stormwater runoff from the surrounding area or alternatively mitigate the additional flows resulting from the proposed construction.

2 BACKGROUND

It is understood that the client is in the process of obtaining a building permit for a proposed residence at the site known as 340 Lowe Road. It is understood that the road extension is required in order to ensure that the proposed dwelling is accessible by City of Ottawa services (Fire and emergency, garbage, snow clearing, etc).

2.1 Existing Conditions prior to Construction of the Temporary Road

2.1.1 Existing Opened Road

The existing roadway is gravel surfaced and has a lane width of about 6.5 metres. There are covered gravel shoulders on either side of the roadway which vary in width from 0 to 0.7 metres. The total roadway width varies from 6.5 to 8.5 metres. The road appears to be only slightly elevated above the adjacent existing ground surface. The first approximately 450 metres from McArton Road appears to have shallow ditches on both sides of the road. The ditch along the northeast side of Lowe Rd from this point is intermittent to nonexistent to about 220 metres from the end of the opened road. There does not appear to be culverts under the driveways along the northeast side of the road between the first 450 metres and the last 220 metres. There appears to a shallow intermittent ditch along the southwest side of Lowe Road. There are culverts under some of the driveways along the southwest side of the road. There are no cross culverts under Lowe Road.

The adjacent land use along both sides of the road appears to consist of agricultural usage with a predominance of forage crops and pasture. Some deciduous and coniferous re-growth has occurred in some areas. The road allowance adjacent the grass covered shoulder is overgrown with brush and trees beyond the first about 450 metres from McArton Road along both sides of the road.

Topographic information for Lowe Road and the surrounding area was obtained from Google Earth. This information was compared to topographic information provided on geoOttawa and on the Ministry of Natural Resources and Forestry Ontario Flow Assessment Tool (OFAT). The topographic information obtained from these three sources is in agreement and indicates that the existing Lowe Road crosses the crest between two watersheds at about 500 metres northwest of McArton Road. The crest between the watersheds is oriented in a north south direction. The general slope to the east is downward to the Manion Corners (Long Swamp) Wetland Complex. The general slope to the west is downward towards the Mississippi River. The land is also sloped downward in both the north and south directions from the above identified high point in Lowe Road.

2.1.2 Existing Unopened Road Allowance

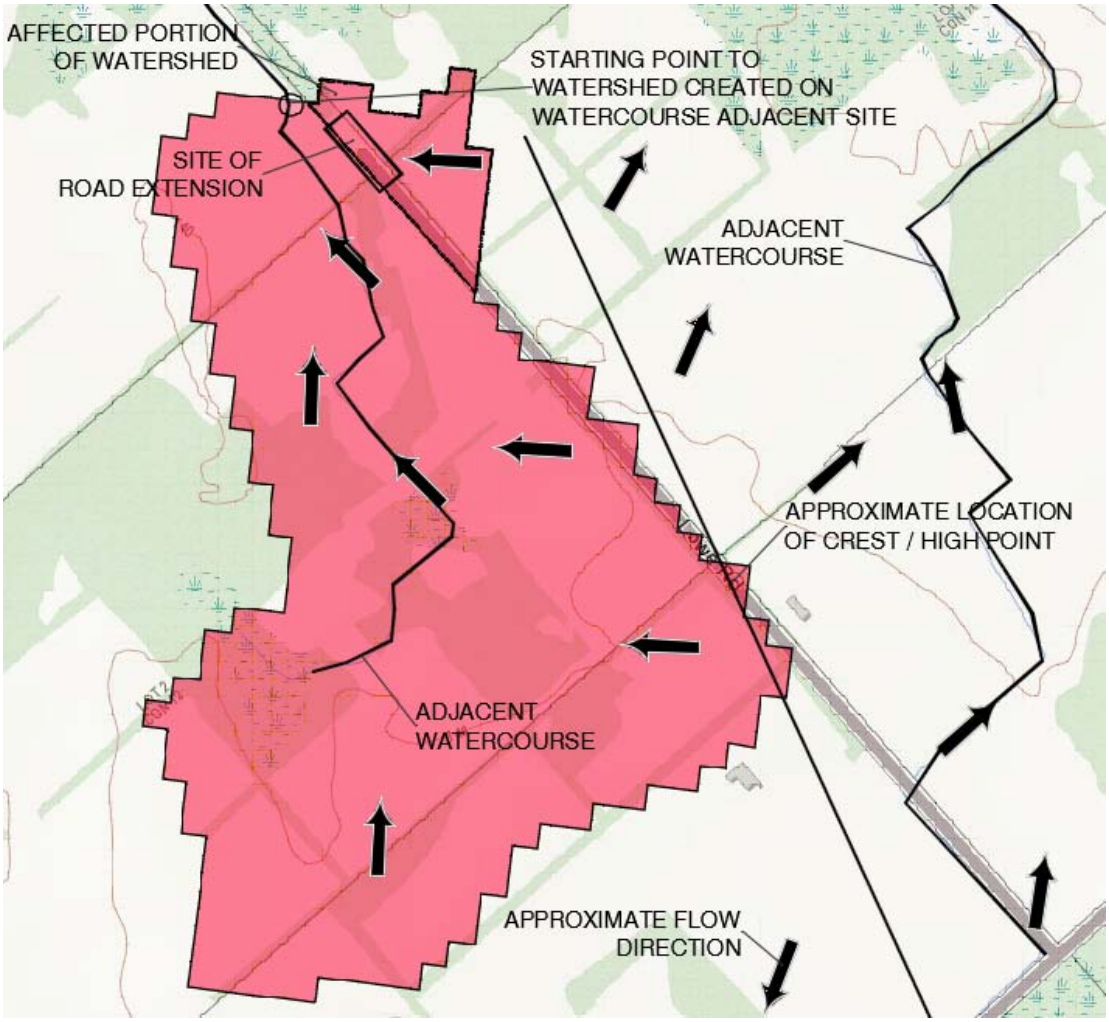
The existing unopened road allowance which will be affected by the proposed road extension has a trail used by all terrain vehicles and farm equipment. The trail has also historically been used to access the property known as 340 Lowe Road.

Historically the land on the northwest side of the proposed road extension is predominately wooded. The land along the southeast side of the proposed road extension is used for agricultural purposes and has historically been used for a rotation of a variety of crops

The topographic information from the above mentioned three sources was also compared to topographic survey information obtained for the portion of the unopened road allowance where the proposed road extension will be constructed. The survey information indicates that the proposed road extension has an overall downward slope to the northwest in keeping with the information previously obtained.

2.1.3 Immediate Surrounding Area

As indicated in the figure below, the agricultural lands immediately south and west of the proposed road extension are drainage by an existing watercourse. This watercourse is the receiving water body for the runoff from the roadway following the roadside ditch along the southwest side of the road. The runoff from the area immediately adjacent the northeast side of the proposed road extension currently flows west to the existing tributary west of the road allowance. This flow is captured by the shallow swale along the northeast side of the road and is directed around the opened portion of the roadway across the existing trail.



The lands immediately east of the majority of the opened portion of Lowe Road as shown in the figure on the previous page drain to an existing watercourse east of Lowe Road and as such will not be impacted in any way by the proposed road extension.

The watershed created on watercourse adjacent the proposed road extension as illustrated above has an area of about 48 hectares. The land cover in general consists of about 70 percent agriculture and undifferentiated land use, about 2.5 percent community and infrastructure, and about 8.4 % hedge rows. The remaindering area is wooded or treed and is either planted or re-growth.

The portion of the watershed affected by the proposed roadway extension has an area of about 2.5 hectares.

3 RECEIVING WATERCOURSE

The receiving watercourse for the runoff from the catchment area affected by the roadway extension is shown on the above figure and is labelled adjacent watercourse.

The watercourse has a u shaped bottom with a width of 0.3 to 0.6 metres. The side slopes of the watercourse range in inclination between from 1 horizontal to 1 vertical to about 3H:1V. The watercourse depth ranges from about 0.8 to 1.1 metres adjacent the site. The bottom slope of the watercourse adjacent the site is about 0.5 percent. Based on the above properties, the watercourse has a flow capacity (without flooding) of between 1.7 and 3.1 m^3/sec depending of the section of the channel assessed.

4 PROPOSED HYDROLOGIC MODEL

Rainfall data from Intensity-Duration-Frequency curves obtained from the Ottawa International Airport as provided in the City of Ottawa Sewer Design Guidelines were utilized to model the storm events at the site.

The IDF formulae utilized are as follows:

100 year Intensity	$= 1735.688 / (\text{Time in min} + 6.014)^{0.820}$
50 year Intensity	$= 1569.580 / (\text{Time in min} + 6.014)^{0.820}$
5 year Intensity	$= 998.071 / (\text{Time in min} + 6.053)^{0.814}$
2 year Intensity	$= 732.951 / (\text{Time in min} + 6.199)^{0.810}$

4.1.1 Methodology

Calculations to determine the pre- and post- development rates and required storage volume were completed using the hydrologic modeling software, Visual OTTHYMO (V2.6.3)

Both the pre-development and post-development runoff conditions were calculated using the NASHYD watershed command. The NASHYD command uses the Nash instantaneous unit hydrograph which is made of a cascade of 'N' linear reservoirs and is used to model rural areas.

The NASHYD command uses the following inputs:
DT – Simulation time step increment (min) – must be shorter than TP
Area – Watershed or catchment area (hectares)
DWF – A constant Dry Weather Flow or Baseflow (m3/s) assumed to be 0 (doesn't change from pre to post development)
CN – SCS Modified Curve Number
IA – Initial Abstraction (mm)
N – Number of Linear reservoir used for derivation of the Nash Unit Hydrograph (commonly set to 3)
TP – Unit hydrograph time to peak (hr)

4.2 Calculation of Modelling Variables.

4.2.1 Initial Abstraction

The initial abstraction for each catchment was calculated as equal to 0.1S were S is the soil storage and is a function of CN. The default calculations for IA is IA = 0.2S however research has shown that this underestimates the peak flow particularly for more permeable watersheds. Since the CN for the site vary between 70 and 72 (excluding the community and infrastructure), IA = 0.1S is appropriate. The soil storage coefficient is related to the CN number as follows: S = 25400 / (CN – 25.4)

A review of a geotechnical report prepared for the site indicates that the subsurface conditions in the area of the proposed roadway extension consist of a layer of organic material (topsoil or peat) followed by either silty sand or fine to medium sand then bedrock or by organic material followed directly by bedrock. The organic material varies in thickness from about 0.2 to 0.5 metres. Based on this information it is considered that these watersheds have a soil group classification of Group C that is *soils having low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water and soils with*

moderately fine to fine texture. These soils have a low rate of water transmission (0.05-0.15 in/hr).

4.2.2 Runoff Curve Number

Runoff curve numbers were established using the United States Department of Agriculture Urban Hydrology for Small Watersheds Technical Release 55 (USDA TR55)

The runoff curve number for the watershed was determined using a weighted average based on land cover as shown in the following table for both before and after (pre and post) the proposed roadway extension.

Total Area	Main Land Cover And CN				Weighted Average CN	Weighted Average n
	agriculture and undifferentiated land use	mixed tree coniferous and deciduous forest	infrastructure	hedge rows		
CN	71	72	98	72		
n	0.051	0.101	0.025	0.101		
Pre						
45.5 ha	31. 85 ha	8.692 ha	1.138 ha	3.82 ha	71.57	0.064
2.5 ha	1.75 ha	0.477 ha	0.063 ha	0.21 ha	71.57	0.064
Post						
45.5 ha	31.85 ha	8.692 ha	1.138 ha	3.82 ha	71.57	0.064
2.5 ha	1.75 ha	0.408 ha	0.132 ha	0.21 ha	72.35	0.062

4.2.3 Time of Concentration

The time of concentration of each catchment was determined using the Velocity method. The velocity method assumes that the time of concentration is the sum of travel times for segments along the hydraulically most distant flow path. The segments used in the velocity method may be of three types: sheet flow T_s, shallow concentrated flow T_{sc}, and open channel flow T_c.

For the purposes of this assessment, the outlet point to the watershed was assumed to be the point at which open channel flow occurs as this point will be downstream of the portion of catchment affected by the development. Since the open channel flow will occur downstream

of the development, the time component will be the same for both pre- and post-development conditions.

The maximum length of sheet flow as defined by the USDA National Handbook et al [USDA Handbook], is 100 ft or 30 metres. Conservatively, it is considered that a maximum length of 15 metres is more likely in forested areas or farm land. From the USDA Handbook Shallow concentrated flow is assumed to occur after sheet flow ends at shallow depths of 0.1 to 0.5 feet. Beyond that channel flow is assumed to occur.

The channel flow was modelled using a route Channel Hydrograph in the Visual OTTHYMO (V2.6.3) model.

4.2.3.1 Time of Travel for Sheet Flow

Based on a review of the aerial photography, the ground cover, for the purposes of assigning a Manning's Roughness coefficient, at the upper reaches of the watershed consists of mixed woods with light underbrush. Table 15-1 of the USDA handbook provides a Manning's roughness coefficient of 0.4 for woods with light underbrush. From the OFAT model, the average slope across both watersheds is 1.1%.

Travel time for sheet flow for the watershed:

$$T_s = \frac{0.091(nl)^{0.8}}{(P_2)^{0.5} S^{0.4}}$$

Where T_s = travel time, h
n = Manning's roughness coefficient = 0.6
l = sheet flow length, 15 m
P_2 = 2-year 24-hour rainfall, cm = 52.6 cm
S = Slope of land surface m/m = 0.011

T_s = 0.32 hours

Rainfall quantities and intensities were obtained using the Ontario Ministry of Transport IDF lookup tool. The IDF curve is included in Appendix A.

Shallow concentrated flow was assumed to occur after 15 m (50 ft) on each catchment. The estimated shallow concentrated flow time was calculated using the velocities developed from Figure 15-4 USDA handbook in which the velocity is a function of the water course slope and type of channel.

4.2.3.2 Time of Travel for Shallow Concentrated Flow

The flow velocity used to calculate the time of travel for shallow concentrated flow was determined using Figure 15-4 of Chapter 15 of the USDA handbook. This figure can be used to determine the velocity when the slope and ground cover is known. The ground cover to be used in reading Figure 15-4 for the watershed follows: The area for each ground cover previously identified was assigned a Manning's n obtained from Table 15-3 of the USDA handbook. A weighted average of the manning's roughness coefficient was then determined for the entire catchment. The weighted average of manning's roughness coefficient was determined to be 0.065. This weighted n was compared to the Flow Type identified in Table 15-3 and is approximately equal to midway between the n values for short-grass pasture and cultivated straight row crops.

From Table 15-4 of the USDA Handbook using a slope of 1.1%, the velocity is estimated at 0.85 ft/s or 0.26 m/s

$$T_{sc} = \frac{l}{3600\,V}$$

Where T_{sc} = travel time, h
l = distance of shallow concentrated flow = 185 m
V = average velocity = 0.26 m/s
T_{sc} = 0.19 hrs

The total time of concentration for catchment for the watershed excluding channel flow is

T_t = 0.32 + 0.19 = 0.51 hrs.

4.2.3.3 Time to Peak

The time to peak of a catchment is theoretically equal to Tp = (N-1)/N x TC where TC is the Time of Concentration and N is the number of liner reservoirs in the model. Standard Engineering practice has accepted that the use of N=3 is appropriate to represent a normally maintained municipal drain. As such it is considered reasonable to used N = 3 to model the watersheds.

Tp = (N-1)/N x TC
TP = (3-1)/3 x 0.51 hrs = 0.34 hrs

4.2.4 Remaining Watershed Area Properties

The following table provides a summary of the remaining variables used in the OTTHYMO Stormwater management model.

Catchment	Model Type	Hydrograph Number	DWF	IA	N	DT
Pre						
45.5	NASHYD	1	0	10.1	3	10
2.5	NASHYD	2	0	10.1	3	10
Post						
45.5	NASHYD	3	0	10.1	3	10
2.5	NASHYD	4	0	9.7	3	10

5 PRE-DEVELOPMENT SITE RUNOFF

Both the Pre and Post-development models were run utilizing Chicago Storm distributions for the 2 year, 5 year, 50 year, and 100 year return periods. Historical Storms were also modelled.

The resulting pre and post-development models contain 6 storm events as follows:

Simulation Number 1 – 12 hour 2 year Chicago
Simulation Number 2 – 12 hour 5 year Chicago
Simulation Number 3 – 12 hour 50 year Chicago
Simulation Number 4 – 12 hour 100 year Chicago
Simulation Number 5 – Historical August 4, 1988
Simulation Number 6 – Historical July 1, 1979

The pre-development runoff rates and runoff volumes for the modeled storm events are summarized in the following table.

Simulation Number	Storm Event	Runoff Rate (m^3/sec)		Runoff Volume (mm/m^2)	
		2.5 ha	48 ha	2.5 ha	48 ha
1	12 hour 2 year Chicago	0.024	0.282	7.7	7.76
2	12 hour 5 year Chicago	0.058	0.644	14.28	14.36
3	12 hour 50 year Chicago	0.156	1.775	31.54	31.71
4	12 hour 100 year Chicago	0.197	2.306	38.95	39.16
5	Historical August 4, 1988	0.199	2.363	28.69	28.84
6	Historical July 1, 1979	0.222	2.939	30.93	31.09

6 POST-DEVELOPMENT CATCHMENT AREA PROPERTIES

The proposed development consists of extending a granular surfaced roadway along about 90 metres of unopened road allowance. The roadway will have a width of 7 metres.

The changes in the runoff curve number and Mannings n and initial abstraction of the watershed and the portion of the watershed affected by the the construction of the proposed roadway are shown in the tables in section 3.2.2 and section 3.2.4 above. From these tables, there is no difference in the catch basin properties for the majority of the watershed. The runoff curve number is slightly increased from 71.57 to 72.35, Manning's n is reduced from 0.064 to 0.042 and the initial abstraction is reduced from 10.1 to 9.7 in the portion of the watershed affected by the proposed roadway expansion.

Both the Pre and Post-development models were run utilizing Chicago Storm distributions for the 2 year, 5 year and 100 year return periods as well as the historical storms of August 4, 1988 and July 1, 1979.

7 POST-DEVELOPMENT SITE RUNOFF

The post-development runoff rates and runoff volumes for the modeled storm events are summarized in the following table.

Simulation Number	Storm Event	Runoff Rate (m^3/sec)		Runoff Volume (mm/m^2)	
		2.5 ha	48 ha	2.5 ha	48 ha
1	12 hour 2 year Chicago	0.026	0.283	8.11	7.78
2	12 hour 5 year Chicago	0.062	0.645	14.88	14.39
3	12 hour 50 year Chicago	0.163	1.777	32.52	31.76
4	12 hour 100 year Chicago	0.204	2.311	40.05	39.21
5	Historical August 4, 1988	0.206	2.368	29.61	28.89
6	Historical July 1, 1979	0.229	2.944	31.89	31.14

The difference between pre-development and post-development runoff rates and runoff volume for each storm event is summarized in the following table.

Simulation Number	Storm Event	Runoff Rate (m^3/sec)		Runoff Volume (mm/m^2)	
		2.5 ha	48 ha	2.5 ha	48 ha
1	12 hour 2 year Chicago	0.002	0.001	0.41	0.02
2	12 hour 5 year Chicago	0.004	0.001	0.6	0.03
3	12 hour 50 year Chicago	0.007	0.002	0.98	0.05
4	12 hour 100 year Chicago	0.007	0.005	1.1	0.05
5	Historical August 4, 1988	0.007	0.005	0.92	0.05
6	Historical July 1, 1979	0.007	0.005	0.96	0.05

The positive difference in the runoff rate of 0.002 to 0.007 m^3/sec and runoff volume of 0.41 to 1.1 mm/m^2 indicates that the roadway extension will result in a slight increase in runoff rate from the portion of the 2.5 ha catchment area immediately affected by the extension. This increase represents an increase of between about 3 to 8 percent when compared to predevelopment levels.

The calculated increase in runoff rate of 0.001 to 0.005 m^3/sec during the various design storms for the entire 48 ha portion of the watershed created on the watercourse adjacent to the roadway extension is somewhat less due in part to a non-coincident peak. The increase in runoff rates of the entire 48 ha watershed when compared to the pre-development rate represents an increase of 0.1 to 0.4 percent.

Also calculated was the increase in runoff volume as a result of the proposed roadway expansion. The above calculated increases in runoff volume indicated in units of mm/m^2 correspond to total volume increases of 10 m^3 for the 2 year 12 hour design storm to 28 m^3 for the 100 year 12 hour design storm when considering the 2.5 hectare catchment area.

These increases in runoff rate and volume are inconsequential when considering the runoff rate and volume from the affected watershed.

8 AFFECT OF INCREASED DEMAND ON WATERCOURSE

As previously indicated the receiving watercourse for the catchment area affected by the proposed roadway extension has a capacity of about 1.7 to 3.1 m^3/sec. The above calculated runoff rates from the approximately 48 hectare watershed discharging to the watercourse range from 0.282 to 2.939 m^3/sec for the various design storms.

Since the calculated flow demand is 1.773 m^3/sec during the 50 year design storm, there is expected to be minor flooding of the watercourse in some sections during a 50 year design storm under existing conditions. The calculated flow velocity in the ditch during the 50 year design storm is about 1.3 m/s. The calculated flow rate of 2.939 m^3/sec resulting from the July 1, 1979 historical design storm results in a flow velocity of about 1.49 m/s. The increase in flow rate to 1.777 m^3/sec during a 50 year design storm will not have a and 2.944 m^3/s during the July 1, 1979 historical design storm as a result of the roadway extension do not significantly increase the flow depth or velocity from the pre-development conditions.

9 QUALITY CONTROL CONSIDERATIONS

Quality control of runoff from the roadway surface of the proposed extension will be provided in a similar manner to that which is provided for the existing opened portion of Lowe Road. As with the existing opened portion of Lowe Road, the source of suspended solids along the proposed roadway is limited due to the limited width of the proposed roadway. With a limited roadway with, the runoff rate and volume generated on the roadway which will carry suspended particles from the roadway is low. This allows the runoff to be treated by low impact development techniques.

Quality control will be achieved by vegetative filtration by ensuring that the runoff from the roadway is directed over the vegetated surfaces of the roadside ditches and the enhanced grassed swale. The Natural Resources Conservation Service (USDA) indicates that a vegetated filter width of in the order of 6.1 metres (20 feet) is will remove suspended solids. A minimum length of 9.1 metres is required to reduce dissolved contaminates in runoff.

Research has shown that vegetative filters can partially remove sediments and pollutants attached to sediment particles in runoff. Field experiments on vegetative filter strips showed average sediment removal varying from 50 to 98% as flow path length increases from 2.5 to 10 metres. The research indicates that almost all particles larger than 40 microns in diameter are captured within the first five meters of a filter strip provided the flow velocity is limited to less than 0.5 m/s during the quality control storm event. About 50% of the sediments are removed within the first 2.5 metre of travel over the vegetative filter flow path. An additional 25% to 45% of sediments are removed within the next 2.5 m of the flow path depending on the flow ate and velocity. The removal efficiency of the vegetative filtration does not significantly increase with a flow path length beyond 10 m.

The Ministry of Transportation Stormwater Management Drainage Design Standards SW-3 Roadside Ditches for Water Quality indicates that the minimum roadside embankment should be 3 metres in length measured transversely from the outside of the shoulder to the invert of the adjacent roadside ditch. The embankment should be planted with dense vegetative cover. The standard further indicates that the ditch bottom should have a minimum width of 1 m.

It is proposed to construct the roadway shallow ditches along both sides of the road. The ditches will be sufficiently deep to provide drainage for the roadway granular structure. There are no proposed culvert crossings along the proposed Lowe Road extension. Flow will be directed by the shallow ditches to the end of the roadway extension. The flow will then be directed to the existing watercourse along a flat bottomed enhanced grassed swale.

The invert of the ditch will be located a minimum distance of 3.0 metres from the edge of the gravel surface of the roadway. The side slope of the ditch will be less than 3H:1V. The bottom width of the roadside ditch and the grassed swale connecting the roadside ditches to the watercourse will be 1.0 metres.

The Ministry of Environment design guidance on the use of grasses swales for water quality control indicates that the flow velocity should be less than 0.5 m/s, the flow rate should be less than 0.15 m^3/s and the flow depth should be less than 0.5 m.

The Ministry of Environment quality control storm event (25 mm 4 hour Chicago design storm) produces a peak rainfall rate of 0.006 m^3/sec from the 2.5 hectare catchment directly affected by the proposed roadway expansion. This flow rate results in flow velocity of less than 0.2 m/s and flow depth of less than 0.1 metres within the roadside ditch.

The proposed ditch length, bottom width and embankment width meet the physical requirements for the use of ditches and grass swales for quality control. The flow rate, flow depth and flow velocity are all less than the maximum allowable values during a quality storm event. As such the proposed ditches will be sufficient to achieve the required level of quality control for runoff from the proposed roadway extension.

10 SEDIMENT AND EROSION CONTROL

The owner (and/or contractor) agrees to prepare and implement an erosion and sediment control plan at least equal to the stated minimum requirements and to the satisfaction of the City of Ottawa and the Conservation Authority, appropriate to the site conditions, prior to undertaking any site alterations (filling, grading, removal of vegetation, etc.) and during all phases of site preparation and construction in general accordance with the current best management practices for erosion and sediment control. It is considered to be the owners and/or contractors responsibility to ensure that the erosion control measures are implemented and maintained.

In order to limit the amount of sediment carried in stormwater runoff from the site during construction, it is recommended to install a silt fence along the limits of both sides of the roadway. The silt fence may be polypropylene, nylon, and polyester or ethylene yarn.

If a standard filter fabric is used, it must be backed by a wire fence supported on posts not over 2.0 m apart. Extra strength filter fabric may be used without a wire fence backing if posts are not over 1.0 m apart. Fabric joints should be lapped at least 150 mm (6") and stapled. The bottom edge of the filter fabric should be anchored in a 300 mm (1 ft) deep trench, to prevent flow under the fence. Sections of fence should be cleaned, if blocked with sediment and replaced if torn.

The side slopes of the roadway and adjacent disturbed areas should be hydroseeded to re-establish the vegetation growth as soon as possible.

The silt fences should only be removed once the site is stabilized and vegetation is established.

These measures will reduce the amount of sediment carried from the site during storm events that may occur during construction.

11 CONCLUSIONS

The proposed roadway extension is located at the north end of Lowe Road about 1.2 km north of McArton Road. Lowe Road crosses the crest between two watersheds at about 500 metres northwest of McArton Road. The crest between the watersheds is oriented in a north south direction sub-parallel to Lowe Road. The proposed roadway extension is west of the crest between the watersheds. General overland flow west of the crest is to an existing watercourse west of Lowe Road. This existing water course is the receiving waterbody for the portion of the watershed catchment area affected by the roadway extension.

The proposed roadway extension will be constructed with shallow ditching to match the existing roadway construction and to promote water quality control by means of vegetative filtration.

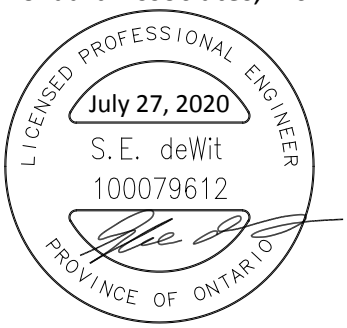
The construction of the proposed roadway will result in a minor increase in the stormwater runoff rate into the adjacent respective unevaluated wetland areas. The increase is less than 1 percent for major storm events and is inconsequential. The increase in runoff will not have a significant effect on the receiving watercourse.

Quality control will be provided by the removal of suspended solids by means of vegetative filtration. There is sufficient length of flow to ensure an enhanced level of treatment.

During all construction activities, erosion and sedimentation shall be controlled.

We trust that this report provides sufficient information for your present purposes. If you have any questions concerning this report or if we can be of any further assistance to you on this project, please do not hesitate to contact our office.

Sincerely,
Kollaard Associates, Inc.



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Steven deWit, P.Eng.

APPENDIX A – OTTHYMO MODEL – DETAILED OUTPUT

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       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
       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
```


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

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

CHICAGO STORM
Ptotal= 42.34 mm

IDF curve parameters: A= 732.951
B= 6.199
C= .810
used in: INTENSITY = A / (t + B)^C

Duration of storm = 12.00 hrs
Storm time step = 10.00 min
Time to peak ratio = .33

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.17	.72	3.17	2.81	6.17	2.12	9.17	1.00
.33	.75	3.33	3.50	6.33	1.99	9.33	.97
.50	.78	3.50	4.69	6.50	1.87	9.50	.95
.67	.82	3.67	7.30	6.67	1.77	9.67	.93
.83	.85	3.83	18.21	6.83	1.68	9.83	.90
1.00	.89	4.00	76.81	7.00	1.60	10.00	.88
1.17	.94	4.17	24.08	7.17	1.52	10.17	.86
1.33	.99	4.33	12.36	7.33	1.46	10.33	.84
1.50	1.04	4.50	8.32	7.50	1.40	10.50	.82
1.67	1.11	4.67	6.30	7.67	1.34	10.67	.81
1.83	1.18	4.83	5.09	7.83	1.29	10.83	.79
2.00	1.27	5.00	4.29	8.00	1.24	11.00	.78
2.17	1.37	5.17	3.72	8.17	1.20	11.17	.76
2.33	1.49	5.33	3.29	8.33	1.16	11.33	.75
2.50	1.63	5.50	2.95	8.50	1.13	11.50	.73
2.67	1.82	5.67	2.68	8.67	1.09	11.67	.72
2.83	2.05	5.83	2.46	8.83	1.06	11.83	.71
3.00	2.37	6.00	2.28	9.00	1.03	12.00	.69

CALIB

```
| NASHYD    (0002) |   Area    (ha)=   2.50   Curve Number   (CN)= 71.6
|ID= 1 DT=10.0 min |   Ia      (mm)=  10.10   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .27

     Unit Hyd Qpeak  (cms)=    .354

     PEAK FLOW       (cms)=    .031 (i)
     TIME TO PEAK    (hrs)=   4.333
     RUNOFF VOLUME    (mm)=   7.741
     TOTAL RAINFALL   (mm)=  42.344
     RUNOFF COEFFICIENT   =    .183

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

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD    (0001) |   Area    (ha)=  45.50   Curve Number   (CN)= 71.6
|ID= 1 DT=10.0 min |   Ia      (mm)=  10.10   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .34

     Unit Hyd Qpeak  (cms)=   5.111

     PEAK FLOW       (cms)=    .498 (i)
     TIME TO PEAK    (hrs)=   4.333
     RUNOFF VOLUME    (mm)=   7.781
     TOTAL RAINFALL   (mm)=  42.344
     RUNOFF COEFFICIENT   =    .184

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

--------------------------------------------------------------------------------
--------------------
| ROUTE CHN (0010) |
| IN= 2---> OUT= 1 |     Routing time step (min)'=  5.00
--------------------
               <------ DATA FOR SECTION (   1.1) ------>
               Distance      Elevation       Manning
                    .00        101.50         .0500
                   1.00        100.70         .0500
                   1.50        100.55     .0500 / .0450  Main Channel
                   2.00         99.50         .0450      Main Channel
                   3.50         99.60         .0450      Main Channel
                   4.50        100.65     .0450 / .0500  Main Channel
                   6.00        101.45         .0500

      <---------------------- TRAVEL TIME TABLE ---------------------->
       DEPTH    ELEV      VOLUME    FLOW RATE    VELOCITY   TRAV.TIME
        (m)      (m)     (cu.m.)      (cms)        (m/s)      (min)
        .10    99.60    .129E+02        .0           .16      18.67
        .19    99.69    .410E+02        .1           .31       9.73
        .29    99.79    .715E+02        .2           .42       7.28
        .38    99.88    .104E+03        .3           .50       6.08
        .48    99.98    .140E+03        .4           .57       5.34
        .57   100.07    .177E+03        .6           .63       4.84
        .67   100.17    .217E+03        .8           .68       4.46
        .76   100.26    .260E+03       1.0           .73       4.16
        .86   100.36    .304E+03       1.3           .78       3.92
        .95   100.45    .352E+03       1.6           .82       3.72
       1.05   100.55    .401E+03       1.9           .86       3.55
       1.16   100.66    .466E+03       2.3           .92       3.33
```

1.28	100.78	.541E+03	2.9	.98	3.12
1.39	100.89	.623E+03	3.5	1.03	2.95
1.50	101.00	.713E+03	4.2	1.09	2.81
1.61	101.11	.810E+03	5.0	1.13	2.69
1.72	101.22	.914E+03	5.9	1.18	2.59
1.84	101.34	.103E+04	6.8	1.22	2.51
1.95	101.45	.114E+04	7.9	1.26	2.43

	<---- hydrograph ---->			<-pipe / channel->	
	AREA	QPEAK	TPEAK	R.V.	MAX DEPTH	MAX VEL
	(ha)	(cms)	(hrs)	(mm)	(m)	(m/s)
INFLOW : ID= 2 (0002)	2.50	.03	4.33	7.74	.13	.19
OUTFLOW: ID= 1 (0010)	2.50	.02	4.50	7.70	.12	.18

ROUTE CHN (0007)
IN= 2---> OUT= 1

Routing time step (min)'= 5.00

<------ DATA FOR SECTION (1.1) ------>

Distance	Elevation	Manning	
.00	101.50	.0500	
1.00	100.70	.0500	
1.50	100.55	.0500 / .0450	Main Channel
2.00	99.50	.0450	Main Channel
3.50	99.60	.0450	Main Channel
4.50	100.65	.0450 / .0500	Main Channel
6.00	101.45	.0500	

<---------- TRAVEL TIME TABLE ---------->

DEPTH (m)	ELEV (m)	VOLUME (cu.m.)	FLOW RATE (cms)	VELOCITY (m/s)	TRAV.TIME (min)
.10	99.60	.120E+03	.0	.16	173.47
.19	99.69	.381E+03	.1	.31	90.37
.29	99.79	.664E+03	.2	.42	67.63
.38	99.88	.969E+03	.3	.50	56.48
.48	99.98	.130E+04	.4	.57	49.65
.57	100.07	.165E+04	.6	.63	44.93
.67	100.17	.202E+04	.8	.68	41.43
.76	100.26	.241E+04	1.0	.73	38.68
.86	100.36	.283E+04	1.3	.78	36.46
.95	100.45	.327E+04	1.6	.82	34.60
1.05	100.55	.373E+04	1.9	.86	33.02
1.16	100.66	.433E+04	2.3	.92	30.95
1.28	100.78	.502E+04	2.9	.98	28.95
1.39	100.89	.579E+04	3.5	1.03	27.38
1.50	101.00	.662E+04	4.2	1.09	26.10
1.61	101.11	.752E+04	5.0	1.13	25.03
1.72	101.22	.849E+04	5.9	1.18	24.10
1.84	101.34	.953E+04	6.8	1.22	23.29
1.95	101.45	.106E+05	7.9	1.26	22.56

	<---- hydrograph ---->			<-pipe / channel->	
	AREA	QPEAK	TPEAK	R.V.	MAX DEPTH	MAX VEL
	(ha)	(cms)	(hrs)	(mm)	(m)	(m/s)
INFLOW : ID= 2 (0001)	45.50	.50	4.33	7.78	.51	.59
OUTFLOW: ID= 1 (0007)	45.50	.26	4.92	7.76	.36	.48

```
--------------------
| ADD HYD   (0011) |
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
         ID1= 1 (0010):     2.50    .024     4.50     7.70
       + ID2= 2 (0007):    45.50    .263     4.92     7.76
         ================================================
         ID = 3 (0011):    48.00    .282     4.92     7.76

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

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

--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 998.071
| Ptotal= 56.17 mm |                          B=   6.053
--------------------                          C=    .814
                         used in:   INTENSITY =  A / (t + B)^C

                         Duration of storm  = 12.00 hrs
                         Storm time step    = 10.00 min
                         Time to peak ratio =   .33

                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                 .17     .94 |  3.17    3.68 |  6.17    2.77 |  9.17    1.30
                 .33     .98 |  3.33    4.58 |  6.33    2.60 |  9.33    1.27
                 .50    1.02 |  3.50    6.15 |  6.50    2.44 |  9.50    1.24
                 .67    1.06 |  3.67    9.61 |  6.67    2.31 |  9.67    1.20
                 .83    1.11 |  3.83   24.17 |  6.83    2.19 |  9.83    1.17
                1.00    1.16 |  4.00  104.19 |  7.00    2.08 | 10.00    1.15
                1.17    1.22 |  4.17   32.04 |  7.17    1.99 | 10.17    1.12
                1.33    1.28 |  4.33   16.34 |  7.33    1.90 | 10.33    1.10
                1.50    1.36 |  4.50   10.96 |  7.50    1.82 | 10.50    1.07
                1.67    1.44 |  4.67    8.29 |  7.67    1.75 | 10.67    1.05
                1.83    1.54 |  4.83    6.69 |  7.83    1.68 | 10.83    1.03
                2.00    1.65 |  5.00    5.63 |  8.00    1.62 | 11.00    1.01
                2.17    1.78 |  5.17    4.87 |  8.17    1.57 | 11.17     .99
                2.33    1.94 |  5.33    4.30 |  8.33    1.51 | 11.33     .97
                2.50    2.13 |  5.50    3.86 |  8.50    1.47 | 11.50     .95
                2.67    2.37 |  5.67    3.51 |  8.67    1.42 | 11.67     .93
                2.83    2.68 |  5.83    3.22 |  8.83    1.38 | 11.83     .92
                3.00    3.10 |  6.00    2.98 |  9.00    1.34 | 12.00     .90


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--------------------
| CALIB            |
| NASHYD    (0002) |   Area    (ha)=   2.50   Curve Number   (CN)= 71.6
|ID= 1 DT=10.0 min |   Ia      (mm)=  10.10   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .27

     Unit Hyd Qpeak  (cms)=    .354

     PEAK FLOW       (cms)=    .064 (i)
     TIME TO PEAK    (hrs)=   4.167
     RUNOFF VOLUME    (mm)=  14.317
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     TOTAL RAINFALL   (mm)=  56.170
     RUNOFF COEFFICIENT   =    .255

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

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--------------------
| CALIB            |
| NASHYD    (0001) |   Area    (ha)=  45.50   Curve Number   (CN)= 71.6
|ID= 1 DT=10.0 min |   Ia      (mm)=  10.10   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .34

     Unit Hyd Qpeak  (cms)=   5.111

     PEAK FLOW       (cms)=   1.058 (i)
     TIME TO PEAK    (hrs)=   4.333
     RUNOFF VOLUME    (mm)=  14.390
     TOTAL RAINFALL   (mm)=  56.170
     RUNOFF COEFFICIENT   =    .256

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

--------------------------------------------------------------------------------
--------------------
| ROUTE CHN (0010) |
| IN= 2---> OUT= 1 |     Routing time step (min)'=  5.00
--------------------
               <------ DATA FOR SECTION (   1.1) ------>
               Distance      Elevation       Manning
                    .00        101.50         .0500
                   1.00        100.70         .0500
                   1.50        100.55     .0500 / .0450  Main Channel
                   2.00         99.50         .0450      Main Channel
                   3.50         99.60         .0450      Main Channel
                   4.50        100.65     .0450 / .0500  Main Channel
                   6.00        101.45         .0500

     <---------------------- TRAVEL TIME TABLE ---------------------->
      DEPTH    ELEV      VOLUME    FLOW RATE    VELOCITY   TRAV.TIME
       (m)      (m)     (cu.m.)      (cms)        (m/s)      (min)
       .10    99.60    .129E+02        .0          .16       18.67
       .19    99.69    .410E+02        .1          .31        9.73
       .29    99.79    .715E+02        .2          .42        7.28
       .38    99.88    .104E+03        .3          .50        6.08
       .48    99.98    .140E+03        .4          .57        5.34
       .57   100.07    .177E+03        .6          .63        4.84
       .67   100.17    .217E+03        .8          .68        4.46
       .76   100.26    .260E+03       1.0          .73        4.16
       .86   100.36    .304E+03       1.3          .78        3.92
       .95   100.45    .352E+03       1.6          .82        3.72
      1.05   100.55    .401E+03       1.9          .86        3.55
      1.16   100.66    .466E+03       2.3          .92        3.33
      1.28   100.78    .541E+03       2.9          .98        3.12
      1.39   100.89    .623E+03       3.5         1.03        2.95
      1.50   101.00    .713E+03       4.2         1.09        2.81
      1.61   101.11    .810E+03       5.0         1.13        2.69
      1.72   101.22    .914E+03       5.9         1.18        2.59
      1.84   101.34    .103E+04       6.8         1.22        2.51
      1.95   101.45    .114E+04       7.9         1.26        2.43

                                  <---- hydrograph ---->   <-pipe / channel->
```

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)	MAX DEPTH (m)	MAX VEL (m/s)
INFLOW : ID= 2 (0002)	2.50	.06	4.17	14.32	.18	.29
OUTFLOW: ID= 1 (0010)	2.50	.06	4.42	14.28	.17	.26

ROUTE CHN (0007)
IN= 2---> OUT= 1

Routing time step (min)'= 5.00

<------ DATA FOR SECTION (1.1) ------>

Distance	Elevation	Manning	
.00	101.50	.0500	
1.00	100.70	.0500	
1.50	100.55	.0500 / .0450	Main Channel
2.00	99.50	.0450	Main Channel
3.50	99.60	.0450	Main Channel
4.50	100.65	.0450 / .0500	Main Channel
6.00	101.45	.0500	

<---------- TRAVEL TIME TABLE ---------->

DEPTH (m)	ELEV (m)	VOLUME (cu.m.)	FLOW RATE (cms)	VELOCITY (m/s)	TRAV.TIME (min)
.10	99.60	.120E+03	.0	.16	173.47
.19	99.69	.381E+03	.1	.31	90.37
.29	99.79	.664E+03	.2	.42	67.63
.38	99.88	.969E+03	.3	.50	56.48
.48	99.98	.130E+04	.4	.57	49.65
.57	100.07	.165E+04	.6	.63	44.93
.67	100.17	.202E+04	.8	.68	41.43
.76	100.26	.241E+04	1.0	.73	38.68
.86	100.36	.283E+04	1.3	.78	36.46
.95	100.45	.327E+04	1.6	.82	34.60
1.05	100.55	.373E+04	1.9	.86	33.02
1.16	100.66	.433E+04	2.3	.92	30.95
1.28	100.78	.502E+04	2.9	.98	28.95
1.39	100.89	.579E+04	3.5	1.03	27.38
1.50	101.00	.662E+04	4.2	1.09	26.10
1.61	101.11	.752E+04	5.0	1.13	25.03
1.72	101.22	.849E+04	5.9	1.18	24.10
1.84	101.34	.953E+04	6.8	1.22	23.29
1.95	101.45	.106E+05	7.9	1.26	22.56

		<---- hydrograph ---->			<-pipe / channel->	
	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)	MAX DEPTH (m)	MAX VEL (m/s)
INFLOW : ID= 2 (0001)	45.50	1.06	4.33	14.39	.77	.74
OUTFLOW: ID= 1 (0007)	45.50	.60	4.75	14.37	.57	.63

ADD HYD (0011)
1 + 2 = 3

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0010):	2.50	.058	4.42	14.28
+ ID2= 2 (0007):	45.50	.603	4.75	14.37
ID = 3 (0011):	48.00	.644	4.75	14.36

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

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

| CHICAGO STORM | Ptotal= 84.91 mm |

IDF curve parameters: A=1569.580
B= 6.014
C= .820
used in: INTENSITY = A / (t + B)^C

Duration of storm = 12.00 hrs
Storm time step = 10.00 min
Time to peak ratio = .33

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.17	1.38	3.17	5.47	6.17	4.10	9.17	1.91
.33	1.43	3.33	6.82	6.33	3.84	9.33	1.86
.50	1.49	3.50	9.19	6.50	3.61	9.50	1.81
.67	1.55	3.67	14.44	6.67	3.41	9.67	1.77
.83	1.62	3.83	36.76	6.83	3.23	9.83	1.72
1.00	1.70	4.00	161.47	7.00	3.07	10.00	1.68
1.17	1.79	4.17	48.88	7.17	2.93	10.17	1.64
1.33	1.89	4.33	24.70	7.33	2.80	10.33	1.61
1.50	2.00	4.50	16.49	7.50	2.68	10.50	1.57
1.67	2.12	4.67	12.42	7.67	2.58	10.67	1.54
1.83	2.26	4.83	10.00	7.83	2.48	10.83	1.51
2.00	2.43	5.00	8.40	8.00	2.39	11.00	1.48
2.17	2.63	5.17	7.26	8.17	2.30	11.17	1.45
2.33	2.86	5.33	6.40	8.33	2.23	11.33	1.42
2.50	3.15	5.50	5.74	8.50	2.16	11.50	1.39
2.67	3.51	5.67	5.21	8.67	2.09	11.67	1.37
2.83	3.97	5.83	4.77	8.83	2.03	11.83	1.34
3.00	4.59	6.00	4.41	9.00	1.97	12.00	1.32

| CALIB | NASHYD (0002) | ID= 1 DT=10.0 min |

Area (ha)= 2.50 Curve Number (CN)= 71.6
Ia (mm)= 10.10 # of Linear Res.(N)= 3.00
U.H. Tp(hrs)= .27

Unit Hyd Qpeak (cms)= .354

PEAK FLOW (cms)= .167 (i)
TIME TO PEAK (hrs)= 4.167
RUNOFF VOLUME (mm)= 31.580
TOTAL RAINFALL (mm)= 84.914
RUNOFF COEFFICIENT = .372

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

| CALIB | NASHYD (0001) |

Area (ha)= 45.50 Curve Number (CN)= 71.6

```
|ID= 1 DT=10.0 min |   Ia      (mm)=  10.10   # of Linear Res.(N)= 3.00
-------------------   U.H. Tp(hrs)=    .34

     Unit Hyd Qpeak  (cms)=   5.111

     PEAK FLOW       (cms)=   2.650 (i)
     TIME TO PEAK    (hrs)=   4.333
     RUNOFF VOLUME    (mm)=  31.740
     TOTAL RAINFALL   (mm)=  84.914
     RUNOFF COEFFICIENT   =    .374

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

--------------------------------------------------------------------------------
--------------------
| ROUTE CHN (0010) |
| IN= 2---> OUT= 1 |     Routing time step (min)'=  5.00
--------------------
               <------ DATA FOR SECTION (   1.1) ------>
               Distance      Elevation       Manning
                    .00        101.50         .0500
                   1.00        100.70         .0500
                   1.50        100.55     .0500 / .0450  Main Channel
                   2.00         99.50         .0450      Main Channel
                   3.50         99.60         .0450      Main Channel
                   4.50        100.65     .0450 / .0500  Main Channel
                   6.00        101.45         .0500

      <---------------------- TRAVEL TIME TABLE ---------------------->
       DEPTH    ELEV      VOLUME    FLOW RATE    VELOCITY   TRAV.TIME
        (m)      (m)     (cu.m.)      (cms)        (m/s)      (min)
        .10    99.60    .129E+02        .0           .16      18.67
        .19    99.69    .410E+02        .1           .31       9.73
        .29    99.79    .715E+02        .2           .42       7.28
        .38    99.88    .104E+03        .3           .50       6.08
        .48    99.98    .140E+03        .4           .57       5.34
        .57   100.07    .177E+03        .6           .63       4.84
        .67   100.17    .217E+03        .8           .68       4.46
        .76   100.26    .260E+03       1.0           .73       4.16
        .86   100.36    .304E+03       1.3           .78       3.92
        .95   100.45    .352E+03       1.6           .82       3.72
       1.05   100.55    .401E+03       1.9           .86       3.55
       1.16   100.66    .466E+03       2.3           .92       3.33
       1.28   100.78    .541E+03       2.9           .98       3.12
       1.39   100.89    .623E+03       3.5          1.03       2.95
       1.50   101.00    .713E+03       4.2          1.09       2.81
       1.61   101.11    .810E+03       5.0          1.13       2.69
       1.72   101.22    .914E+03       5.9          1.18       2.59
       1.84   101.34    .103E+04       6.8          1.22       2.51
       1.95   101.45    .114E+04       7.9          1.26       2.43

                                    <---- hydrograph ---->   <-pipe / channel->
                            AREA     QPEAK   TPEAK   R.V.   MAX DEPTH  MAX VEL
                            (ha)     (cms)   (hrs)   (mm)      (m)      (m/s)
     INFLOW : ID= 2 (0002)    2.50      .17    4.17  31.58       .29       .42
     OUTFLOW: ID= 1 (0010)    2.50      .16    4.33  31.54       .28       .41


--------------------------------------------------------------------------------
--------------------
| ROUTE CHN (0007) |
```

```
| IN= 2---> OUT= 1 |     Routing time step (min)'=  5.00
--------------------
               <------ DATA FOR SECTION (   1.1) ------>
               Distance      Elevation       Manning
                    .00        101.50         .0500
                   1.00        100.70         .0500
                   1.50        100.55     .0500 / .0450  Main Channel
                   2.00         99.50         .0450      Main Channel
                   3.50         99.60         .0450      Main Channel
                   4.50        100.65     .0450 / .0500  Main Channel
                   6.00        101.45         .0500
```

<-------------------- TRAVEL TIME TABLE ---------------------->

DEPTH (m)	ELEV (m)	VOLUME (cu.m.)	FLOW RATE (cms)	VELOCITY (m/s)	TRAV.TIME (min)
.10	99.60	.120E+03	.0	.16	173.47
.19	99.69	.381E+03	.1	.31	90.37
.29	99.79	.664E+03	.2	.42	67.63
.38	99.88	.969E+03	.3	.50	56.48
.48	99.98	.130E+04	.4	.57	49.65
.57	100.07	.165E+04	.6	.63	44.93
.67	100.17	.202E+04	.8	.68	41.43
.76	100.26	.241E+04	1.0	.73	38.68
.86	100.36	.283E+04	1.3	.78	36.46
.95	100.45	.327E+04	1.6	.82	34.60
1.05	100.55	.373E+04	1.9	.86	33.02
1.16	100.66	.433E+04	2.3	.92	30.95
1.28	100.78	.502E+04	2.9	.98	28.95
1.39	100.89	.579E+04	3.5	1.03	27.38
1.50	101.00	.662E+04	4.2	1.09	26.10
1.61	101.11	.752E+04	5.0	1.13	25.03
1.72	101.22	.849E+04	5.9	1.18	24.10
1.84	101.34	.953E+04	6.8	1.22	23.29
1.95	101.45	.106E+05	7.9	1.26	22.56

		<---- hydrograph ---->			<-pipe / channel->	
	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)	MAX DEPTH (m)	MAX VEL (m/s)
INFLOW : ID= 2 (0001)	45.50	2.65	4.33	31.74	1.23	.95
OUTFLOW: ID= 1 (0007)	45.50	1.67	4.67	31.72	.98	.83

```
--------------------
| ADD HYD   (0011) |
|   1 +  2 =  3    |
--------------------
```

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0010):	2.50	.156	4.33	31.54
+ ID2= 2 (0007):	45.50	1.670	4.67	31.72
ID = 3 (0011):	48.00	1.775	4.67	31.71

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

```
  ***************************
  ** SIMULATION NUMBER:   4 **
  ***************************

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

```
| CHICAGO STORM    |    IDF curve parameters: A=1770.000
| Ptotal= 95.76 mm |                          B=   6.014
--------------------                          C=    .820
                       used in:   INTENSITY =  A / (t + B)^C

                       Duration of storm  = 12.00 hrs
                       Storm time step    = 10.00 min
                       Time to peak ratio =   .33
```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.17	1.55	3.17	6.17	6.17	4.63	9.17	2.16
.33	1.61	3.33	7.69	6.33	4.33	9.33	2.10
.50	1.68	3.50	10.36	6.50	4.07	9.50	2.05
.67	1.75	3.67	16.28	6.67	3.84	9.67	1.99
.83	1.83	3.83	41.46	6.83	3.64	9.83	1.95
1.00	1.92	4.00	182.09	7.00	3.46	10.00	1.90
1.17	2.02	4.17	55.12	7.17	3.30	10.17	1.85
1.33	2.13	4.33	27.86	7.33	3.16	10.33	1.81
1.50	2.25	4.50	18.60	7.50	3.02	10.50	1.77
1.67	2.39	4.67	14.01	7.67	2.90	10.67	1.74
1.83	2.55	4.83	11.28	7.83	2.79	10.83	1.70
2.00	2.74	5.00	9.47	8.00	2.69	11.00	1.67
2.17	2.96	5.17	8.18	8.17	2.60	11.17	1.63
2.33	3.23	5.33	7.22	8.33	2.51	11.33	1.60
2.50	3.55	5.50	6.47	8.50	2.43	11.50	1.57
2.67	3.95	5.67	5.87	8.67	2.36	11.67	1.54
2.83	4.47	5.83	5.38	8.83	2.29	11.83	1.51
3.00	5.17	6.00	4.98	9.00	2.22	12.00	1.49

```
--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD    (0002) |   Area    (ha)=   2.50   Curve Number   (CN)= 71.6
|ID= 1 DT=10.0 min |   Ia      (mm)=  10.10   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .27

     Unit Hyd Qpeak  (cms)=    .354

     PEAK FLOW       (cms)=    .212 (i)
     TIME TO PEAK    (hrs)=   4.167
     RUNOFF VOLUME    (mm)=  38.991
     TOTAL RAINFALL   (mm)=  95.756
     RUNOFF COEFFICIENT   =    .407

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

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD    (0001) |   Area    (ha)=  45.50   Curve Number   (CN)= 71.6
|ID= 1 DT=10.0 min |   Ia      (mm)=  10.10   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .34

     Unit Hyd Qpeak  (cms)=   5.111

     PEAK FLOW       (cms)=   3.344 (i)
     TIME TO PEAK    (hrs)=   4.333
     RUNOFF VOLUME    (mm)=  39.189
     TOTAL RAINFALL   (mm)=  95.756
```

```
     RUNOFF COEFFICIENT   =    .409

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

--------------------------------------------------------------------------------
--------------------
| ROUTE CHN (0010) |
| IN= 2---> OUT= 1 |     Routing time step (min)'=  5.00
--------------------
               <------ DATA FOR SECTION (   1.1) ------>
               Distance      Elevation       Manning
                    .00        101.50         .0500
                   1.00        100.70         .0500
                   1.50        100.55     .0500 / .0450  Main Channel
                   2.00         99.50         .0450      Main Channel
                   3.50         99.60         .0450      Main Channel
                   4.50        100.65     .0450 / .0500  Main Channel
                   6.00        101.45         .0500

      <--------------------- TRAVEL TIME TABLE ---------------------->
       DEPTH    ELEV      VOLUME    FLOW RATE    VELOCITY   TRAV.TIME
        (m)      (m)     (cu.m.)      (cms)        (m/s)      (min)
        .10    99.60    .129E+02        .0           .16      18.67
        .19    99.69    .410E+02        .1           .31       9.73
        .29    99.79    .715E+02        .2           .42       7.28
        .38    99.88    .104E+03        .3           .50       6.08
        .48    99.98    .140E+03        .4           .57       5.34
        .57   100.07    .177E+03        .6           .63       4.84
        .67   100.17    .217E+03        .8           .68       4.46
        .76   100.26    .260E+03       1.0           .73       4.16
        .86   100.36    .304E+03       1.3           .78       3.92
        .95   100.45    .352E+03       1.6           .82       3.72
       1.05   100.55    .401E+03       1.9           .86       3.55
       1.16   100.66    .466E+03       2.3           .92       3.33
       1.28   100.78    .541E+03       2.9           .98       3.12
       1.39   100.89    .623E+03       3.5          1.03       2.95
       1.50   101.00    .713E+03       4.2          1.09       2.81
       1.61   101.11    .810E+03       5.0          1.13       2.69
       1.72   101.22    .914E+03       5.9          1.18       2.59
       1.84   101.34    .103E+04       6.8          1.22       2.51
       1.95   101.45    .114E+04       7.9          1.26       2.43

                                    <---- hydrograph ---->   <-pipe / channel->
                            AREA     QPEAK   TPEAK   R.V.   MAX DEPTH  MAX VEL
                            (ha)     (cms)   (hrs)   (mm)      (m)      (m/s)
     INFLOW : ID= 2 (0002)    2.50      .21    4.17  38.99       .32       .45
     OUTFLOW: ID= 1 (0010)    2.50      .20    4.33  38.95       .31       .44


--------------------------------------------------------------------------------
--------------------
| ROUTE CHN (0007) |
| IN= 2---> OUT= 1 |     Routing time step (min)'=  5.00
--------------------
               <------ DATA FOR SECTION (   1.1) ------>
               Distance      Elevation       Manning
                    .00        101.50         .0500
                   1.00        100.70         .0500
                   1.50        100.55     .0500 / .0450  Main Channel
                   2.00         99.50         .0450      Main Channel
                   3.50         99.60         .0450      Main Channel
```

```
                4.50        100.65     .0450 / .0500  Main Channel
                6.00        101.45         .0500
```

<-------------------- TRAVEL TIME TABLE ---------------------->

DEPTH (m)	ELEV (m)	VOLUME (cu.m.)	FLOW RATE (cms)	VELOCITY (m/s)	TRAV.TIME (min)
.10	99.60	.120E+03	.0	.16	173.47
.19	99.69	.381E+03	.1	.31	90.37
.29	99.79	.664E+03	.2	.42	67.63
.38	99.88	.969E+03	.3	.50	56.48
.48	99.98	.130E+04	.4	.57	49.65
.57	100.07	.165E+04	.6	.63	44.93
.67	100.17	.202E+04	.8	.68	41.43
.76	100.26	.241E+04	1.0	.73	38.68
.86	100.36	.283E+04	1.3	.78	36.46
.95	100.45	.327E+04	1.6	.82	34.60
1.05	100.55	.373E+04	1.9	.86	33.02
1.16	100.66	.433E+04	2.3	.92	30.95
1.28	100.78	.502E+04	2.9	.98	28.95
1.39	100.89	.579E+04	3.5	1.03	27.38
1.50	101.00	.662E+04	4.2	1.09	26.10
1.61	101.11	.752E+04	5.0	1.13	25.03
1.72	101.22	.849E+04	5.9	1.18	24.10
1.84	101.34	.953E+04	6.8	1.22	23.29
1.95	101.45	.106E+05	7.9	1.26	22.56

		<---- hydrograph ---->			<-pipe / channel->	
	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)	MAX DEPTH (m)	MAX VEL (m/s)
INFLOW : ID= 2 (0001)	45.50	3.34	4.33	39.19	1.36	1.02
OUTFLOW: ID= 1 (0007)	45.50	2.17	4.67	39.17	1.12	.89

ADD HYD (0011)				
1 + 2 = 3	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0010):	2.50	.197	4.33	38.95
+ ID2= 2 (0007):	45.50	2.169	4.67	39.17
ID = 3 (0011):	48.00	2.306	4.58	39.16

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

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  ***************************
  ** SIMULATION NUMBER:   5 **
  ***************************
```

READ STORM	Filename: G:\Projects\2020\ 200143 - Aaron Wolf - 340 Lowe Road - Structu \Storm\Design Storm Text Files\Historical Aug
Ptotal= 80.57 mm	Comments: Ottawa Aug 4 1988

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.08	.10	1.58	27.50	3.08	14.00	4.58	.20

.17	.10	1.67	62.50	3.17	22.20	4.67	.20
.25	.00	1.75	31.80	3.25	21.80	4.75	.20
.33	3.70	1.83	79.80	3.33	1.40	4.83	.20
.42	6.20	1.92	67.50	3.42	.20	4.92	.20
.50	101.50	2.00	156.20	3.50	.20	5.00	2.90
.58	15.20	2.08	5.10	3.58	.20	5.08	7.80
.67	29.30	2.17	.20	3.67	.20	5.17	10.00
.75	19.80	2.25	.20	3.75	.20	5.25	6.30
.83	1.50	2.33	.20	3.83	.20	5.33	5.10
.92	1.70	2.42	.20	3.92	.20	5.42	9.80
1.00	5.40	2.50	.20	4.00	.20	5.50	2.60
1.08	24.60	2.58	.20	4.08	.20	5.58	1.70
1.17	26.50	2.67	.20	4.17	.20	5.67	.00
1.25	34.90	2.75	.20	4.25	.20	5.75	.00
1.33	10.20	2.83	.20	4.33	.20		
1.42	27.10	2.92	.20	4.42	.20		
1.50	104.40	3.00	12.80	4.50	.20		

CALIB			
NASHYD (0002)	Area (ha)=	2.50	Curve Number (CN)= 71.6
ID= 1 DT=10.0 min	Ia (mm)=	10.10	# of Linear Res.(N)= 3.00
	U.H. Tp(hrs)=	.27	

NOTE: RAINFALL WAS TRANSFORMED TO 10.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.167	.10	1.667	45.00	3.167	18.10	4.67	.20
.333	1.85	1.833	55.80	3.333	11.60	4.83	.20
.500	53.85	2.000	111.85	3.500	.20	5.00	1.55
.667	22.25	2.167	2.65	3.667	.20	5.17	8.90
.833	10.65	2.333	.20	3.833	.20	5.33	5.70
1.000	3.55	2.500	.20	4.000	.20	5.50	6.20
1.167	25.55	2.667	.20	4.167	.20	5.67	.85
1.333	22.55	2.833	.20	4.333	.20	5.83	.00
1.500	65.75	3.000	6.50	4.500	.20		

Unit Hyd Qpeak (cms)= .354

PEAK FLOW (cms)= .216 (i)
TIME TO PEAK (hrs)= 2.000
RUNOFF VOLUME (mm)= 28.727
TOTAL RAINFALL (mm)= 80.567
RUNOFF COEFFICIENT = .357

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

CALIB			
NASHYD (0001)	Area (ha)=	45.50	Curve Number (CN)= 71.6
ID= 1 DT=10.0 min	Ia (mm)=	10.10	# of Linear Res.(N)= 3.00
	U.H. Tp(hrs)=	.34	

Unit Hyd Qpeak (cms)= 5.111

```
     PEAK FLOW       (cms)=   3.412 (i)
     TIME TO PEAK    (hrs)=   2.167
     RUNOFF VOLUME    (mm)=  28.873
     TOTAL RAINFALL   (mm)=  80.567
     RUNOFF COEFFICIENT   =    .358

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

--------------------------------------------------------------------------------
--------------------
| ROUTE CHN (0010) |
| IN= 2---> OUT= 1 |     Routing time step (min)'=  5.00
--------------------
               <------ DATA FOR SECTION (   1.1) ------>
               Distance      Elevation       Manning
                    .00        101.50         .0500
                   1.00        100.70         .0500
                   1.50        100.55     .0500 / .0450  Main Channel
                   2.00         99.50         .0450      Main Channel
                   3.50         99.60         .0450      Main Channel
                   4.50        100.65     .0450 / .0500  Main Channel
                   6.00        101.45         .0500

      <---------------------- TRAVEL TIME TABLE ----------------------->
       DEPTH    ELEV      VOLUME    FLOW RATE    VELOCITY   TRAV.TIME
        (m)      (m)     (cu.m.)      (cms)        (m/s)      (min)
        .10    99.60    .129E+02        .0          .16       18.67
        .19    99.69    .410E+02        .1          .31        9.73
        .29    99.79    .715E+02        .2          .42        7.28
        .38    99.88    .104E+03        .3          .50        6.08
        .48    99.98    .140E+03        .4          .57        5.34
        .57   100.07    .177E+03        .6          .63        4.84
        .67   100.17    .217E+03        .8          .68        4.46
        .76   100.26    .260E+03       1.0          .73        4.16
        .86   100.36    .304E+03       1.3          .78        3.92
        .95   100.45    .352E+03       1.6          .82        3.72
       1.05   100.55    .401E+03       1.9          .86        3.55
       1.16   100.66    .466E+03       2.3          .92        3.33
       1.28   100.78    .541E+03       2.9          .98        3.12
       1.39   100.89    .623E+03       3.5         1.03        2.95
       1.50   101.00    .713E+03       4.2         1.09        2.81
       1.61   101.11    .810E+03       5.0         1.13        2.69
       1.72   101.22    .914E+03       5.9         1.18        2.59
       1.84   101.34    .103E+04       6.8         1.22        2.51
       1.95   101.45    .114E+04       7.9         1.26        2.43

                                  <---- hydrograph ---->   <-pipe / channel->
                            AREA    QPEAK   TPEAK   R.V.   MAX DEPTH  MAX VEL
                            (ha)    (cms)   (hrs)   (mm)      (m)      (m/s)
     INFLOW : ID= 2 (0002)    2.50      .22    2.00  28.73       .33       .45
     OUTFLOW: ID= 1 (0010)    2.50      .20    2.08  28.69       .31       .44


--------------------------------------------------------------------------------
--------------------
| ROUTE CHN (0007) |
| IN= 2---> OUT= 1 |     Routing time step (min)'=  5.00
--------------------
               <------ DATA FOR SECTION (   1.1) ------>
               Distance      Elevation       Manning
                    .00        101.50         .0500
```

```
                  1.00        100.70         .0500
                  1.50        100.55     .0500 / .0450  Main Channel
                  2.00         99.50         .0450      Main Channel
                  3.50         99.60         .0450      Main Channel
                  4.50        100.65     .0450 / .0500  Main Channel
                  6.00        101.45         .0500

      <---------------------- TRAVEL TIME TABLE ---------------------->
       DEPTH    ELEV      VOLUME    FLOW RATE    VELOCITY   TRAV.TIME
        (m)      (m)     (cu.m.)      (cms)        (m/s)      (min)
        .10    99.60    .120E+03        .0           .16     173.47
        .19    99.69    .381E+03        .1           .31      90.37
        .29    99.79    .664E+03        .2           .42      67.63
        .38    99.88    .969E+03        .3           .50      56.48
        .48    99.98    .130E+04        .4           .57      49.65
        .57   100.07    .165E+04        .6           .63      44.93
        .67   100.17    .202E+04        .8           .68      41.43
        .76   100.26    .241E+04       1.0           .73      38.68
        .86   100.36    .283E+04       1.3           .78      36.46
        .95   100.45    .327E+04       1.6           .82      34.60
       1.05   100.55    .373E+04       1.9           .86      33.02
       1.16   100.66    .433E+04       2.3           .92      30.95
       1.28   100.78    .502E+04       2.9           .98      28.95
       1.39   100.89    .579E+04       3.5          1.03      27.38
       1.50   101.00    .662E+04       4.2          1.09      26.10
       1.61   101.11    .752E+04       5.0          1.13      25.03
       1.72   101.22    .849E+04       5.9          1.18      24.10
       1.84   101.34    .953E+04       6.8          1.22      23.29
       1.95   101.45    .106E+05       7.9          1.26      22.56

                                    <---- hydrograph ---->   <-pipe / channel->
                             AREA    QPEAK   TPEAK   R.V.    MAX DEPTH  MAX VEL
                             (ha)    (cms)   (hrs)   (mm)      (m)      (m/s)
    INFLOW : ID= 2 (0001)   45.50     3.41    2.17  28.87      1.37      1.02
    OUTFLOW: ID= 1 (0007)   45.50     2.21    2.33  28.85      1.13       .90


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

--------------------
| ADD HYD   (0011) |
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0010):     2.50    .199     2.08    28.69
        + ID2= 2 (0007):    45.50   2.212     2.33    28.85
          ================================================
          ID = 3 (0011):    48.00   2.363     2.33    28.84

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

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


--------------------
|    READ STORM    |    Filename: G:\Projects\2020\
|                  |              200143 - Aaron Wolf - 340 Lowe Road - Structu
|                  |              \Storm\Design Storm Text Files\Historical Jul
| Ptotal= 83.99 mm |    Comments: Ottawa July 1 1979
```

```
--------------------
                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                 .08    2.30 |   .83   38.10 |  1.58   71.10 |  2.33    3.80
                 .17    2.30 |   .92   38.10 |  1.67   71.10 |  2.42    3.80
                 .25    8.89 |  1.00   38.10 |  1.75   30.50 |  2.50    3.80
                 .33    8.89 |  1.08   38.10 |  1.83   30.50 |  2.58    3.80
                 .42    8.89 |  1.17   50.80 |  1.92   30.50 |  2.67    3.80
                 .50    8.89 |  1.25   50.80 |  2.00   30.50 |  2.75    3.80
                 .58   38.10 |  1.33   76.20 |  2.08    3.80 |  2.83    3.80
                 .67   38.10 |  1.42  106.70 |  2.17    3.80 |  2.92    3.80
                 .75   38.10 |  1.50  106.70 |  2.25    3.80 |  3.00    3.80

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

--------------------
| CALIB            |
| NASHYD    (0002) |   Area    (ha)=   2.50   Curve Number   (CN)= 71.6
|ID= 1 DT=10.0 min |   Ia      (mm)=  10.10   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .27

         NOTE:  RAINFALL WAS TRANSFORMED TO  10.0 MIN. TIME STEP.


                              ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                .167    2.30 | 1.000   38.10 | 1.833   30.50 |  2.67    3.80
                .333    8.89 | 1.167   44.45 | 2.000   30.50 |  2.83    3.80
                .500    8.89 | 1.333   63.50 | 2.167    3.80 |  3.00    3.80
                .667   38.10 | 1.500  106.70 | 2.333    3.80 |
                .833   38.10 | 1.667   71.10 | 2.500    3.80 |

     Unit Hyd Qpeak  (cms)=    .354

     PEAK FLOW       (cms)=    .234 (i)
     TIME TO PEAK    (hrs)=   1.667
     RUNOFF VOLUME    (mm)=  30.967
     TOTAL RAINFALL   (mm)=  83.988
     RUNOFF COEFFICIENT   =    .369

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

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD    (0001) |   Area    (ha)=  45.50   Curve Number   (CN)= 71.6
|ID= 1 DT=10.0 min |   Ia      (mm)=  10.10   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .34

     Unit Hyd Qpeak  (cms)=   5.111

     PEAK FLOW       (cms)=   3.833 (i)
     TIME TO PEAK    (hrs)=   1.833
     RUNOFF VOLUME    (mm)=  31.124
     TOTAL RAINFALL   (mm)=  83.988
     RUNOFF COEFFICIENT   =    .371

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

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

```
--------------------
| ROUTE CHN (0010) |
| IN= 2---> OUT= 1 |     Routing time step (min)'=  5.00
--------------------
               <------ DATA FOR SECTION (   1.1) ------>
               Distance      Elevation       Manning
                    .00        101.50         .0500
                   1.00        100.70         .0500
                   1.50        100.55     .0500 / .0450  Main Channel
                   2.00         99.50         .0450      Main Channel
                   3.50         99.60         .0450      Main Channel
                   4.50        100.65     .0450 / .0500  Main Channel
                   6.00        101.45         .0500

      <---------------------- TRAVEL TIME TABLE ---------------------->
       DEPTH    ELEV      VOLUME    FLOW RATE    VELOCITY   TRAV.TIME
        (m)      (m)     (cu.m.)      (cms)        (m/s)      (min)
        .10    99.60    .129E+02        .0           .16      18.67
        .19    99.69    .410E+02        .1           .31       9.73
        .29    99.79    .715E+02        .2           .42       7.28
        .38    99.88    .104E+03        .3           .50       6.08
        .48    99.98    .140E+03        .4           .57       5.34
        .57   100.07    .177E+03        .6           .63       4.84
        .67   100.17    .217E+03        .8           .68       4.46
        .76   100.26    .260E+03       1.0           .73       4.16
        .86   100.36    .304E+03       1.3           .78       3.92
        .95   100.45    .352E+03       1.6           .82       3.72
       1.05   100.55    .401E+03       1.9           .86       3.55
       1.16   100.66    .466E+03       2.3           .92       3.33
       1.28   100.78    .541E+03       2.9           .98       3.12
       1.39   100.89    .623E+03       3.5          1.03       2.95
       1.50   101.00    .713E+03       4.2          1.09       2.81
       1.61   101.11    .810E+03       5.0          1.13       2.69
       1.72   101.22    .914E+03       5.9          1.18       2.59
       1.84   101.34    .103E+04       6.8          1.22       2.51
       1.95   101.45    .114E+04       7.9          1.26       2.43

                                  <---- hydrograph ---->   <-pipe / channel->
                            AREA    QPEAK   TPEAK   R.V.   MAX DEPTH  MAX VEL
                            (ha)    (cms)   (hrs)   (mm)      (m)      (m/s)
     INFLOW : ID= 2 (0002)    2.50      .23    1.67  30.97       .34       .46
     OUTFLOW: ID= 1 (0010)    2.50      .22    1.83  30.93       .33       .45


--------------------------------------------------------------------------------
--------------------
| ROUTE CHN (0007) |
| IN= 2---> OUT= 1 |     Routing time step (min)'=  5.00
--------------------
               <------ DATA FOR SECTION (   1.1) ------>
               Distance      Elevation       Manning
                    .00        101.50         .0500
                   1.00        100.70         .0500
                   1.50        100.55     .0500 / .0450  Main Channel
                   2.00         99.50         .0450      Main Channel
                   3.50         99.60         .0450      Main Channel
                   4.50        100.65     .0450 / .0500  Main Channel
                   6.00        101.45         .0500

      <---------------------- TRAVEL TIME TABLE ---------------------->
       DEPTH    ELEV      VOLUME    FLOW RATE    VELOCITY   TRAV.TIME
```

(m)	(m)	(cu.m.)	(cms)	(m/s)	(min)
.10	99.60	.120E+03	.0	.16	173.47
.19	99.69	.381E+03	.1	.31	90.37
.29	99.79	.664E+03	.2	.42	67.63
.38	99.88	.969E+03	.3	.50	56.48
.48	99.98	.130E+04	.4	.57	49.65
.57	100.07	.165E+04	.6	.63	44.93
.67	100.17	.202E+04	.8	.68	41.43
.76	100.26	.241E+04	1.0	.73	38.68
.86	100.36	.283E+04	1.3	.78	36.46
.95	100.45	.327E+04	1.6	.82	34.60
1.05	100.55	.373E+04	1.9	.86	33.02
1.16	100.66	.433E+04	2.3	.92	30.95
1.28	100.78	.502E+04	2.9	.98	28.95
1.39	100.89	.579E+04	3.5	1.03	27.38
1.50	101.00	.662E+04	4.2	1.09	26.10
1.61	101.11	.752E+04	5.0	1.13	25.03
1.72	101.22	.849E+04	5.9	1.18	24.10
1.84	101.34	.953E+04	6.8	1.22	23.29
1.95	101.45	.106E+05	7.9	1.26	22.56

		<---- hydrograph ---->			<-pipe / channel->	
		AREA	QPEAK	TPEAK	R.V.	MAX DEPTH	MAX VEL
		(ha)	(cms)	(hrs)	(mm)	(m)	(m/s)
INFLOW :	ID= 2 (0001)	45.50	3.83	1.83	31.12	1.44	1.06
OUTFLOW:	ID= 1 (0007)	45.50	2.76	2.08	31.10	1.25	.96

ADD HYD (0011)		AREA	QPEAK	TPEAK	R.V.
1 + 2 = 3		(ha)	(cms)	(hrs)	(mm)
	ID1= 1 (0010):	2.50	.222	1.83	30.93
	+ ID2= 2 (0007):	45.50	2.759	2.08	31.10
	ID = 3 (0011):	48.00	2.939	2.08	31.09

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

****
** SIMULATION NUMBER: 7 **
****

READ STORM	Filename: G:\Projects\2016\ 160570 - Bob Wachna - Mill Ridge Rd Subdivisi \Storm\Design Storm Text Files\25mm4hrChicago
Ptotal= 25.00 mm	Comments: twentyfive mm 4 hr chicago storm

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.17	2.07	1.17	5.70	2.17	5.19	3.17	2.80
.33	2.27	1.33	10.78	2.33	4.47	3.33	2.62
.50	2.52	1.50	50.21	2.50	3.95	3.50	2.48
.67	2.88	1.67	13.37	2.67	3.56	3.67	2.35
.83	3.38	1.83	8.29	2.83	3.25	3.83	2.23
1.00	4.18	2.00	6.30	3.00	3.01	4.00	2.14

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

--------------------
| CALIB            |
| NASHYD    (0002) |   Area    (ha)=   2.50   Curve Number   (CN)= 71.6
|ID= 1 DT=10.0 min |   Ia      (mm)=  10.10   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .27

     Unit Hyd Qpeak  (cms)=    .354

     PEAK FLOW       (cms)=    .006 (i)
     TIME TO PEAK    (hrs)=   2.000
     RUNOFF VOLUME    (mm)=   1.900
     TOTAL RAINFALL   (mm)=  24.996
     RUNOFF COEFFICIENT   =    .076

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

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD    (0001) |   Area    (ha)=  45.50   Curve Number   (CN)= 71.6
|ID= 1 DT=10.0 min |   Ia      (mm)=  10.10   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .34

     Unit Hyd Qpeak  (cms)=   5.111

     PEAK FLOW       (cms)=    .110 (i)
     TIME TO PEAK    (hrs)=   2.167
     RUNOFF VOLUME    (mm)=   1.909
     TOTAL RAINFALL   (mm)=  24.996
     RUNOFF COEFFICIENT   =    .076

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

--------------------------------------------------------------------------------
--------------------
| ROUTE CHN (0010) |
| IN= 2---> OUT= 1 |     Routing time step (min)'=  5.00
--------------------
               <------ DATA FOR SECTION (   1.1) ------>
               Distance      Elevation       Manning
                    .00        101.50         .0500
                   1.00        100.70         .0500
                   1.50        100.55     .0500 / .0450  Main Channel
                   2.00         99.50         .0450      Main Channel
                   3.50         99.60         .0450      Main Channel
                   4.50        100.65     .0450 / .0500  Main Channel
                   6.00        101.45         .0500

      <---------------------- TRAVEL TIME TABLE ---------------------->
       DEPTH    ELEV      VOLUME    FLOW RATE    VELOCITY   TRAV.TIME
        (m)      (m)     (cu.m.)      (cms)        (m/s)      (min)
        .10    99.60    .129E+02        .0           .16      18.67
        .19    99.69    .410E+02        .1           .31       9.73
        .29    99.79    .715E+02        .2           .42       7.28
        .38    99.88    .104E+03        .3           .50       6.08
        .48    99.98    .140E+03        .4           .57       5.34
        .57   100.07    .177E+03        .6           .63       4.84
        .67   100.17    .217E+03        .8           .68       4.46
```

.76	100.26	.260E+03	1.0	.73	4.16
.86	100.36	.304E+03	1.3	.78	3.92
.95	100.45	.352E+03	1.6	.82	3.72
1.05	100.55	.401E+03	1.9	.86	3.55
1.16	100.66	.466E+03	2.3	.92	3.33
1.28	100.78	.541E+03	2.9	.98	3.12
1.39	100.89	.623E+03	3.5	1.03	2.95
1.50	101.00	.713E+03	4.2	1.09	2.81
1.61	101.11	.810E+03	5.0	1.13	2.69
1.72	101.22	.914E+03	5.9	1.18	2.59
1.84	101.34	.103E+04	6.8	1.22	2.51
1.95	101.45	.114E+04	7.9	1.26	2.43

	<---- hydrograph ---->			<-pipe / channel->	
	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)	MAX DEPTH (m)	MAX VEL (m/s)
INFLOW : ID= 2 (0002)	2.50	.01	2.00	1.90	.05	.16
OUTFLOW: ID= 1 (0010)	2.50	.01	2.42	1.86	.05	.16

ROUTE CHN (0007)
IN= 2---> OUT= 1

Routing time step (min)'= 5.00

<------ DATA FOR SECTION (1.1) ------>

Distance	Elevation	Manning	
.00	101.50	.0500	
1.00	100.70	.0500	
1.50	100.55	.0500 / .0450	Main Channel
2.00	99.50	.0450	Main Channel
3.50	99.60	.0450	Main Channel
4.50	100.65	.0450 / .0500	Main Channel
6.00	101.45	.0500	

<---------- TRAVEL TIME TABLE ---------->

DEPTH (m)	ELEV (m)	VOLUME (cu.m.)	FLOW RATE (cms)	VELOCITY (m/s)	TRAV.TIME (min)
.10	99.60	.120E+03	.0	.16	173.47
.19	99.69	.381E+03	.1	.31	90.37
.29	99.79	.664E+03	.2	.42	67.63
.38	99.88	.969E+03	.3	.50	56.48
.48	99.98	.130E+04	.4	.57	49.65
.57	100.07	.165E+04	.6	.63	44.93
.67	100.17	.202E+04	.8	.68	41.43
.76	100.26	.241E+04	1.0	.73	38.68
.86	100.36	.283E+04	1.3	.78	36.46
.95	100.45	.327E+04	1.6	.82	34.60
1.05	100.55	.373E+04	1.9	.86	33.02
1.16	100.66	.433E+04	2.3	.92	30.95
1.28	100.78	.502E+04	2.9	.98	28.95
1.39	100.89	.579E+04	3.5	1.03	27.38
1.50	101.00	.662E+04	4.2	1.09	26.10
1.61	101.11	.752E+04	5.0	1.13	25.03
1.72	101.22	.849E+04	5.9	1.18	24.10
1.84	101.34	.953E+04	6.8	1.22	23.29
1.95	101.45	.106E+05	7.9	1.26	22.56

	<---- hydrograph ---->			<-pipe / channel->	
	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)	MAX DEPTH (m)	MAX VEL (m/s)

```
     INFLOW : ID= 2 (0001)   45.50      .11    2.17   1.91       .23       .35
     OUTFLOW: ID= 1 (0007)   45.50      .07    3.83   1.89       .19       .30


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

--------------------
| ADD HYD   (0011) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0010):     2.50    .006     2.42     1.86
        + ID2= 2 (0007):    45.50    .068     3.83     1.89
          ================================================
          ID = 3 (0011):    48.00    .072     3.75     1.89

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

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

 FINISH
```

```
       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
       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

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                  *****  D E T A I L E D   O U T P U T *****
----------------------------
  ***************************
  ** SIMULATION NUMBER:   1 **
  ***************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 732.951
| Ptotal= 42.34 mm |                          B=   6.199
--------------------                          C=    .810
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  = 12.00 hrs
                        Storm time step    = 10.00 min
                        Time to peak ratio =   .33

                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                 .17     .72 |  3.17    2.81 |  6.17    2.12 |  9.17    1.00
                 .33     .75 |  3.33    3.50 |  6.33    1.99 |  9.33     .97
                 .50     .78 |  3.50    4.69 |  6.50    1.87 |  9.50     .95
                 .67     .82 |  3.67    7.30 |  6.67    1.77 |  9.67     .93
                 .83     .85 |  3.83   18.21 |  6.83    1.68 |  9.83     .90
                1.00     .89 |  4.00   76.81 |  7.00    1.60 | 10.00     .88
                1.17     .94 |  4.17   24.08 |  7.17    1.52 | 10.17     .86
                1.33     .99 |  4.33   12.36 |  7.33    1.46 | 10.33     .84
                1.50    1.04 |  4.50    8.32 |  7.50    1.40 | 10.50     .82
                1.67    1.11 |  4.67    6.30 |  7.67    1.34 | 10.67     .81
                1.83    1.18 |  4.83    5.09 |  7.83    1.29 | 10.83     .79
                2.00    1.27 |  5.00    4.29 |  8.00    1.24 | 11.00     .78
                2.17    1.37 |  5.17    3.72 |  8.17    1.20 | 11.17     .76
                2.33    1.49 |  5.33    3.29 |  8.33    1.16 | 11.33     .75
                2.50    1.63 |  5.50    2.95 |  8.50    1.13 | 11.50     .73
                2.67    1.82 |  5.67    2.68 |  8.67    1.09 | 11.67     .72
                2.83    2.05 |  5.83    2.46 |  8.83    1.06 | 11.83     .71
                3.00    2.37 |  6.00    2.28 |  9.00    1.03 | 12.00     .69


--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD    (0003) |   Area    (ha)=   2.50   Curve Number   (CN)= 72.3
|ID= 1 DT=10.0 min |   Ia      (mm)=   9.70   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .27
```

```
     Unit Hyd Qpeak  (cms)=    .354

     PEAK FLOW       (cms)=    .033 (i)
     TIME TO PEAK    (hrs)=   4.333
     RUNOFF VOLUME    (mm)=   8.144
     TOTAL RAINFALL   (mm)=  42.344
     RUNOFF COEFFICIENT   =    .192

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

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD    (0004) |   Area    (ha)=  45.50   Curve Number   (CN)= 71.6
|ID= 1 DT=10.0 min |   Ia      (mm)=  10.10   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .34

     Unit Hyd Qpeak  (cms)=   5.111

     PEAK FLOW       (cms)=    .498 (i)
     TIME TO PEAK    (hrs)=   4.333
     RUNOFF VOLUME    (mm)=   7.781
     TOTAL RAINFALL   (mm)=  42.344
     RUNOFF COEFFICIENT   =    .184

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

--------------------------------------------------------------------------------
--------------------
| ROUTE CHN (0012) |
| IN= 2---> OUT= 1 |     Routing time step (min)'=  5.00
--------------------
               <------ DATA FOR SECTION (   1.1) ------>
               Distance      Elevation       Manning
                    .00        101.50         .0500
                   1.00        100.70         .0500
                   1.50        100.55     .0500 / .0450  Main Channel
                   2.00         99.50         .0450      Main Channel
                   3.50         99.60         .0450      Main Channel
                   4.50        100.65     .0450 / .0500  Main Channel
                   6.00        101.45         .0500

     <---------------------- TRAVEL TIME TABLE ---------------------->
      DEPTH    ELEV      VOLUME    FLOW RATE    VELOCITY   TRAV.TIME
       (m)      (m)     (cu.m.)      (cms)        (m/s)      (min)
       .10    99.60    .129E+02        .0           .16      18.67
       .19    99.69    .410E+02        .1           .31       9.73
       .29    99.79    .715E+02        .2           .42       7.28
       .38    99.88    .104E+03        .3           .50       6.08
       .48    99.98    .140E+03        .4           .57       5.34
       .57   100.07    .177E+03        .6           .63       4.84
       .67   100.17    .217E+03        .8           .68       4.46
       .76   100.26    .260E+03       1.0           .73       4.16
       .86   100.36    .304E+03       1.3           .78       3.92
       .95   100.45    .352E+03       1.6           .82       3.72
      1.05   100.55    .401E+03       1.9           .86       3.55
      1.16   100.66    .466E+03       2.3           .92       3.33
      1.28   100.78    .541E+03       2.9           .98       3.12
      1.39   100.89    .623E+03       3.5          1.03       2.95
      1.50   101.00    .713E+03       4.2          1.09       2.81
```

1.61	101.11	.810E+03	5.0	1.13	2.69
1.72	101.22	.914E+03	5.9	1.18	2.59
1.84	101.34	.103E+04	6.8	1.22	2.51
1.95	101.45	.114E+04	7.9	1.26	2.43

		<---- hydrograph ---->			<-pipe / channel->	
	AREA	QPEAK	TPEAK	R.V.	MAX DEPTH	MAX VEL
	(ha)	(cms)	(hrs)	(mm)	(m)	(m/s)
INFLOW : ID= 2 (0003)	2.50	.03	4.33	8.14	.13	.20
OUTFLOW: ID= 1 (0012)	2.50	.03	4.50	8.11	.12	.19

ROUTE CHN (0008)	
IN= 2---> OUT= 1	Routing time step (min)'= 5.00

<------ DATA FOR SECTION (1.1) ------>

Distance	Elevation	Manning	
.00	101.50	.0500	
1.00	100.70	.0500	
1.50	100.55	.0500 / .0450	Main Channel
2.00	99.50	.0450	Main Channel
3.50	99.60	.0450	Main Channel
4.50	100.65	.0450 / .0500	Main Channel
6.00	101.45	.0500	

<---------- TRAVEL TIME TABLE ---------->

DEPTH (m)	ELEV (m)	VOLUME (cu.m.)	FLOW RATE (cms)	VELOCITY (m/s)	TRAV.TIME (min)
.10	99.60	.120E+03	.0	.16	173.47
.19	99.69	.381E+03	.1	.31	90.37
.29	99.79	.664E+03	.2	.42	67.63
.38	99.88	.969E+03	.3	.50	56.48
.48	99.98	.130E+04	.4	.57	49.65
.57	100.07	.165E+04	.6	.63	44.93
.67	100.17	.202E+04	.8	.68	41.43
.76	100.26	.241E+04	1.0	.73	38.68
.86	100.36	.283E+04	1.3	.78	36.46
.95	100.45	.327E+04	1.6	.82	34.60
1.05	100.55	.373E+04	1.9	.86	33.02
1.16	100.66	.433E+04	2.3	.92	30.95
1.28	100.78	.502E+04	2.9	.98	28.95
1.39	100.89	.579E+04	3.5	1.03	27.38
1.50	101.00	.662E+04	4.2	1.09	26.10
1.61	101.11	.752E+04	5.0	1.13	25.03
1.72	101.22	.849E+04	5.9	1.18	24.10
1.84	101.34	.953E+04	6.8	1.22	23.29
1.95	101.45	.106E+05	7.9	1.26	22.56

		<---- hydrograph ---->			<-pipe / channel->	
	AREA	QPEAK	TPEAK	R.V.	MAX DEPTH	MAX VEL
	(ha)	(cms)	(hrs)	(mm)	(m)	(m/s)
INFLOW : ID= 2 (0004)	45.50	.50	4.33	7.78	.51	.59
OUTFLOW: ID= 1 (0008)	45.50	.26	4.92	7.76	.36	.48

ROUTE PIPE (0018)|	PIPE Number = 1.00
IN= 2---> OUT= 1	Diameter (mm)= 450.00

```
| DT=  5.0 min     |     Length       (m)=  25.00
--------------------     Slope      (m/m)=   .010
                         Manning n       =   .013

     <----------------- TRAVEL TIME TABLE -------------------->
       DEPTH      VOLUME    FLOW RATE    VELOCITY    TRAV.TIME
        (m)      (cu.m.)      (cms)        (m/s)        min
        .02     .802E-01        .0          .48          .87
        .05     .223E+00        .0          .74          .56
        .07     .403E+00        .0          .96          .44
        .09     .609E+00        .0         1.14          .37
        .12     .836E+00        .0         1.29          .32
        .14     .108E+01        .1         1.43          .29
        .17     .133E+01        .1         1.55          .27
        .19     .159E+01        .1         1.66          .25
        .21     .185E+01        .1         1.75          .24
        .24     .212E+01        .2         1.83          .23
        .26     .239E+01        .2         1.90          .22
        .28     .265E+01        .2         1.96          .21
        .31     .290E+01        .2         2.00          .21
        .33     .314E+01        .3         2.03          .21
        .36     .337E+01        .3         2.04          .20
        .38     .357E+01        .3         2.04          .20
        .40     .375E+01        .3         2.02          .21
        .43     .390E+01        .3         1.97          .21
        .45     .398E+01        .3         1.79          .23
                                    <---- hydrograph ---->   <-pipe / channel->
                                AREA    QPEAK   TPEAK   R.V.   MAX DEPTH  MAX VEL
                                (ha)    (cms)   (hrs)   (mm)      (m)      (m/s)
     INFLOW : ID= 2 (0012)    2.50      .03    4.50   8.11       .09      1.11
     OUTFLOW: ID= 1 (0018)    2.50      .03    4.50   8.10       .09      1.11


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

--------------------
| ADD HYD   (0014) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0018):     2.50    .026     4.50     8.10
        + ID2= 2 (0008):    45.50    .263     4.92     7.76
          ================================================
          ID = 3 (0014):    48.00    .283     4.92     7.78

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

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

--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 998.071
| Ptotal= 56.17 mm |                          B=   6.053
--------------------                          C=    .814
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  = 12.00 hrs
                        Storm time step    = 10.00 min
                        Time to peak ratio =   .33
```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.17	.94	3.17	3.68	6.17	2.77	9.17	1.30
.33	.98	3.33	4.58	6.33	2.60	9.33	1.27
.50	1.02	3.50	6.15	6.50	2.44	9.50	1.24
.67	1.06	3.67	9.61	6.67	2.31	9.67	1.20
.83	1.11	3.83	24.17	6.83	2.19	9.83	1.17
1.00	1.16	4.00	104.19	7.00	2.08	10.00	1.15
1.17	1.22	4.17	32.04	7.17	1.99	10.17	1.12
1.33	1.28	4.33	16.34	7.33	1.90	10.33	1.10
1.50	1.36	4.50	10.96	7.50	1.82	10.50	1.07
1.67	1.44	4.67	8.29	7.67	1.75	10.67	1.05
1.83	1.54	4.83	6.69	7.83	1.68	10.83	1.03
2.00	1.65	5.00	5.63	8.00	1.62	11.00	1.01
2.17	1.78	5.17	4.87	8.17	1.57	11.17	.99
2.33	1.94	5.33	4.30	8.33	1.51	11.33	.97
2.50	2.13	5.50	3.86	8.50	1.47	11.50	.95
2.67	2.37	5.67	3.51	8.67	1.42	11.67	.93
2.83	2.68	5.83	3.22	8.83	1.38	11.83	.92
3.00	3.10	6.00	2.98	9.00	1.34	12.00	.90

```
| CALIB             |
| NASHYD    (0003) |   Area    (ha)=   2.50   Curve Number   (CN)= 72.3
|ID= 1 DT=10.0 min |   Ia      (mm)=   9.70   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .27

     Unit Hyd Qpeak  (cms)=    .354

     PEAK FLOW       (cms)=    .068 (i)
     TIME TO PEAK    (hrs)=   4.167
     RUNOFF VOLUME    (mm)=  14.914
     TOTAL RAINFALL   (mm)=  56.170
     RUNOFF COEFFICIENT   =    .266

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

```
| CALIB             |
| NASHYD    (0004) |   Area    (ha)=  45.50   Curve Number   (CN)= 71.6
|ID= 1 DT=10.0 min |   Ia      (mm)=  10.10   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .34

     Unit Hyd Qpeak  (cms)=   5.111

     PEAK FLOW       (cms)=   1.058 (i)
     TIME TO PEAK    (hrs)=   4.333
     RUNOFF VOLUME    (mm)=  14.390
     TOTAL RAINFALL   (mm)=  56.170
     RUNOFF COEFFICIENT   =    .256

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

```
| ROUTE CHN (0012) |
| IN= 2---> OUT= 1 |     Routing time step (min)'=  5.00
--------------------
```

```
               <------ DATA FOR SECTION (   1.1) ------>
               Distance      Elevation       Manning
                    .00        101.50         .0500
                   1.00        100.70         .0500
                   1.50        100.55     .0500 / .0450  Main Channel
                   2.00         99.50         .0450      Main Channel
                   3.50         99.60         .0450      Main Channel
                   4.50        100.65     .0450 / .0500  Main Channel
                   6.00        101.45         .0500

      <---------------------- TRAVEL TIME TABLE ---------------------->
       DEPTH    ELEV      VOLUME    FLOW RATE    VELOCITY   TRAV.TIME
        (m)      (m)     (cu.m.)      (cms)        (m/s)      (min)
        .10    99.60    .129E+02        .0           .16      18.67
        .19    99.69    .410E+02        .1           .31       9.73
        .29    99.79    .715E+02        .2           .42       7.28
        .38    99.88    .104E+03        .3           .50       6.08
        .48    99.98    .140E+03        .4           .57       5.34
        .57   100.07    .177E+03        .6           .63       4.84
        .67   100.17    .217E+03        .8           .68       4.46
        .76   100.26    .260E+03       1.0           .73       4.16
        .86   100.36    .304E+03       1.3           .78       3.92
        .95   100.45    .352E+03       1.6           .82       3.72
       1.05   100.55    .401E+03       1.9           .86       3.55
       1.16   100.66    .466E+03       2.3           .92       3.33
       1.28   100.78    .541E+03       2.9           .98       3.12
       1.39   100.89    .623E+03       3.5          1.03       2.95
       1.50   101.00    .713E+03       4.2          1.09       2.81
       1.61   101.11    .810E+03       5.0          1.13       2.69
       1.72   101.22    .914E+03       5.9          1.18       2.59
       1.84   101.34    .103E+04       6.8          1.22       2.51
       1.95   101.45    .114E+04       7.9          1.26       2.43

                                    <---- hydrograph ---->   <-pipe / channel->
                              AREA    QPEAK   TPEAK   R.V.   MAX DEPTH  MAX VEL
                              (ha)    (cms)   (hrs)   (mm)      (m)      (m/s)
     INFLOW : ID= 2 (0003)    2.50      .07    4.17  14.91       .19       .30
     OUTFLOW: ID= 1 (0012)    2.50      .06    4.42  14.88       .18       .28


--------------------------------------------------------------------------------
--------------------
| ROUTE CHN (0008) |
| IN= 2---> OUT= 1 |     Routing time step (min)'=  5.00
--------------------
               <------ DATA FOR SECTION (   1.1) ------>
               Distance      Elevation       Manning
                    .00        101.50         .0500
                   1.00        100.70         .0500
                   1.50        100.55     .0500 / .0450  Main Channel
                   2.00         99.50         .0450      Main Channel
                   3.50         99.60         .0450      Main Channel
                   4.50        100.65     .0450 / .0500  Main Channel
                   6.00        101.45         .0500

      <---------------------- TRAVEL TIME TABLE ---------------------->
       DEPTH    ELEV      VOLUME    FLOW RATE    VELOCITY   TRAV.TIME
        (m)      (m)     (cu.m.)      (cms)        (m/s)      (min)
        .10    99.60    .120E+03        .0           .16     173.47
        .19    99.69    .381E+03        .1           .31      90.37
        .29    99.79    .664E+03        .2           .42      67.63
```

.38	99.88	.969E+03	.3	.50	56.48
.48	99.98	.130E+04	.4	.57	49.65
.57	100.07	.165E+04	.6	.63	44.93
.67	100.17	.202E+04	.8	.68	41.43
.76	100.26	.241E+04	1.0	.73	38.68
.86	100.36	.283E+04	1.3	.78	36.46
.95	100.45	.327E+04	1.6	.82	34.60
1.05	100.55	.373E+04	1.9	.86	33.02
1.16	100.66	.433E+04	2.3	.92	30.95
1.28	100.78	.502E+04	2.9	.98	28.95
1.39	100.89	.579E+04	3.5	1.03	27.38
1.50	101.00	.662E+04	4.2	1.09	26.10
1.61	101.11	.752E+04	5.0	1.13	25.03
1.72	101.22	.849E+04	5.9	1.18	24.10
1.84	101.34	.953E+04	6.8	1.22	23.29
1.95	101.45	.106E+05	7.9	1.26	22.56

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)	MAX DEPTH (m)	MAX VEL (m/s)
	<---- hydrograph ---->				<-pipe / channel->	
INFLOW : ID= 2 (0004)	45.50	1.06	4.33	14.39	.77	.74
OUTFLOW: ID= 1 (0008)	45.50	.60	4.75	14.37	.57	.63

| ROUTE PIPE (0018)|	PIPE Number = 1.00
| IN= 2---> OUT= 1 |	Diameter (mm)= 450.00
| DT= 5.0 min |	Length (m)= 25.00
	Slope (m/m)= .010
	Manning n = .013

<---------- TRAVEL TIME TABLE ---------->

DEPTH (m)	VOLUME (cu.m.)	FLOW RATE (cms)	VELOCITY (m/s)	TRAV.TIME min
.02	.802E-01	.0	.48	.87
.05	.223E+00	.0	.74	.56
.07	.403E+00	.0	.96	.44
.09	.609E+00	.0	1.14	.37
.12	.836E+00	.0	1.29	.32
.14	.108E+01	.1	1.43	.29
.17	.133E+01	.1	1.55	.27
.19	.159E+01	.1	1.66	.25
.21	.185E+01	.1	1.75	.24
.24	.212E+01	.2	1.83	.23
.26	.239E+01	.2	1.90	.22
.28	.265E+01	.2	1.96	.21
.31	.290E+01	.2	2.00	.21
.33	.314E+01	.3	2.03	.21
.36	.337E+01	.3	2.04	.20
.38	.357E+01	.3	2.04	.20
.40	.375E+01	.3	2.02	.21
.43	.390E+01	.3	1.97	.21
.45	.398E+01	.3	1.79	.23

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)	MAX DEPTH (m)	MAX VEL (m/s)
	<---- hydrograph ---->				<-pipe / channel->	
INFLOW : ID= 2 (0012)	2.50	.06	4.42	14.88	.14	1.43
OUTFLOW: ID= 1 (0018)	2.50	.06	4.42	14.88	.14	1.43

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

--------------------
| ADD HYD   (0014) |
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
         ID1= 1 (0018):     2.50    .062     4.42    14.88
       + ID2= 2 (0008):    45.50    .603     4.75    14.37
         ================================================
         ID = 3 (0014):    48.00    .645     4.75    14.39

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

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

--------------------
| CHICAGO STORM    |    IDF curve parameters: A=1569.580
| Ptotal= 84.91 mm |                          B=   6.014
--------------------                          C=    .820
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  = 12.00 hrs
                        Storm time step    = 10.00 min
                        Time to peak ratio =   .33

                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                 .17    1.38 |  3.17    5.47 |  6.17    4.10 |  9.17    1.91
                 .33    1.43 |  3.33    6.82 |  6.33    3.84 |  9.33    1.86
                 .50    1.49 |  3.50    9.19 |  6.50    3.61 |  9.50    1.81
                 .67    1.55 |  3.67   14.44 |  6.67    3.41 |  9.67    1.77
                 .83    1.62 |  3.83   36.76 |  6.83    3.23 |  9.83    1.72
                1.00    1.70 |  4.00  161.47 |  7.00    3.07 | 10.00    1.68
                1.17    1.79 |  4.17   48.88 |  7.17    2.93 | 10.17    1.64
                1.33    1.89 |  4.33   24.70 |  7.33    2.80 | 10.33    1.61
                1.50    2.00 |  4.50   16.49 |  7.50    2.68 | 10.50    1.57
                1.67    2.12 |  4.67   12.42 |  7.67    2.58 | 10.67    1.54
                1.83    2.26 |  4.83   10.00 |  7.83    2.48 | 10.83    1.51
                2.00    2.43 |  5.00    8.40 |  8.00    2.39 | 11.00    1.48
                2.17    2.63 |  5.17    7.26 |  8.17    2.30 | 11.17    1.45
                2.33    2.86 |  5.33    6.40 |  8.33    2.23 | 11.33    1.42
                2.50    3.15 |  5.50    5.74 |  8.50    2.16 | 11.50    1.39
                2.67    3.51 |  5.67    5.21 |  8.67    2.09 | 11.67    1.37
                2.83    3.97 |  5.83    4.77 |  8.83    2.03 | 11.83    1.34
                3.00    4.59 |  6.00    4.41 |  9.00    1.97 | 12.00    1.32


--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD    (0003) |   Area    (ha)=   2.50   Curve Number   (CN)= 72.3
|ID= 1 DT=10.0 min |   Ia      (mm)=   9.70   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .27

     Unit Hyd Qpeak  (cms)=    .354

     PEAK FLOW       (cms)=    .174 (i)
     TIME TO PEAK    (hrs)=   4.167
```

```
     RUNOFF VOLUME    (mm)=  32.553
     TOTAL RAINFALL   (mm)=  84.914
     RUNOFF COEFFICIENT   =    .383

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

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD    (0004) |   Area    (ha)=  45.50   Curve Number   (CN)= 71.6
|ID= 1 DT=10.0 min |   Ia      (mm)=  10.10   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .34

     Unit Hyd Qpeak  (cms)=   5.111

     PEAK FLOW       (cms)=   2.650 (i)
     TIME TO PEAK    (hrs)=   4.333
     RUNOFF VOLUME    (mm)=  31.740
     TOTAL RAINFALL   (mm)=  84.914
     RUNOFF COEFFICIENT   =    .374

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

--------------------------------------------------------------------------------
--------------------
| ROUTE CHN (0012) |
| IN= 2---> OUT= 1 |     Routing time step (min)'=  5.00
--------------------
               <------ DATA FOR SECTION (   1.1) ------>
               Distance      Elevation       Manning
                    .00        101.50         .0500
                   1.00        100.70         .0500
                   1.50        100.55     .0500 / .0450  Main Channel
                   2.00         99.50         .0450      Main Channel
                   3.50         99.60         .0450      Main Channel
                   4.50        100.65     .0450 / .0500  Main Channel
                   6.00        101.45         .0500

      <---------------------- TRAVEL TIME TABLE ---------------------->
       DEPTH    ELEV      VOLUME    FLOW RATE    VELOCITY   TRAV.TIME
        (m)      (m)     (cu.m.)      (cms)        (m/s)      (min)
        .10    99.60    .129E+02        .0           .16      18.67
        .19    99.69    .410E+02        .1           .31       9.73
        .29    99.79    .715E+02        .2           .42       7.28
        .38    99.88    .104E+03        .3           .50       6.08
        .48    99.98    .140E+03        .4           .57       5.34
        .57   100.07    .177E+03        .6           .63       4.84
        .67   100.17    .217E+03        .8           .68       4.46
        .76   100.26    .260E+03       1.0           .73       4.16
        .86   100.36    .304E+03       1.3           .78       3.92
        .95   100.45    .352E+03       1.6           .82       3.72
       1.05   100.55    .401E+03       1.9           .86       3.55
       1.16   100.66    .466E+03       2.3           .92       3.33
       1.28   100.78    .541E+03       2.9           .98       3.12
       1.39   100.89    .623E+03       3.5          1.03       2.95
       1.50   101.00    .713E+03       4.2          1.09       2.81
       1.61   101.11    .810E+03       5.0          1.13       2.69
       1.72   101.22    .914E+03       5.9          1.18       2.59
       1.84   101.34    .103E+04       6.8          1.22       2.51
       1.95   101.45    .114E+04       7.9          1.26       2.43
```

		<---- hydrograph ---->			<-pipe / channel->	
	AREA	QPEAK	TPEAK	R.V.	MAX DEPTH	MAX VEL
	(ha)	(cms)	(hrs)	(mm)	(m)	(m/s)
INFLOW : ID= 2 (0003)	2.50	.17	4.17	32.55	.29	.42
OUTFLOW: ID= 1 (0012)	2.50	.16	4.33	32.52	.29	.42

ROUTE CHN (0008)	
IN= 2---> OUT= 1	Routing time step (min)'= 5.00

<------ DATA FOR SECTION (1.1) ------>

Distance	Elevation	Manning	
.00	101.50	.0500	
1.00	100.70	.0500	
1.50	100.55	.0500 / .0450	Main Channel
2.00	99.50	.0450	Main Channel
3.50	99.60	.0450	Main Channel
4.50	100.65	.0450 / .0500	Main Channel
6.00	101.45	.0500	

<---------- TRAVEL TIME TABLE ---------->

DEPTH (m)	ELEV (m)	VOLUME (cu.m.)	FLOW RATE (cms)	VELOCITY (m/s)	TRAV.TIME (min)
.10	99.60	.120E+03	.0	.16	173.47
.19	99.69	.381E+03	.1	.31	90.37
.29	99.79	.664E+03	.2	.42	67.63
.38	99.88	.969E+03	.3	.50	56.48
.48	99.98	.130E+04	.4	.57	49.65
.57	100.07	.165E+04	.6	.63	44.93
.67	100.17	.202E+04	.8	.68	41.43
.76	100.26	.241E+04	1.0	.73	38.68
.86	100.36	.283E+04	1.3	.78	36.46
.95	100.45	.327E+04	1.6	.82	34.60
1.05	100.55	.373E+04	1.9	.86	33.02
1.16	100.66	.433E+04	2.3	.92	30.95
1.28	100.78	.502E+04	2.9	.98	28.95
1.39	100.89	.579E+04	3.5	1.03	27.38
1.50	101.00	.662E+04	4.2	1.09	26.10
1.61	101.11	.752E+04	5.0	1.13	25.03
1.72	101.22	.849E+04	5.9	1.18	24.10
1.84	101.34	.953E+04	6.8	1.22	23.29
1.95	101.45	.106E+05	7.9	1.26	22.56

		<---- hydrograph ---->			<-pipe / channel->	
	AREA	QPEAK	TPEAK	R.V.	MAX DEPTH	MAX VEL
	(ha)	(cms)	(hrs)	(mm)	(m)	(m/s)
INFLOW : ID= 2 (0004)	45.50	2.65	4.33	31.74	1.23	.95
OUTFLOW: ID= 1 (0008)	45.50	1.67	4.67	31.72	.98	.83

ROUTE PIPE (0018)		
IN= 2---> OUT= 1	Diameter (mm)=	450.00
DT= 5.0 min	Length (m)=	25.00
	Slope (m/m)=	.010
	Manning n =	.013

<---------- TRAVEL TIME TABLE ---------->

DEPTH (m)	VOLUME (cu.m.)	FLOW RATE (cms)	VELOCITY (m/s)	TRAV.TIME min
.02	.802E-01	.0	.48	.87
.05	.223E+00	.0	.74	.56
.07	.403E+00	.0	.96	.44
.09	.609E+00	.0	1.14	.37
.12	.836E+00	.0	1.29	.32
.14	.108E+01	.1	1.43	.29
.17	.133E+01	.1	1.55	.27
.19	.159E+01	.1	1.66	.25
.21	.185E+01	.1	1.75	.24
.24	.212E+01	.2	1.83	.23
.26	.239E+01	.2	1.90	.22
.28	.265E+01	.2	1.96	.21
.31	.290E+01	.2	2.00	.21
.33	.314E+01	.3	2.03	.21
.36	.337E+01	.3	2.04	.20
.38	.357E+01	.3	2.04	.20
.40	.375E+01	.3	2.02	.21
.43	.390E+01	.3	1.97	.21
.45	.398E+01	.3	1.79	.23

	<---- hydrograph ---->			<-pipe / channel->	
	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)	MAX DEPTH (m)	MAX VEL (m/s)
INFLOW : ID= 2 (0012)	2.50	.16	4.33	32.52	.24	1.85
OUTFLOW: ID= 1 (0018)	2.50	.16	4.33	32.52	.24	1.85

ADD HYD (0014)		AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
1 + 2 = 3	ID1= 1 (0018):	2.50	.163	4.33	32.52
	+ ID2= 2 (0008):	45.50	1.670	4.67	31.72
	ID = 3 (0014):	48.00	1.778	4.67	31.76

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

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

CHICAGO STORM	Ptotal= 95.76 mm

IDF curve parameters: A=1770.000
B= 6.014
C= .820
used in: INTENSITY = A / (t + B)^C

Duration of storm = 12.00 hrs
Storm time step = 10.00 min
Time to peak ratio = .33

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.17	1.55	3.17	6.17	6.17	4.63	9.17	2.16
.33	1.61	3.33	7.69	6.33	4.33	9.33	2.10
.50	1.68	3.50	10.36	6.50	4.07	9.50	2.05

.67	1.75	3.67	16.28	6.67	3.84	9.67	1.99
.83	1.83	3.83	41.46	6.83	3.64	9.83	1.95
1.00	1.92	4.00	182.09	7.00	3.46	10.00	1.90
1.17	2.02	4.17	55.12	7.17	3.30	10.17	1.85
1.33	2.13	4.33	27.86	7.33	3.16	10.33	1.81
1.50	2.25	4.50	18.60	7.50	3.02	10.50	1.77
1.67	2.39	4.67	14.01	7.67	2.90	10.67	1.74
1.83	2.55	4.83	11.28	7.83	2.79	10.83	1.70
2.00	2.74	5.00	9.47	8.00	2.69	11.00	1.67
2.17	2.96	5.17	8.18	8.17	2.60	11.17	1.63
2.33	3.23	5.33	7.22	8.33	2.51	11.33	1.60
2.50	3.55	5.50	6.47	8.50	2.43	11.50	1.57
2.67	3.95	5.67	5.87	8.67	2.36	11.67	1.54
2.83	4.47	5.83	5.38	8.83	2.29	11.83	1.51
3.00	5.17	6.00	4.98	9.00	2.22	12.00	1.49

```
--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD    (0003) |   Area    (ha)=   2.50   Curve Number   (CN)= 72.3
|ID= 1 DT=10.0 min |   Ia      (mm)=   9.70   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .27

     Unit Hyd Qpeak  (cms)=    .354

     PEAK FLOW       (cms)=    .220 (i)
     TIME TO PEAK    (hrs)=   4.167
     RUNOFF VOLUME    (mm)=  40.092
     TOTAL RAINFALL   (mm)=  95.756
     RUNOFF COEFFICIENT   =    .419

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

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD    (0004) |   Area    (ha)=  45.50   Curve Number   (CN)= 71.6
|ID= 1 DT=10.0 min |   Ia      (mm)=  10.10   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .34

     Unit Hyd Qpeak  (cms)=   5.111

     PEAK FLOW       (cms)=   3.344 (i)
     TIME TO PEAK    (hrs)=   4.333
     RUNOFF VOLUME    (mm)=  39.189
     TOTAL RAINFALL   (mm)=  95.756
     RUNOFF COEFFICIENT   =    .409

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

--------------------------------------------------------------------------------
--------------------
| ROUTE CHN (0012) |
| IN= 2---> OUT= 1 |     Routing time step (min)'=  5.00
--------------------
               <------ DATA FOR SECTION (   1.1) ------>
               Distance      Elevation       Manning
                    .00        101.50         .0500
                   1.00        100.70         .0500
                   1.50        100.55     .0500 / .0450  Main Channel
```

```
                2.00         99.50         .0450      Main Channel
                3.50         99.60         .0450      Main Channel
                4.50        100.65     .0450 / .0500  Main Channel
                6.00        101.45         .0500

     <---------------------- TRAVEL TIME TABLE ---------------------->
      DEPTH    ELEV      VOLUME    FLOW RATE    VELOCITY   TRAV.TIME
       (m)      (m)     (cu.m.)      (cms)        (m/s)      (min)
       .10    99.60    .129E+02        .0           .16      18.67
       .19    99.69    .410E+02        .1           .31       9.73
       .29    99.79    .715E+02        .2           .42       7.28
       .38    99.88    .104E+03        .3           .50       6.08
       .48    99.98    .140E+03        .4           .57       5.34
       .57   100.07    .177E+03        .6           .63       4.84
       .67   100.17    .217E+03        .8           .68       4.46
       .76   100.26    .260E+03       1.0           .73       4.16
       .86   100.36    .304E+03       1.3           .78       3.92
       .95   100.45    .352E+03       1.6           .82       3.72
      1.05   100.55    .401E+03       1.9           .86       3.55
      1.16   100.66    .466E+03       2.3           .92       3.33
      1.28   100.78    .541E+03       2.9           .98       3.12
      1.39   100.89    .623E+03       3.5          1.03       2.95
      1.50   101.00    .713E+03       4.2          1.09       2.81
      1.61   101.11    .810E+03       5.0          1.13       2.69
      1.72   101.22    .914E+03       5.9          1.18       2.59
      1.84   101.34    .103E+04       6.8          1.22       2.51
      1.95   101.45    .114E+04       7.9          1.26       2.43

                                  <---- hydrograph ---->   <-pipe / channel->
                           AREA    QPEAK   TPEAK   R.V.   MAX DEPTH  MAX VEL
                           (ha)    (cms)   (hrs)   (mm)      (m)      (m/s)
     INFLOW : ID= 2 (0003)    2.50      .22    4.17  40.09       .33       .45
     OUTFLOW: ID= 1 (0012)    2.50      .20    4.33  40.05       .32       .44


--------------------------------------------------------------------------------
--------------------
| ROUTE CHN (0008) |
| IN= 2---> OUT= 1 |     Routing time step (min)'=  5.00
--------------------
               <------ DATA FOR SECTION (   1.1) ------>
               Distance      Elevation       Manning
                    .00        101.50         .0500
                   1.00        100.70         .0500
                   1.50        100.55     .0500 / .0450  Main Channel
                   2.00         99.50         .0450      Main Channel
                   3.50         99.60         .0450      Main Channel
                   4.50        100.65     .0450 / .0500  Main Channel
                   6.00        101.45         .0500

     <---------------------- TRAVEL TIME TABLE ---------------------->
      DEPTH    ELEV      VOLUME    FLOW RATE    VELOCITY   TRAV.TIME
       (m)      (m)     (cu.m.)      (cms)        (m/s)      (min)
       .10    99.60    .120E+03        .0           .16     173.47
       .19    99.69    .381E+03        .1           .31      90.37
       .29    99.79    .664E+03        .2           .42      67.63
       .38    99.88    .969E+03        .3           .50      56.48
       .48    99.98    .130E+04        .4           .57      49.65
       .57   100.07    .165E+04        .6           .63      44.93
       .67   100.17    .202E+04        .8           .68      41.43
       .76   100.26    .241E+04       1.0           .73      38.68
```

.86	100.36	.283E+04	1.3	.78	36.46
.95	100.45	.327E+04	1.6	.82	34.60
1.05	100.55	.373E+04	1.9	.86	33.02
1.16	100.66	.433E+04	2.3	.92	30.95
1.28	100.78	.502E+04	2.9	.98	28.95
1.39	100.89	.579E+04	3.5	1.03	27.38
1.50	101.00	.662E+04	4.2	1.09	26.10
1.61	101.11	.752E+04	5.0	1.13	25.03
1.72	101.22	.849E+04	5.9	1.18	24.10
1.84	101.34	.953E+04	6.8	1.22	23.29
1.95	101.45	.106E+05	7.9	1.26	22.56

	<---- hydrograph ---->			<-pipe / channel->	
	AREA	QPEAK	TPEAK	R.V.	MAX DEPTH	MAX VEL
	(ha)	(cms)	(hrs)	(mm)	(m)	(m/s)
INFLOW : ID= 2 (0004)	45.50	3.34	4.33	39.19	1.36	1.02
OUTFLOW: ID= 1 (0008)	45.50	2.17	4.67	39.17	1.12	.89

ROUTE PIPE (0018)	PIPE Number	= 1.00
IN= 2---> OUT= 1	Diameter (mm)=	450.00
DT= 5.0 min	Length (m)=	25.00
	Slope (m/m)=	.010
	Manning n	= .013

<---------- TRAVEL TIME TABLE ---------->

DEPTH (m)	VOLUME (cu.m.)	FLOW RATE (cms)	VELOCITY (m/s)	TRAV.TIME min
.02	.802E-01	.0	.48	.87
.05	.223E+00	.0	.74	.56
.07	.403E+00	.0	.96	.44
.09	.609E+00	.0	1.14	.37
.12	.836E+00	.0	1.29	.32
.14	.108E+01	.1	1.43	.29
.17	.133E+01	.1	1.55	.27
.19	.159E+01	.1	1.66	.25
.21	.185E+01	.1	1.75	.24
.24	.212E+01	.2	1.83	.23
.26	.239E+01	.2	1.90	.22
.28	.265E+01	.2	1.96	.21
.31	.290E+01	.2	2.00	.21
.33	.314E+01	.3	2.03	.21
.36	.337E+01	.3	2.04	.20
.38	.357E+01	.3	2.04	.20
.40	.375E+01	.3	2.02	.21
.43	.390E+01	.3	1.97	.21
.45	.398E+01	.3	1.79	.23

	<---- hydrograph ---->			<-pipe / channel->	
	AREA	QPEAK	TPEAK	R.V.	MAX DEPTH	MAX VEL
	(ha)	(cms)	(hrs)	(mm)	(m)	(m/s)
INFLOW : ID= 2 (0012)	2.50	.20	4.33	40.05	.28	1.95
OUTFLOW: ID= 1 (0018)	2.50	.20	4.33	40.05	.28	1.95

ADD HYD (0014)				
1 + 2 = 3	AREA	QPEAK	TPEAK	R.V.

```
--------------------          (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0018):     2.50     .204     4.33    40.05
        + ID2= 2 (0008):    45.50    2.169     4.67    39.17
          ================================================
          ID = 3 (0014):    48.00    2.312     4.58    39.21

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

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


--------------------
|    READ STORM    |    Filename: G:\Projects\2020\
|                  |              200143 - Aaron Wolf - 340 Lowe Road - Structu
|                  |              \Storm\Design Storm Text Files\Historical Aug
| Ptotal= 80.57 mm |    Comments: Ottawa Aug 4 1988
--------------------
                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                 .08     .10 |  1.58   27.50 |  3.08   14.00 |  4.58     .20
                 .17     .10 |  1.67   62.50 |  3.17   22.20 |  4.67     .20
                 .25     .00 |  1.75   31.80 |  3.25   21.80 |  4.75     .20
                 .33    3.70 |  1.83   79.80 |  3.33    1.40 |  4.83     .20
                 .42    6.20 |  1.92   67.50 |  3.42     .20 |  4.92     .20
                 .50  101.50 |  2.00  156.20 |  3.50     .20 |  5.00    2.90
                 .58   15.20 |  2.08    5.10 |  3.58     .20 |  5.08    7.80
                 .67   29.30 |  2.17     .20 |  3.67     .20 |  5.17   10.00
                 .75   19.80 |  2.25     .20 |  3.75     .20 |  5.25    6.30
                 .83    1.50 |  2.33     .20 |  3.83     .20 |  5.33    5.10
                 .92    1.70 |  2.42     .20 |  3.92     .20 |  5.42    9.80
                1.00    5.40 |  2.50     .20 |  4.00     .20 |  5.50    2.60
                1.08   24.60 |  2.58     .20 |  4.08     .20 |  5.58    1.70
                1.17   26.50 |  2.67     .20 |  4.17     .20 |  5.67     .00
                1.25   34.90 |  2.75     .20 |  4.25     .20 |  5.75     .00
                1.33   10.20 |  2.83     .20 |  4.33     .20 |
                1.42   27.10 |  2.92     .20 |  4.42     .20 |
                1.50  104.40 |  3.00   12.80 |  4.50     .20 |

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

--------------------
| CALIB            |
| NASHYD    (0003) |   Area    (ha)=   2.50   Curve Number   (CN)= 72.3
|ID= 1 DT=10.0 min |   Ia      (mm)=   9.70   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .27

         NOTE:  RAINFALL WAS TRANSFORMED TO  10.0 MIN. TIME STEP.


                          ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                .167     .10 | 1.667   45.00 | 3.167   18.10 |  4.67     .20
                .333    1.85 | 1.833   55.80 | 3.333   11.60 |  4.83     .20
                .500   53.85 | 2.000  111.85 | 3.500     .20 |  5.00    1.55
                .667   22.25 | 2.167    2.65 | 3.667     .20 |  5.17    8.90
                .833   10.65 | 2.333     .20 | 3.833     .20 |  5.33    5.70
               1.000    3.55 | 2.500     .20 | 4.000     .20 |  5.50    6.20
```

```
               1.167   25.55 | 2.667     .20 | 4.167     .20 |  5.67     .85
               1.333   22.55 | 2.833     .20 | 4.333     .20 |  5.83     .00
               1.500   65.75 | 3.000    6.50 | 4.500     .20 |

     Unit Hyd Qpeak  (cms)=    .354

     PEAK FLOW       (cms)=    .222 (i)
     TIME TO PEAK    (hrs)=   2.000
     RUNOFF VOLUME    (mm)=  29.647
     TOTAL RAINFALL   (mm)=  80.567
     RUNOFF COEFFICIENT   =    .368

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

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD    (0004) |   Area    (ha)=  45.50   Curve Number   (CN)= 71.6
|ID= 1 DT=10.0 min |   Ia      (mm)=  10.10   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .34

     Unit Hyd Qpeak  (cms)=   5.111

     PEAK FLOW       (cms)=   3.412 (i)
     TIME TO PEAK    (hrs)=   2.167
     RUNOFF VOLUME    (mm)=  28.873
     TOTAL RAINFALL   (mm)=  80.567
     RUNOFF COEFFICIENT   =    .358

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

--------------------------------------------------------------------------------
--------------------
| ROUTE CHN (0012) |
| IN= 2---> OUT= 1 |     Routing time step (min)'=  5.00
--------------------
               <------ DATA FOR SECTION (   1.1) ------>
               Distance      Elevation       Manning
                    .00        101.50         .0500
                   1.00        100.70         .0500
                   1.50        100.55     .0500 / .0450  Main Channel
                   2.00         99.50         .0450      Main Channel
                   3.50         99.60         .0450      Main Channel
                   4.50        100.65     .0450 / .0500  Main Channel
                   6.00        101.45         .0500

      <---------------------- TRAVEL TIME TABLE ---------------------->
       DEPTH    ELEV      VOLUME    FLOW RATE    VELOCITY   TRAV.TIME
        (m)      (m)     (cu.m.)      (cms)        (m/s)      (min)
        .10    99.60    .129E+02        .0           .16      18.67
        .19    99.69    .410E+02        .1           .31       9.73
        .29    99.79    .715E+02        .2           .42       7.28
        .38    99.88    .104E+03        .3           .50       6.08
        .48    99.98    .140E+03        .4           .57       5.34
        .57   100.07    .177E+03        .6           .63       4.84
        .67   100.17    .217E+03        .8           .68       4.46
        .76   100.26    .260E+03       1.0           .73       4.16
        .86   100.36    .304E+03       1.3           .78       3.92
        .95   100.45    .352E+03       1.6           .82       3.72
       1.05   100.55    .401E+03       1.9           .86       3.55
       1.16   100.66    .466E+03       2.3           .92       3.33
```

1.28	100.78	.541E+03	2.9	.98	3.12
1.39	100.89	.623E+03	3.5	1.03	2.95
1.50	101.00	.713E+03	4.2	1.09	2.81
1.61	101.11	.810E+03	5.0	1.13	2.69
1.72	101.22	.914E+03	5.9	1.18	2.59
1.84	101.34	.103E+04	6.8	1.22	2.51
1.95	101.45	.114E+04	7.9	1.26	2.43

	<---- hydrograph ---->			<-pipe / channel->	
	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)	MAX DEPTH (m)	MAX VEL (m/s)
INFLOW : ID= 2 (0003)	2.50	.22	2.00	29.65	.33	.45
OUTFLOW: ID= 1 (0012)	2.50	.21	2.08	29.61	.32	.44

ROUTE CHN (0008)	
IN= 2---> OUT= 1	Routing time step (min)'= 5.00

<------ DATA FOR SECTION (1.1) ------>

Distance	Elevation	Manning	
.00	101.50	.0500	
1.00	100.70	.0500	
1.50	100.55	.0500 / .0450	Main Channel
2.00	99.50	.0450	Main Channel
3.50	99.60	.0450	Main Channel
4.50	100.65	.0450 / .0500	Main Channel
6.00	101.45	.0500	

<---------- TRAVEL TIME TABLE ---------->

DEPTH (m)	ELEV (m)	VOLUME (cu.m.)	FLOW RATE (cms)	VELOCITY (m/s)	TRAV.TIME (min)
.10	99.60	.120E+03	.0	.16	173.47
.19	99.69	.381E+03	.1	.31	90.37
.29	99.79	.664E+03	.2	.42	67.63
.38	99.88	.969E+03	.3	.50	56.48
.48	99.98	.130E+04	.4	.57	49.65
.57	100.07	.165E+04	.6	.63	44.93
.67	100.17	.202E+04	.8	.68	41.43
.76	100.26	.241E+04	1.0	.73	38.68
.86	100.36	.283E+04	1.3	.78	36.46
.95	100.45	.327E+04	1.6	.82	34.60
1.05	100.55	.373E+04	1.9	.86	33.02
1.16	100.66	.433E+04	2.3	.92	30.95
1.28	100.78	.502E+04	2.9	.98	28.95
1.39	100.89	.579E+04	3.5	1.03	27.38
1.50	101.00	.662E+04	4.2	1.09	26.10
1.61	101.11	.752E+04	5.0	1.13	25.03
1.72	101.22	.849E+04	5.9	1.18	24.10
1.84	101.34	.953E+04	6.8	1.22	23.29
1.95	101.45	.106E+05	7.9	1.26	22.56

	<---- hydrograph ---->			<-pipe / channel->	
	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)	MAX DEPTH (m)	MAX VEL (m/s)
INFLOW : ID= 2 (0004)	45.50	3.41	2.17	28.87	1.37	1.02
OUTFLOW: ID= 1 (0008)	45.50	2.21	2.33	28.85	1.13	.90

```
--------------------
| ROUTE PIPE (0018)|     PIPE Number     =   1.00
| IN= 2---> OUT= 1 |     Diameter    (mm)= 450.00
| DT=  5.0 min     |     Length       (m)=  25.00
--------------------     Slope      (m/m)=   .010
                         Manning n       =   .013

     <----------------- TRAVEL TIME TABLE -------------------->
       DEPTH      VOLUME    FLOW RATE    VELOCITY    TRAV.TIME
        (m)      (cu.m.)      (cms)        (m/s)        min
        .02     .802E-01        .0          .48          .87
        .05     .223E+00        .0          .74          .56
        .07     .403E+00        .0          .96          .44
        .09     .609E+00        .0         1.14          .37
        .12     .836E+00        .0         1.29          .32
        .14     .108E+01        .1         1.43          .29
        .17     .133E+01        .1         1.55          .27
        .19     .159E+01        .1         1.66          .25
        .21     .185E+01        .1         1.75          .24
        .24     .212E+01        .2         1.83          .23
        .26     .239E+01        .2         1.90          .22
        .28     .265E+01        .2         1.96          .21
        .31     .290E+01        .2         2.00          .21
        .33     .314E+01        .3         2.03          .21
        .36     .337E+01        .3         2.04          .20
        .38     .357E+01        .3         2.04          .20
        .40     .375E+01        .3         2.02          .21
        .43     .390E+01        .3         1.97          .21
        .45     .398E+01        .3         1.79          .23
                                    <---- hydrograph ---->   <-pipe / channel->
                              AREA    QPEAK   TPEAK   R.V.   MAX DEPTH  MAX VEL
                              (ha)    (cms)   (hrs)   (mm)      (m)      (m/s)
     INFLOW : ID= 2 (0012)    2.50      .21    2.08  29.61       .28      1.95
     OUTFLOW: ID= 1 (0018)    2.50      .21    2.08  29.61       .28      1.95


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--------------------
| ADD HYD   (0014) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0018):     2.50    .205     2.08    29.61
        + ID2= 2 (0008):    45.50   2.212     2.33    28.85
          ================================================
          ID = 3 (0014):    48.00   2.369     2.33    28.89

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

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


--------------------
|    READ STORM    |    Filename: G:\Projects\2020\
|                  |              200143 - Aaron Wolf - 340 Lowe Road - Structu
|                  |              \Storm\Design Storm Text Files\Historical Jul
| Ptotal= 83.99 mm |    Comments: Ottawa July 1 1979
--------------------
```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.08	2.30	.83	38.10	1.58	71.10	2.33	3.80
.17	2.30	.92	38.10	1.67	71.10	2.42	3.80
.25	8.89	1.00	38.10	1.75	30.50	2.50	3.80
.33	8.89	1.08	38.10	1.83	30.50	2.58	3.80
.42	8.89	1.17	50.80	1.92	30.50	2.67	3.80
.50	8.89	1.25	50.80	2.00	30.50	2.75	3.80
.58	38.10	1.33	76.20	2.08	3.80	2.83	3.80
.67	38.10	1.42	106.70	2.17	3.80	2.92	3.80
.75	38.10	1.50	106.70	2.25	3.80	3.00	3.80

CALIB			
NASHYD (0003)	Area (ha)=	2.50	Curve Number (CN)= 72.3
ID= 1 DT=10.0 min	Ia (mm)=	9.70	# of Linear Res.(N)= 3.00
	U.H. Tp(hrs)=	.27	

NOTE: RAINFALL WAS TRANSFORMED TO 10.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.167	2.30	1.000	38.10	1.833	30.50	2.67	3.80
.333	8.89	1.167	44.45	2.000	30.50	2.83	3.80
.500	8.89	1.333	63.50	2.167	3.80	3.00	3.80
.667	38.10	1.500	106.70	2.333	3.80		
.833	38.10	1.667	71.10	2.500	3.80		

Unit Hyd Qpeak (cms)= .354

PEAK FLOW (cms)= .242 (i)
TIME TO PEAK (hrs)= 1.667
RUNOFF VOLUME (mm)= 31.929
TOTAL RAINFALL (mm)= 83.988
RUNOFF COEFFICIENT = .380

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

CALIB			
NASHYD (0004)	Area (ha)=	45.50	Curve Number (CN)= 71.6
ID= 1 DT=10.0 min	Ia (mm)=	10.10	# of Linear Res.(N)= 3.00
	U.H. Tp(hrs)=	.34	

Unit Hyd Qpeak (cms)= 5.111

PEAK FLOW (cms)= 3.833 (i)
TIME TO PEAK (hrs)= 1.833
RUNOFF VOLUME (mm)= 31.124
TOTAL RAINFALL (mm)= 83.988
RUNOFF COEFFICIENT = .371

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

```
| ROUTE CHN (0012) |
| IN= 2---> OUT= 1 |     Routing time step (min)'=  5.00
--------------------
               <------ DATA FOR SECTION (   1.1) ------>
               Distance      Elevation       Manning
                    .00        101.50         .0500
                   1.00        100.70         .0500
                   1.50        100.55     .0500 / .0450  Main Channel
                   2.00         99.50         .0450      Main Channel
                   3.50         99.60         .0450      Main Channel
                   4.50        100.65     .0450 / .0500  Main Channel
                   6.00        101.45         .0500

      <---------------------- TRAVEL TIME TABLE ---------------------->
       DEPTH    ELEV      VOLUME    FLOW RATE    VELOCITY   TRAV.TIME
        (m)      (m)     (cu.m.)      (cms)        (m/s)      (min)
        .10    99.60    .129E+02        .0           .16      18.67
        .19    99.69    .410E+02        .1           .31       9.73
        .29    99.79    .715E+02        .2           .42       7.28
        .38    99.88    .104E+03        .3           .50       6.08
        .48    99.98    .140E+03        .4           .57       5.34
        .57   100.07    .177E+03        .6           .63       4.84
        .67   100.17    .217E+03        .8           .68       4.46
        .76   100.26    .260E+03       1.0           .73       4.16
        .86   100.36    .304E+03       1.3           .78       3.92
        .95   100.45    .352E+03       1.6           .82       3.72
       1.05   100.55    .401E+03       1.9           .86       3.55
       1.16   100.66    .466E+03       2.3           .92       3.33
       1.28   100.78    .541E+03       2.9           .98       3.12
       1.39   100.89    .623E+03       3.5          1.03       2.95
       1.50   101.00    .713E+03       4.2          1.09       2.81
       1.61   101.11    .810E+03       5.0          1.13       2.69
       1.72   101.22    .914E+03       5.9          1.18       2.59
       1.84   101.34    .103E+04       6.8          1.22       2.51
       1.95   101.45    .114E+04       7.9          1.26       2.43

                                  <---- hydrograph ---->   <-pipe / channel->
                            AREA    QPEAK   TPEAK   R.V.   MAX DEPTH  MAX VEL
                            (ha)    (cms)   (hrs)   (mm)      (m)      (m/s)
     INFLOW : ID= 2 (0003)    2.50      .24    1.67  31.93       .35       .47
     OUTFLOW: ID= 1 (0012)    2.50      .23    1.83  31.89       .34       .46


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--------------------
| ROUTE CHN (0008) |
| IN= 2---> OUT= 1 |     Routing time step (min)'=  5.00
--------------------
               <------ DATA FOR SECTION (   1.1) ------>
               Distance      Elevation       Manning
                    .00        101.50         .0500
                   1.00        100.70         .0500
                   1.50        100.55     .0500 / .0450  Main Channel
                   2.00         99.50         .0450      Main Channel
                   3.50         99.60         .0450      Main Channel
                   4.50        100.65     .0450 / .0500  Main Channel
                   6.00        101.45         .0500

      <---------------------- TRAVEL TIME TABLE ---------------------->
       DEPTH    ELEV      VOLUME    FLOW RATE    VELOCITY   TRAV.TIME
        (m)      (m)     (cu.m.)      (cms)        (m/s)      (min)
```

.10	99.60	.120E+03	.0	.16	173.47
.19	99.69	.381E+03	.1	.31	90.37
.29	99.79	.664E+03	.2	.42	67.63
.38	99.88	.969E+03	.3	.50	56.48
.48	99.98	.130E+04	.4	.57	49.65
.57	100.07	.165E+04	.6	.63	44.93
.67	100.17	.202E+04	.8	.68	41.43
.76	100.26	.241E+04	1.0	.73	38.68
.86	100.36	.283E+04	1.3	.78	36.46
.95	100.45	.327E+04	1.6	.82	34.60
1.05	100.55	.373E+04	1.9	.86	33.02
1.16	100.66	.433E+04	2.3	.92	30.95
1.28	100.78	.502E+04	2.9	.98	28.95
1.39	100.89	.579E+04	3.5	1.03	27.38
1.50	101.00	.662E+04	4.2	1.09	26.10
1.61	101.11	.752E+04	5.0	1.13	25.03
1.72	101.22	.849E+04	5.9	1.18	24.10
1.84	101.34	.953E+04	6.8	1.22	23.29
1.95	101.45	.106E+05	7.9	1.26	22.56

		<---- hydrograph ---->			<-pipe / channel->	
	AREA	QPEAK	TPEAK	R.V.	MAX DEPTH	MAX VEL
	(ha)	(cms)	(hrs)	(mm)	(m)	(m/s)
INFLOW : ID= 2 (0004)	45.50	3.83	1.83	31.12	1.44	1.06
OUTFLOW: ID= 1 (0008)	45.50	2.76	2.08	31.10	1.25	.96

ROUTE PIPE (0018)	PIPE Number	= 1.00
IN= 2---> OUT= 1	Diameter (mm)	= 450.00
DT= 5.0 min	Length (m)	= 25.00
	Slope (m/m)	= .010
	Manning n	= .013

<---------- TRAVEL TIME TABLE ---------->

DEPTH (m)	VOLUME (cu.m.)	FLOW RATE (cms)	VELOCITY (m/s)	TRAV.TIME min
.02	.802E-01	.0	.48	.87
.05	.223E+00	.0	.74	.56
.07	.403E+00	.0	.96	.44
.09	.609E+00	.0	1.14	.37
.12	.836E+00	.0	1.29	.32
.14	.108E+01	.1	1.43	.29
.17	.133E+01	.1	1.55	.27
.19	.159E+01	.1	1.66	.25
.21	.185E+01	.1	1.75	.24
.24	.212E+01	.2	1.83	.23
.26	.239E+01	.2	1.90	.22
.28	.265E+01	.2	1.96	.21
.31	.290E+01	.2	2.00	.21
.33	.314E+01	.3	2.03	.21
.36	.337E+01	.3	2.04	.20
.38	.357E+01	.3	2.04	.20
.40	.375E+01	.3	2.02	.21
.43	.390E+01	.3	1.97	.21
.45	.398E+01	.3	1.79	.23

		<---- hydrograph ---->			<-pipe / channel->	
	AREA	QPEAK	TPEAK	R.V.	MAX DEPTH	MAX VEL
	(ha)	(cms)	(hrs)	(mm)	(m)	(m/s)
INFLOW : ID= 2 (0012)	2.50	.23	1.83	31.89	.30	1.99

```
     OUTFLOW: ID= 1 (0018)    2.50      .23    1.83  31.89       .30      1.99


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--------------------
| ADD HYD   (0014) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0018):     2.50    .229     1.83    31.89
        + ID2= 2 (0008):    45.50   2.759     2.08    31.10
          ================================================
          ID = 3 (0014):    48.00   2.945     2.08    31.14

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

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  ***************************
  ** SIMULATION NUMBER:   7 **
  ***************************


--------------------
|    READ STORM    |    Filename: G:\Projects\2016\
|                  |              160570 - Bob Wachna - Mill Ridge Rd Subdivisi
|                  |              \Storm\Design Storm Text Files\25mm4hrChicago
| Ptotal= 25.00 mm |    Comments: twentyfive mm 4 hr chicago storm
--------------------
                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                 .17    2.07 |  1.17    5.70 |  2.17    5.19 |  3.17    2.80
                 .33    2.27 |  1.33   10.78 |  2.33    4.47 |  3.33    2.62
                 .50    2.52 |  1.50   50.21 |  2.50    3.95 |  3.50    2.48
                 .67    2.88 |  1.67   13.37 |  2.67    3.56 |  3.67    2.35
                 .83    3.38 |  1.83    8.29 |  2.83    3.25 |  3.83    2.23
                1.00    4.18 |  2.00    6.30 |  3.00    3.01 |  4.00    2.14

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--------------------
| CALIB            |
| NASHYD    (0003) |   Area    (ha)=   2.50   Curve Number   (CN)= 72.3
|ID= 1 DT=10.0 min |   Ia      (mm)=   9.70   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .27

     Unit Hyd Qpeak  (cms)=    .354

     PEAK FLOW       (cms)=    .007 (i)
     TIME TO PEAK    (hrs)=   2.000
     RUNOFF VOLUME    (mm)=   2.064
     TOTAL RAINFALL   (mm)=  24.996
     RUNOFF COEFFICIENT   =    .083

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

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD    (0004) |   Area    (ha)=  45.50   Curve Number   (CN)= 71.6
|ID= 1 DT=10.0 min |   Ia      (mm)=  10.10   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .34
```

```
     Unit Hyd Qpeak  (cms)=   5.111

     PEAK FLOW       (cms)=    .110 (i)
     TIME TO PEAK    (hrs)=   2.167
     RUNOFF VOLUME    (mm)=   1.909
     TOTAL RAINFALL   (mm)=  24.996
     RUNOFF COEFFICIENT   =    .076

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

--------------------------------------------------------------------------------
--------------------
| ROUTE CHN (0012) |
| IN= 2---> OUT= 1 |     Routing time step (min)'=  5.00
--------------------
               <------ DATA FOR SECTION (   1.1) ------>
               Distance      Elevation       Manning
                    .00        101.50         .0500
                   1.00        100.70         .0500
                   1.50        100.55     .0500 / .0450  Main Channel
                   2.00         99.50         .0450      Main Channel
                   3.50         99.60         .0450      Main Channel
                   4.50        100.65     .0450 / .0500  Main Channel
                   6.00        101.45         .0500

      <---------------------- TRAVEL TIME TABLE ---------------------->
       DEPTH    ELEV      VOLUME    FLOW RATE    VELOCITY   TRAV.TIME
        (m)      (m)     (cu.m.)      (cms)        (m/s)      (min)
        .10    99.60    .129E+02        .0          .16       18.67
        .19    99.69    .410E+02        .1          .31        9.73
        .29    99.79    .715E+02        .2          .42        7.28
        .38    99.88    .104E+03        .3          .50        6.08
        .48    99.98    .140E+03        .4          .57        5.34
        .57   100.07    .177E+03        .6          .63        4.84
        .67   100.17    .217E+03        .8          .68        4.46
        .76   100.26    .260E+03       1.0          .73        4.16
        .86   100.36    .304E+03       1.3          .78        3.92
        .95   100.45    .352E+03       1.6          .82        3.72
       1.05   100.55    .401E+03       1.9          .86        3.55
       1.16   100.66    .466E+03       2.3          .92        3.33
       1.28   100.78    .541E+03       2.9          .98        3.12
       1.39   100.89    .623E+03       3.5         1.03        2.95
       1.50   101.00    .713E+03       4.2         1.09        2.81
       1.61   101.11    .810E+03       5.0         1.13        2.69
       1.72   101.22    .914E+03       5.9         1.18        2.59
       1.84   101.34    .103E+04       6.8         1.22        2.51
       1.95   101.45    .114E+04       7.9         1.26        2.43

                                  <---- hydrograph ---->   <-pipe / channel->
                            AREA    QPEAK   TPEAK   R.V.   MAX DEPTH  MAX VEL
                            (ha)    (cms)   (hrs)   (mm)      (m)      (m/s)
     INFLOW : ID= 2 (0003)    2.50      .01    2.00   2.06       .06       .16
     OUTFLOW: ID= 1 (0012)    2.50      .01    2.42   2.02       .05       .16


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--------------------
| ROUTE CHN (0008) |
| IN= 2---> OUT= 1 |     Routing time step (min)'=  5.00
--------------------
```

<------ DATA FOR SECTION (1.1) ------>

Distance	Elevation	Manning	
.00	101.50	.0500	
1.00	100.70	.0500	
1.50	100.55	.0500 / .0450	Main Channel
2.00	99.50	.0450	Main Channel
3.50	99.60	.0450	Main Channel
4.50	100.65	.0450 / .0500	Main Channel
6.00	101.45	.0500	

<---------- TRAVEL TIME TABLE ---------->

DEPTH (m)	ELEV (m)	VOLUME (cu.m.)	FLOW RATE (cms)	VELOCITY (m/s)	TRAV.TIME (min)
.10	99.60	.120E+03	.0	.16	173.47
.19	99.69	.381E+03	.1	.31	90.37
.29	99.79	.664E+03	.2	.42	67.63
.38	99.88	.969E+03	.3	.50	56.48
.48	99.98	.130E+04	.4	.57	49.65
.57	100.07	.165E+04	.6	.63	44.93
.67	100.17	.202E+04	.8	.68	41.43
.76	100.26	.241E+04	1.0	.73	38.68
.86	100.36	.283E+04	1.3	.78	36.46
.95	100.45	.327E+04	1.6	.82	34.60
1.05	100.55	.373E+04	1.9	.86	33.02
1.16	100.66	.433E+04	2.3	.92	30.95
1.28	100.78	.502E+04	2.9	.98	28.95
1.39	100.89	.579E+04	3.5	1.03	27.38
1.50	101.00	.662E+04	4.2	1.09	26.10
1.61	101.11	.752E+04	5.0	1.13	25.03
1.72	101.22	.849E+04	5.9	1.18	24.10
1.84	101.34	.953E+04	6.8	1.22	23.29
1.95	101.45	.106E+05	7.9	1.26	22.56

		<---- hydrograph ---->			<-pipe / channel->	
	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)	MAX DEPTH (m)	MAX VEL (m/s)
INFLOW : ID= 2 (0004)	45.50	.11	2.17	1.91	.23	.35
OUTFLOW: ID= 1 (0008)	45.50	.07	3.83	1.89	.19	.30

ROUTE PIPE (0018)	PIPE Number	= 1.00
IN= 2---> OUT= 1	Diameter (mm)	= 450.00
DT= 5.0 min	Length (m)	= 25.00
	Slope (m/m)	= .010
	Manning n	= .013

<---------- TRAVEL TIME TABLE ---------->

DEPTH (m)	VOLUME (cu.m.)	FLOW RATE (cms)	VELOCITY (m/s)	TRAV.TIME min
.02	.802E-01	.0	.48	.87
.05	.223E+00	.0	.74	.56
.07	.403E+00	.0	.96	.44
.09	.609E+00	.0	1.14	.37
.12	.836E+00	.0	1.29	.32
.14	.108E+01	.1	1.43	.29
.17	.133E+01	.1	1.55	.27
.19	.159E+01	.1	1.66	.25
.21	.185E+01	.1	1.75	.24
.24	.212E+01	.2	1.83	.23

```
        .26     .239E+01        .2          1.90          .22
        .28     .265E+01        .2          1.96          .21
        .31     .290E+01        .2          2.00          .21
        .33     .314E+01        .3          2.03          .21
        .36     .337E+01        .3          2.04          .20
        .38     .357E+01        .3          2.04          .20
        .40     .375E+01        .3          2.02          .21
        .43     .390E+01        .3          1.97          .21
        .45     .398E+01        .3          1.79          .23
                                    <---- hydrograph ---->   <-pipe / channel->
                              AREA    QPEAK   TPEAK   R.V.   MAX DEPTH  MAX VEL
                              (ha)    (cms)   (hrs)   (mm)      (m)      (m/s)
    INFLOW : ID= 2 (0012)    2.50      .01    2.42   2.02       .04       .70
    OUTFLOW: ID= 1 (0018)    2.50      .01    2.42   2.02       .04       .70


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

--------------------
| ADD HYD   (0014) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0018):     2.50    .006     2.42     2.02
        + ID2= 2 (0008):    45.50    .068     3.83     1.89
          ================================================
          ID = 3 (0014):    48.00    .072     3.75     1.89

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

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 FINISH
```