PRELIMINARY STORMWATER MANAGEMENT REPORT

Upper Mill Pond Development

Norwood, ON

December 1, 2023

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Revision Summary

December 1, 2023

Preliminary SWM Report issued for draft plan approval.

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1 Introduction and Background

CAP Norwood Developments Inc. is proposing to develop a 36ha parcel of land in Norwood, ON. The development is bounded by Mill St to the southwest, Asphodel 10th Line in the east, and the CP Railway in the northwest (Figure 1-1). The proposed development will include construction of approx. 640 residential units, in the form of 400 single-detached and townhouse units (17ha), and 240 medium-density units (7ha).

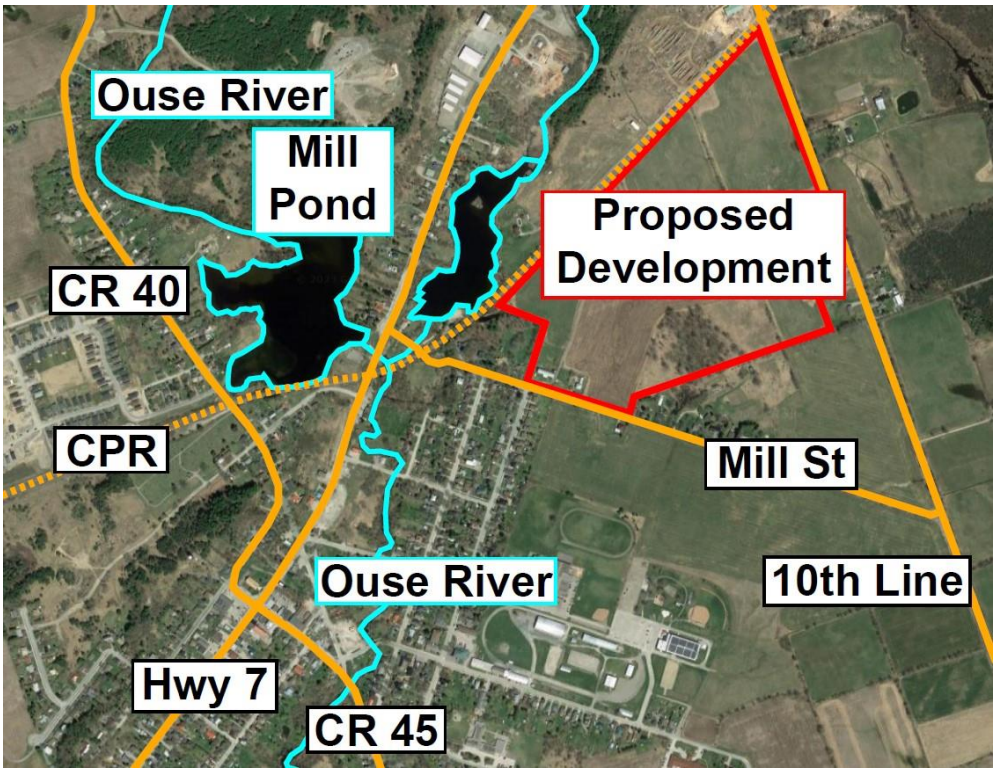

Figure 1-1: Development Site Location (Google, Maxar Tech 2018)

2 Existing Conditions

The existing site consists of an open agricultural field, with some sparse trees and vegetation. The property boundary is highlighted in Figure 2-1.

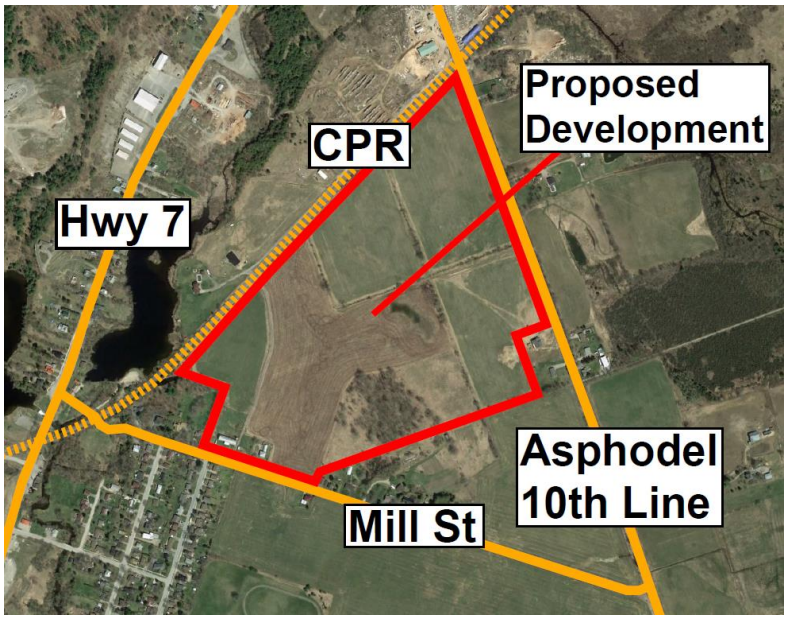

Figure 2-1: Existing Conditions (Google, Maxar Tech 2018)

2.1 Drainage Scheme

In existing conditions, the development site drains naturally to the southwest where there is a waterbody located on adjacent lands (the north portion of the site drains north to the rail corridor before draining southwest to the same outlet).

Norwood has two main bodies of water. The Mill Pond, northwest of Highway 7, has an area of approx. 8ha and a contributing area of 79km^2. The smaller pond to the east (hereafter referred to as "east pond") has an area of 3.5ha and a contributing area of 13km^2. The effluent from both ponds converges before crossing under the CP Rail corridor and draining 16km via the Ouse River to the lower end of Rice Lake (refer to Figure 1-1).

Jewell completed a hydraulic analysis of the east pond for Otonabee Region Conservation Authority in October 2020, and determined that the 100Yr water surface elevation in the pond is 202.22m. The east pond is controlled by several logs that function as a dam, and the elevation of 202.22 is based on all the logs being in place during the 100Yr event.

Runoff from the development site collects in a relatively small (~500m^2) pond (hereafter referred to as "south pond") that is hydraulically connected to the east pond via a culvert under the CP Rail corridor. The culvert has dimensions of approx. 48 x 18" (1.22 x 0.46m) and is constructed of wood/concrete.

2.2 Soils

Soils were reviewed from the Soil Survey of Peterborough County (Ontario Insitute of Pedology, 1981). The predominant soil type at the development site is Bondhead Sandy Loam, which is a moderately well-drained soil. The development lands fall under hydrologic soils group (HSG) B. Figure 2-2 (MTO, 2008) outlines the classifications of Hydrologic Soils Groups.

Hydrologic Soil Group

The hydrologic soil group is used to classify soils into groups of various runoff potential.

The Soil Conservation Service (SCS) classifies bare thoroughly wet soils into four hydrologic soil groups (A, B, C and D). SCS descriptions of the four groups, modified slightly to suit Ontario conditions, are as follows: (Design Chart 1.09)

A: High infiltration and transmission rates when thoroughly wet, eg. deep, well drained to excessively-drained sands and gravels. These soils have a low runoff potential.

B: Moderate infiltration and transmission rates when thoroughly wet, such as moderately deep to deep open textured loam.

C: Slow infiltration and transmission rates when thoroughly wet, eg. fine to moderately fine-textured soils such as silty clay loam.

D: Very slow infiltration and transmission rates when thoroughly wet, eg. clay loams with a high swelling potential. These soils have the highest runoff potential.

In Ontario, soils have been found to lie between the main groups given above, and have therefore been interpolated as AB, BC, CD as appropriate, such as Guelph loam, which is classified as BC.

Figure 2-2: Soils MTO Drainage Management Manual – Description of Hydrologic Soils Groups

2.3 Geotechnical Report

Cambium completed a geotechnical investigation of the site in April 2022, which involved digging several test pits and boreholes on site. The investigation concluded the following:

- Site soils are a mixture of SM (sand with silty fines) and ML (low liquid-limit silt), which is consistent with OMAFRA's soil mapping.
- Bedrock is encountered at a depth of between 2 and 5m for the majority of the site.

- Groundwater was encountered in less than half of the test pits and boreholes dug. Of the encounters, water was generally first encountered at a depth of between 1.5 and 3m.

2.4 Targets

The stormwater management plan focuses on three environmental objectives when considering the treatment and conveyance of stormwater runoff. The objectives are to mitigate flooding, quality, and erosion impacts to the receiving system. These objectives, such as preventing increase in flood risk and protecting water quality, comply with the environmental guidelines set out by Otonabee Region Conservation Authority (2015) and the Ministry of Environment Stormwater Planning and Design Manual (2003).

The MTO Drainage Manual (1997) outlines potential negative impacts as a result of development, including increase in surface runoff, soil erosion, and higher downstream flow velocities.

Based on the guidance above, Jewell proposed a SWM methodology to achieve the following targets:

Quantity Control

- Ensure the development does not increase peak flows to the downstream culvert.

Quality Control

- Follow the Ministry of Environment guidelines to provide adequate quality treatment to runoff to ensure effluent meets **Enhanced** quality control objectives.

Erosion and Sediment Control

- Minimize the potential for erosion of soils,
- Mitigate the release of sediment offsite.

Quality controls will be provided using a treatment train approach and a combination of best management practices, discussed further in Section 4.

3 Proposed Conditions

3.1 Drainage Scheme

Runoff from the proposed development will be directed to a stormwater management facility which has been located at the southwest corner of the site, thereby maintaining existing drainage patterns and outlet locations. The site's pre-development catchment area is 35.6ha, and the facility has been sized to treat runoff from the entire development site.

Runoff from roof areas and front yards will drain towards the road where it will be collected in catch basins. Storm sewers will be sized to convey the 5Yr (minor) event, while additional flows will be conveyed via overland flow to the site's SWM pond via Street A (north route) or Street B (south route).

Runoff from rear yards will be conveyed to the roads via rear-yard swales. The swales will provide preliminary polishing of runoff before treatment in the proposed SWM pond.

The site is very near the Norwood Mill Dam and ultimately drains into the head pond (east pond) behind the dam. Discharge from the SWM pond will first drain into a small natural pond (south pond), then through a culvert under the CP rail corridor and into the east pond. The two ponds (east pond and south pond) are hydraulically connected by the culvert under the CP rail. Therefore, there is potential for backwater from both the east pond and the CP railway culvert. The backwater has the potential to affect the SWM pond operation and was reviewed as part of this preliminary stormwater management investigation.

The proposed SWM facility calculations are presented with and without the backwater effect. The facility design will meet or exceed the design objectives in either condition.

A brief discussion of the Norwood mill dam and the CP Railway culvert follows.

3.1.1 Norwood Mill Dam

The mill dam was reviewed by Jewell Engineering in October 2020. The dam is an embankment dam with a concrete outlet controlled by stop logs. The operation of the dam is not formalized and no log lifting equipment is permanently affixed to the structure. Instead, logs are removed using a backhoe or excavator as required. The contributing area to the millpond is just over 13km^2 and during an event the watershed will respond quickly leaving little response time for an operator to remove logs. With this understanding, the reviewers determined a 100-yr flood elevation of 202.22m in the headpond (east pond) assuming all logs are left in place.

3.1.2 CP Railway Culvert

The culvert under the railway was inspected by Jewell Engineering in October 2023. The culvert is submerged and could only be reviewed using an underwater camera. The size was measured as 18" high by 48" wide. Discharge from the proposed SWM facility is estimated to develop a head differential across the culvert by as much as 0.91m during the 100-yr event (see Appendix E).

3.2 Site Hydrology

Jewell used OTTHYMO, a hydrologic model commonly used in Eastern Ontario for estimating peak flows from watersheds. Pre-development peak flows were determined using the Nashyd subroutine, while post-development peak flows were determined using the Standhyd subroutine.

OTTHYMO provides opportunity for the user to assign rainfall information; adjust watershed parameters such as area, slope, losses and % imperviousness; and analyze the impact of conveyance features or reservoirs.

Jewell used the Rational Method for sizing of storm sewers. The Rational Method relies on an estimation of runoff coefficient, flow intensity, and drainage area.

Equation 1: Rational Method

$$Q = \frac{CiA}{360}$$

Where:

Q = Peak Flow in m^3/s
C = Runoff Coefficient
i = Rainfall Intensity in mm/hr
A = Area in hectares

Rainfall intensities are derived from the Environment Canada Peterborough IDF curves (Appendix A).

The Nash unit hydrograph method requires a time to peak value for the catchment. The time to peak is derived from the time of concentration that is calculated using the Airport Method. The Airport Method uses site topography and soil conditions to estimate time of concentration, as follows:

Equation 2: Time of Concentration

$$T_c = \frac{3.26 * (1.1 - C) * \sqrt{L}}{S_w^{0.33}}$$

Where

T_c = Time of concentration
C = Runoff Coefficient
L = watershed length, m
S_w = Slope of watershed, %

The site's pre-development time-to-peak is

Equation 3: Time to Peak

$$T_p = \frac{2}{3}T_c$$

The quality event was estimated with the assistance of OTTHYMO using a 25mm 4-hr Chicago storm as recommended in the design manual (MOE, 2003).

3.3 Climate Resiliency

Climate Change projections typically increase rainfall intensity values by 10% compared to base-year events. The proposed development's conveyance features are designed with surplus capacity to ensure that runoff is adequately conveyed during events larger than the 100Yr design event (Appendix D). Therefore, climate resiliency is provided.

4 Stormwater Management Controls

Runoff from the subject site will increase in post-development conditions as a result of the conversion of agricultural lands to an urban subdivision with impervious surfaces. Therefore, SWM controls for quality and quantity control will be required. Due to the large development area (36ha), the most appropriate and effective treatment option for this site is a SWM wet pond to provide quality and quantity treatment.

Table 4-1: Proposed SWMF - Design Summary

Elevation, masl	Storage, m^3	Discharge, m^3/s	Notes
199.8	0	-	Bottom of Pond
202.3	5,882	0	Permanent Pool
202.8	2,868	0.183	Top of Quality Storage
204.0	11,802	2.204	Full Storage
204.3	14,359	3.059	Top of Berm

The SWMF's proposed controls are as follows:

Table 4-2: Proposed SWMF - Controls

Invert	Control Type	Number of Controls	Dimension
202.30	Orifice	1	400mm diam.
202.80	Orifice	2	420mm diam.
203.20	Broad-crested weir	1	1.0m

4.1 Quality Treatment

4.1.1 Enhanced Swales

Although not relied upon for quality treatment, the rear-yard swales provide polishing and suspended solids removal for rooftop and rear yard drainage.

4.1.2 SWM Pond

The SWM Pond will be used to provide *Enhanced* (80%) TSS removal to runoff. The minimum required permanent pool volume of 5,757m^3 was calculated based on 60% impervious cover for the development.

Major maintenance is required when a facility's treatment efficiency drops more than 5% below the design TSS removal. The facility designed has capacity to store collected sediment for 28 years before treatment efficiency drops to 75%, and major maintenance is triggered (Appendix D).

Discharge during the quality event will be through a 400mm diameter orifice with invert set at the permanent pool elevation of 202.3m. The outlet was sized using the orifice equation:

Equation 4: Orifice Equation

$$Q = C_d A_0 \sqrt{2gh}$$

Where

Q is peak flow in m^3/s
C_d is coefficient of discharge, = 0.60
A_0 is the area of the orifice, m^2
h is the pressure head on the orifice, m

During the quality (4hr, 25mm) event, a quality drawdown check is performed to ensure that collected runoff discharges over a period in excess of 24hr. The 25mm event's peak storage ($2{,}832m^3$) occurs at a stage of 202.79m, and drains over a period of 41hr (see Appendix D). Therefore, the **quality control target is achieved**.

Table 4-3: Quality Control Targets

Quality Target	Minimum Required	Provided	Requirements Met?
Permanent Pool Volume (m^3)	5,757	5,882	✓
Drawdown Time (hours)	24	41	✓

4.2 Quantity Treatment

Quantity controls are required to ensure that post-development peak flows do not exceed pre-development peak flows. The SWM pond will be used to provide quantity control to limit post-development flows to the south pond.

The orifice equation (Equation 3) was used to size two 420mm orifices at invert 202.80m for quantity control. The same equation applies in backwater conditions, with **h** calculated by subtracting the backwater elevation from the water surface elevation in the pond.

The top outlet (broad crested weir) was sized using the weir equation:

Equation 5: Weir Equation

$$Q = 1.67LH^{3/2}$$

Where

L is the length of the weir, m
H is the head above the invert of the weir, m

The maximum backwater effect of the flow through the culvert has been calculated to be 0.91m. When added to the 100-yr flood elevation of the east pond, one finds the maximum backwater at the outlet of the proposed SWM facility will be 203.13m.

The invert of the 1.0m wide weir is at 203.20m, and the maximum water level in the south pond is 203.13m (Appendix E), therefore the flow through the weir will be unaffected by backwater conditions in the downstream receiver.

The OTTHYMO reservoir simulations were completed for each of the conditions:

1) No backwater — Discharge starts at PP elevation 202.3m
2) With backwater — Discharge starts at 202.6m

The 100-yr flood elevation of the east pond is 202.22m (Jewell 2020). Since the permanent pool is maintained above the 100-yr flood elevation, the backwater effect of the east pond is considered in each scenario. The backwater influence from the culvert was emulated in OTTHYMO by adjusting the storage / discharge relationship in the ROUTE RESERVOIR routine.

The pond routing with backwater conditions models the pond with storage at 202.6m at the start of the event. This accounts for a partially backwatered condition of 1m^3/s that results in a head differential of 0.38m (Appendix E).

As a final check, Jewell assumed full backwater conditions and set the 1m weir invert above the backwater effect such that it will safely pass the full 100-yr discharge.

The SWM pond will limit post-development peak flows to less than pre-development peaks as follows:

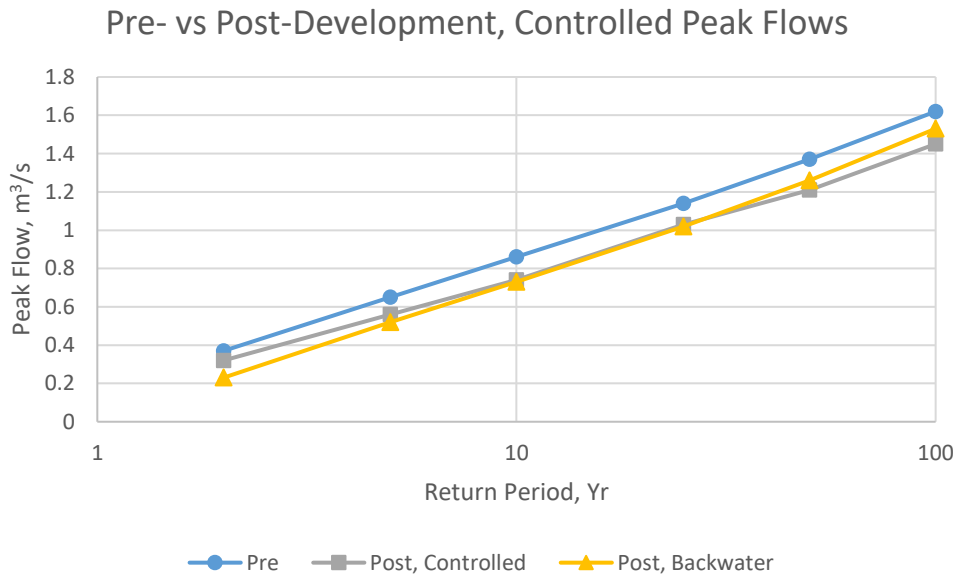

Figure 4-1: Pre- vs Post-Development Peak Flows

Table 4-4: Quantity Control Target - Summary

Return Period (Yr)	Pre-Development Peak Flow, m^3/s	Post-Development Peak Flow, m^3/s			Post < Pre?
		Uncontrolled	Controlled		
			No Backwater	Backwater at 202.3m	
2	0.37	2.89	0.32	0.23	✓
5	0.65	4.21	0.56	0.52	✓
10	0.86	5.21	0.74	0.73	✓
25	1.14	6.39	1.00	1.02	✓
50	1.37	7.36	1.21	1.26	✓
100	1.62	8.30	1.45	1.53	✓

4.2.1 Timmins Event

The proposed SWMF safely conveys the Timmins event, and provides a controlled release of runoff at a peak discharge of 2.26m^3/s (max WSEL of 204.02m). As the pond provides safe conveyance without overtopping in the Timmins Event, and the post-development peak flows are limited to the pre-development peaks, **the quantity control target is achieved.**

4.3 CLI-ECA Requirements

CLI-ECA stormwater management requirements are addressed as follows:

1) Water Balance - Water balance assessment was not completed at this site, therefore recharge is required to be controlled to meet pre-development conditions on property. Control is in the following hierarchial order and is addressed as described:
    i. Retention (infiltration, reuse, evapotranspiration) – runoff is retained in the SWM pond which allows opportunity for evapotranspiration. Infiltration opportunities are limited at this site – according to the geotechnical investigation, soils in the area of the SWM pond have a high silt/clay content and are not ideal for infiltration opportunities.
    ii. LID filtration – surfaces are disconnected and runoff is directed to grassed surfaces wherever possible (ie. rooftops, sump pumps, etc.) in order to provide filtration opportunities
    iii. Conventional SWM – a conventional SWM wet pond has been provided

2) Water Quality
    i. characterize the water quality to be protected and stormwater contaminants for potential impact on the natural environment and control as necessary –

TSS removal is the primary focus and Enhanced level protection (80% TSS removal) has been provided

ii. Suspended Solids - Enhanced level protection (80%TSS removal) has been provided

iii. Phosphorus – N/A, development is not within Lake Erie or Lake Simcoe (or their tributaries)

3) Erosion Control – guiding study was not completed at this site, therefore runoff from 25mm event is to be detained 24-48 hours - runoff volume from 25mm event will be detained for 41 hours in the SWM pond

4) Water Quantity – per municipal standards – pre>post has been achieved

5) Flood Control – manage peak flow as per municipal criteria (minimum 100 year return storm) – storm events up to and including the 100 year event are controlled in the SWM pond

6) Construction and Erosion Sediment Control – an erosion and sediment control plan will be part of the detailed design of the development

5 Low-Impact Development

Low Impact Development is a requirement of the 2020 Provincial Policy Statement. This requires that all developments consider LID strategies to reduce the impact of development on the hydrologic regime.

The Low Impact Development Guidelines (Toronto and Region Conservation Authority, 2010) states that "increases in the quantity, rate, and frequency of runoff can be linked to two root causes:

- the conversion of undeveloped or agricultural land cover to urban uses, and
- the application of storm sewer systems."

The goal of LID site design strategies is to minimize these two sources of hydrologic impacts (Toronto and Region Conservation Authority, 2010, p. 3.3). Large urban areas are negatively impacted by flash flooding associated with extensive hardening. The LID design techniques seek to mitigate flooding and erosion associated with urbanization. While water quality improvements are associated with the recommended techniques, quantity control remains the focus of LID.

The guidelines provide some site design strategies for reducing the hydrologic impact postulating 4 major groupings or "themes":

1) Preserving important hydrologic features and functions;
2) siting and layout of development;
3) reducing impervious area; and
4) using natural drainage systems.

The site design incorporates all four of the themes. Some strategies are applied with greater care since municipal requirements limit such techniques as setbacks, road design, parking, and drainage design. The LID guidelines provide a hierarchy of applying the LID techniques by first invoking the use of natural hydrologic areas and then development of green infrastructure. As such, the design adds limited green technologies that will encourage infiltration.

Discussion of the LID design used in the stormwater management design is provided below.

5.1 Theme 1 – Preserving Important Hydrologic Features

This theme focuses on preservation. Site design is adjusted to preserve natural features that benefit hydrology.

- Preserve stream buffers, including along intermittent and ephemeral channels
- Preserve areas of undisturbed soil and vegetation cover
- Avoid development on permeable soils
- Preserve existing trees and, where possible, tree clusters

Important hydrologic features include:

- Highly permeable soils
- Pocket wetlands
- Significant small (headwater) drainage features
- Riparian buffers
- Floodplains
- Undisturbed natural vegetation
- Tree clusters

The Upper Mill Pond development preserves the south pond (and respects a 30m buffer), which is a small headwater drainage feature of the east pond.

5.2 Theme 2 – Application of Siting and Layout Techniques

Siting and layout techniques aim to reduce the environmental impacts of the development by fitting the development within the framework of the natural heritage features.

- Fit the design to the terrain
- Use open space or clustered development
- Use innovative street network designs
- Reduce roadway setbacks and lot frontages

The upper Mill Pond development utilizes varying residential intensities to effectively utilize the development area and achieve density targets while maintaining/providing green space. Grading of the development site respects the existing topography as closely as possible.

5.3 Theme 3 – Reducing the Impervious Area

Imperviousness can be reduced by minimizing unnecessary surface hardening. Some strategies include:

- Reducing street width
- Reducing building footprints
- Reducing parking footprints

- Considering alternatives to cul-de-sacs
- Eliminating unnecessary sidewalks and driveways

The Upper Mill pond development has been designed to eliminate the need for any cul-de-sacs. The developer will work will Asphodel-Norwood staff to seek opportunities to limit impervious surfaces within the right-of-way where possible.

5.4 Theme 4 – Using Natural Drainage Systems

These strategies focus on the use of existing natural drainage systems where available "to take advantage of undisturbed vegetated areas and natural drainage patterns."

- "Disconnect" impervious areas
- Preserve or create micro-topography
- Extend drainage flow paths

The Upper Mill Pond development will be designed to encourage flows to drain across pervious grassed surfaces prior to collection in the storm sewers (where possible). Rooftop areas are also disconnected from the street and will discharge to grassed surfaces. Pervious grassed surfaces will encourage infiltration into the soils.

5.5 LID Summary

The development site design follows the LID strategies provided in the Low Impact Development guide and makes extensive use of techniques to preserve natural drainage features, adjust the layout to the site, reduce impervious areas, and take advantage of natural drainage features.

6 Maintenance

The stormwater management features adopted by this plan may include:

1) Wet Pond SWMF
2) Enhanced Swales

During the first few years of operation, the developer will retain the responsibility of maintenance and will gain the experience of how the technologies perform at the Upper Mill Pond development.

For further detail and guidance, Section 6 of the 2003 Stormwater Planning and Design Manual outlines maintenance activities for various SWM technologies.

6.1 Wet Pond SWMF

Good maintenance is important to ensure the proposed SWMF functions as designed. Some very simple maintenance practices are recommended that include both surveillance and general cleaning/trash removal. Some maintenance activities, such as sediment removal, take place at very infrequent intervals. The ability of the wet pond to collect sediment will diminish over time as the volume of captured sediment accumulates. Major maintenance of a facility is triggered when the effectiveness of TSS removal is reduced by 5%.

6.1.1 Routine Maintenance

Once per month the pond operators should perform a visual check including observations of:

- trash or debris collecting in the pond
- water level between events (comparing with expected levels)
- signs of leaks or material loss
- presence of public safety measures (ensuring they are still in place)

Pond operators should remove any trash that may be impeding the pond outlet structures. Additionally, grass and weeds should be cut as needed. During and after a large rainfall event the operator should also perform a visual check to see that pond elevations are within expected levels.

- Permanent Pool – 202.3m
- Quality Event storage – 202.79m
- Top of Active Storage – 203.70m (during 100Yr, 24hr event with no outlet backwater)
    - 203.95m with outlet backwater elevation of 203.3m
- Top of Berm – 204.30m

6.1.2 Infrequent Maintenance

The pond will collect sediment in proportion to the construction activity or winter road maintenance of the upstream catchment area. Vehicle access will be provided to the forebay area to allow pumping to remove the water and sediment. The anticipated cleanout frequency for the proposed SWMF is in excess of 25 years (Appendix D).

The cleanout frequency is based on a contributing area imperviousness of 60%. This results in a sediment loading of 2.20m^3/ha, and an annual accumulation of 1.76m^3/yr per ha (based on 80% removal).

6.1.3 Troubleshooting

Some basic issues that can develop with a pond and the remedies are described below.

Symptom – Pond is not emptying

The outflow pipe may become blocked with debris and should be monitored after every large runoff event. Observe that the pond is not overfilling and that it is emptying out between events. Full storage for the 100-yr event should be 203.70m. Orifices have been selected to be as large as possible to allow smaller debris to pass through.

Symptom – Pond does not fill

The orifice and weir sizes should impose ponding during large runoff events. If the pond does not hold water during large events check to see the orifice plates have not been tampered with or removed.

Symptom – Pond routinely overfills

If the stored water discharges through the emergency spillway during typical rainfall events, the cause is blockage of the orifice plate and/or weir. The outlet structures should be checked for blockage by debris and cleaned if necessary. Grating on outlet pipes may also clog with vegetation and can also be a cause of poor outflow. The grating may be cleaned by raking.

6.2 Enhanced Swales

Enhanced grassed swales rely on healthy grass cover and benefit from infiltration; therefore, the grass should be watered as necessary and mowed to keep the grass height between 75 mm and 150 mm. Other maintenance activities, such as weed control, removal of accumulated sediment, and trash removal, will need to be carried out to ensure the facilities continue to provide quality treatment to runoff. In addition, proper maintenance will ensure the swales can convey runoff without overtopping. The frequency of these maintenance activities will vary based on experience.

7 Erosion and Sediment Control

Erosion and sediment control is one of the three targets identified in Section 2.3. The following measures are proposed to prevent the negative erosion and sediment impacts of development.

Typical site development requires removal of some vegetated cover. While it is the intention to reduce vegetation removal, exposed soils from the work will be at risk of eroding into the receiving drainage system. Measures will need to be put in place to reduce erosion during construction, and for a period of up to one year after construction is completed. Typical erosion and sediment control measures include:

- Siltation fencing.
- Strawbale check dams.
- Rip-rap check dams.
- Filter sock inserts in catch basins.

Controls are to be placed downstream of all active work areas and upstream of protected receivers. Controls should also be placed around stockpiles of topsoil and fill materials.

Typical OPSDs provide good instruction on the correct placement and construction of the controls. The controls provide some protection if they are properly maintained, but they should be considered last-resort measures. The most effective means of control are those which prevent or reduce erosion at the source. This would include diligent stabilization of exposed areas immediately after grading is completed. Stabilization measures include sod, erosion blankets, or rip-rap and filter cloth on steep slopes, as well as topsoil and hydroseed on gently sloped areas (with slope 10% or less).

The site developer and contractor should actively maintain the new drainage works to remove accumulations of sediment within catch basin sumps.

A silt fence should be located along the upland perimeter of all sensitive features during the construction process, which should be maintained until the lands have stabilized or as directed by the municipality. There would be benefit in maintaining this silt fence for up to 2 growing seasons.

8 Conclusions

CAP Norwood Developments Inc. is proposing to construct a subdivision northeast of Mill St in Norwood with a total area of approx. 36ha. The development will include 400 low-density residential units and 240 medium-density units, with an estimated impervious cover of 60%.

The development drains to a natural pond on the south side of the CP rail line in Norwood, so quantity controls will be employed to limit peak flows to pre-development peaks. The proposed wet pond SWMF will achieve the quantity control target for return periods from the 2- to 100-Yr event, as required by the ORCA Stormwater Guidelines.

The proposed SWMF will detain runoff from the quality event for 41hr, exceeding the 24hr minimum requirement. The permanent pool volume achieves the minimum volume required for the contributing area and percent impervious, therefore the ***Enhanced*** quality treatment target is achieved. Additional polishing will be provided through use of rear-yard swales, which will increase the overall TSS removal provided.

Low impact development guidance (including disconnecting impervious areas, extending drainage distances, and reducing road widths) will be followed to ensure environmental impact of the development is successfully mitigated.

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9 References

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APPENDIX A

Environment Canada IDF Curves

Environment and Climate Change Canada
Environnement et Changement climatique Canada

Short Duration Rainfall Intensity-Duration-Frequency Data
Données sur l'intensité, la durée et la fréquence des chutes de pluie de courte durée

Gumbel - Method of moments/Méthode des moments

2022/10/31

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PETERBOROUGH STP ON 6166450

Latitude: 44 17'N Longitude: 78 19'W Elevation/Altitude: 192 m

Years/Années : 1965 - 1992 # Years/Années : 28

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Table 1 : Annual Maximum (mm)/Maximum annuel (mm)

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Year / Année	5 min	10 min	15 min	30 min	1 h	2 h	6 h	12 h	24 h
1965	10.7	15.5	17.8	19.3	24.4	38.9	46.2	47.8	48.8
1966	13.5	23.9	26.9	34.0	37.6	37.6	38.6	38.6	38.6
1967	6.9	9.1	11.9	14.7	18.0	23.1	45.2	57.9	72.6
1968	10.9	15.2	18.0	19.3	21.1	23.1	27.2	28.2	33.3
1969	5.1	6.1	8.9	17.5	24.9	35.6	56.4	59.2	59.2
1970	4.8	9.4	14.0	17.5	18.8	20.8	23.1	25.9	28.7
1971	3.8	7.6	10.9	14.0	19.8	26.4	32.5	38.4	38.9
1972	4.6	8.9	13.2	20.3	30.5	37.8	56.1	63.2	67.3
1973	5.6	10.9	15.5	22.6	34.8	38.6	46.5	47.2	55.9
1974	6.6	13.0	15.7	19.6	20.1	22.6	38.9	46.5	46.5
1975	6.3	11.9	15.0	22.4	32.0	47.5	48.3	57.9	57.9
1976	3.8	6.6	9.7	9.7	13.5	15.7	20.8	23.6	25.7
1977	4.3	8.1	8.4	11.2	17.0	23.9	50.0	57.1	57.4
1978	5.9	10.3	13.9	16.0	16.0	18.8	25.6	28.0	34.6
1979	10.0	14.6	15.8	19.2	31.2	35.6	37.0	37.4	37.4
1980	9.1	15.4	19.6	21.1	35.0	53.6	62.2	62.8	91.7
1981	10.6	18.6	19.7	37.8	39.4	39.9	40.9	40.9	44.4
1982	5.0	8.8	11.0	12.0	17.4	18.3	33.8	43.0	43.0
1983	18.0	23.5	25.7	28.4	29.1	36.4	51.6	52.2	78.3
1984	8.8	10.5	12.0	12.3	15.2	28.3	35.0	35.0	35.0
1985	7.7	9.6	11.2	17.8	25.3	25.4	30.8	40.1	40.1
1986	6.7	7.4	8.5	10.7	16.7	29.2	39.4	43.9	48.0

1987	12.2	13.9	14.3	22.0	23.2	25.0	25.3	25.3	25.3
1988	9.4	16.7	21.0	22.9	23.2	26.7	27.6	27.8	28.8
1989	10.1	18.2	24.7	33.2	34.2	34.4	67.5	69.0	69.0
1990	4.8	8.8	10.8	15.8	16.0	18.8	29.5	30.4	31.2
1991	7.6	11.5	16.1	17.7	19.1	20.2	20.8	22.9	39.8
1992	5.3	6.6	9.7	15.6	19.6	23.0	26.1	27.4	34.7
# Yrs. Années	28	28	28	28	28	28	28	28	28
Mean Moyenne	7.8	12.2	15.0	19.4	24.0	29.5	38.7	42.1	46.9
Std. Dev. Écart-type	3.4	4.8	5.2	7.0	7.6	9.5	12.8	13.8	17.0
Skew. Dissymétrie	1.16	0.97	0.84	1.10	0.57	0.71	0.52	0.31	0.95
Kurtosis	4.80	3.65	3.31	4.32	2.34	3.23	2.74	2.21	3.59

*-99.9 Indicates Missing Data/Données manquantes

****

Table 2a : Return Period Rainfall Amounts (mm)
Quantité de pluie (mm) par période de retour

****

Duration/Durée	2 yr/ans	5 yr/ans	10 yr/ans	25 yr/ans	50 yr/ans	100 yr/ans	#Years Années
5 min	7.2	10.2	12.2	14.7	16.5	18.3	28
10 min	11.4	15.6	18.5	22.0	24.7	27.3	28
15 min	14.1	18.7	21.7	25.5	28.4	31.2	28
30 min	18.3	24.5	28.5	33.7	37.5	41.3	28
1 h	22.8	29.5	34.0	39.6	43.8	47.9	28
2 h	27.9	36.3	41.8	48.9	54.1	59.2	28
6 h	36.6	47.9	55.4	64.8	71.9	78.8	28
12 h	39.8	52.0	60.0	70.2	77.7	85.2	28
24 h	44.1	59.1	69.1	81.6	91.0	100.2	28

****

Table 2b :

Return Period Rainfall Rates (mm/h) - 95% Confidence limits
Intensité de la pluie (mm/h) par période de retour - Limites de confiance de 95%

****

Duration/Durée	2 yr/ans	5 yr/ans	10 yr/ans	25 yr/ans	50 yr/ans	100 yr/ans	#Years Années
5 min	86.8	122.5	146.1	175.9	198.1	220.0	28

	+/- 13.7	+/- 23.1	+/- 31.2	+/- 42.1	+/- 50.3	+/- 58.6	28
10 min	68.2	93.8	110.8	132.2	148.1	163.8	28
	+/- 9.8	+/- 16.6	+/- 22.4	+/- 30.2	+/- 36.1	+/- 42.1	28
15 min	56.6	74.8	86.9	102.1	113.4	124.7	28
	+/- 7.0	+/- 11.8	+/- 15.9	+/- 21.5	+/- 25.7	+/- 30.0	28
30 min	36.6	48.9	57.1	67.4	75.0	82.6	28
	+/- 4.7	+/- 8.0	+/- 10.8	+/- 14.5	+/- 17.4	+/- 20.3	28
1 h	22.8	29.5	34.0	39.6	43.8	47.9	28
	+/- 2.6	+/- 4.4	+/- 5.9	+/- 7.9	+/- 9.5	+/- 11.1	28
2 h	14.0	18.1	20.9	24.4	27.0	29.6	28
	+/- 1.6	+/- 2.7	+/- 3.7	+/- 4.9	+/- 5.9	+/- 6.9	28
6 h	6.1	8.0	9.2	10.8	12.0	13.1	28
	+/- 0.7	+/- 1.2	+/- 1.6	+/- 2.2	+/- 2.7	+/- 3.1	28
12 h	3.3	4.3	5.0	5.8	6.5	7.1	28
	+/- 0.4	+/- 0.7	+/- 0.9	+/- 1.2	+/- 1.4	+/- 1.7	28
24 h	1.8	2.5	2.9	3.4	3.8	4.2	28
	+/- 0.2	+/- 0.4	+/- 0.5	+/- 0.7	+/- 0.9	+/- 1.0	28

****

Table 3 : Interpolation Equation / Équation d'interpolation: R = A*T^B

R = Interpolated Rainfall rate (mm/h)/Intensité interpolée de la pluie (mm/h)
RR = Rainfall rate (mm/h) / Intensité de la pluie (mm/h)
T = Rainfall duration (h) / Durée de la pluie (h)

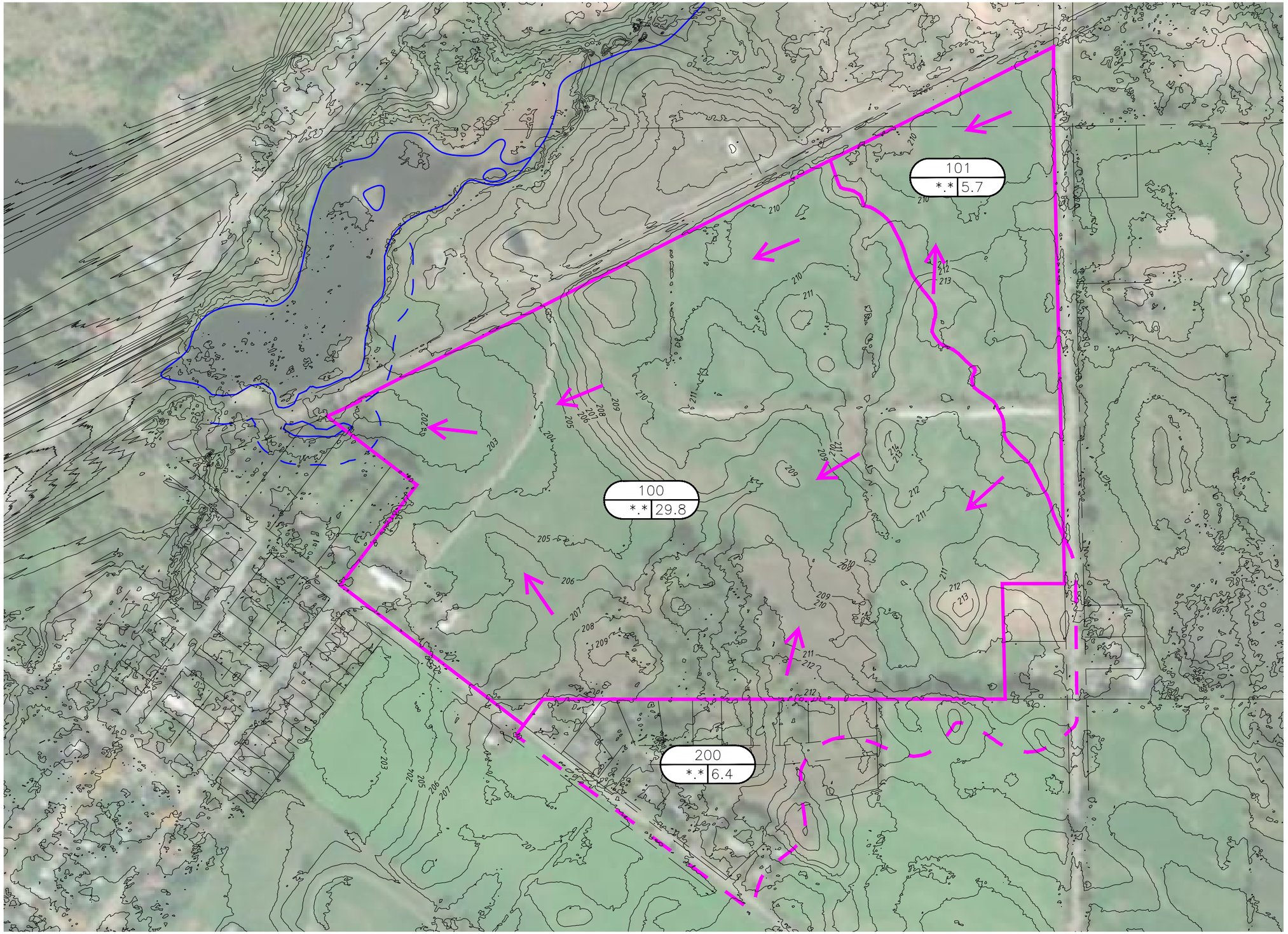
****

Statistics/Statistiques	2 yr/ans	5 yr/ans	10 yr/ans	25 yr/ans	50 yr/ans	100 yr/ans
Mean of RR/Moyenne de RR	32.9	44.7	52.5	62.4	69.7	77.0
Std. Dev. /Écart-type (RR)	31.1	43.4	51.6	61.9	69.6	77.2
Std. Error/Erreur-type	10.2	12.2	13.6	15.3	16.5	17.7
Coefficient (A)	20.0	26.7	31.1	36.6	40.8	44.9
Exponent/Exposant (B)	-0.697	-0.706	-0.709	-0.713	-0.714	-0.716
Mean % Error/% erreur moyenne	11.8	9.9	9.2	8.6	8.3	8.0

APPENDIX B

Drawings

11/09/2023



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- ALL UTILITY LOCATIONS SHOWN ON THE DRAWINGS ARE APPROXIMATE. THE CONTRACTOR SHALL CONFIRM THE LOCATION ON SITE AND ASSUME ALL LIABILITY FOR DAMAGE TO ALL UTILITIES.
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GEOMETRIC NOTE:

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- ALL ELEVATIONS ARE IN REFERENCE TO LOCAL DATUM NAD83 - GEODETIC MODEL HT2_0, UNLESS DESCRIBED OTHERWISE.

** DRAWINGS ARE NOT TO BE SCALED **

REVISIONS

NO.	DATE	DESCRIPTION	BY

LEGEND

ID #
%IMP | ha

INTERIOR BOUNDARY

EXTERIOR BOUNDARY

FLOW DIRECTION

N W E S

JEWELL ENGINEERING

UPPER MILL POND PARK GATE DEVELOPMENT

NORWOOD, ONTARIO

TOWNSHIP OF ASPHODEL-NORWOOD

CATCHMENT PLAN
PRE-DEVELOPMENT

DRAWN BY: JH
PROJECT NO: 210-5049
DESIGNED BY:
DATE: November 2023
CHECKED BY: AMR
SCALE: HORIZONTAL -1:4000 VERTICAL -N/A
APPROVED BY:
CONTRACT NO:
DRAWING NO: B-1

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11/10/2023

F:\FTP\PROJECT FILES\1 CIVIL 3D PROJECT FILES\2105049 - MILL ST NORWOOD\3 SHEETS\2105049 - APPENDIX B - SWM FACILITY

EAST POND
100-YR MAX WL = 202.22

EXISTING CULVERT

202
203
204

204
203
202

CANADIAN PACIFIC RAILWAY

SOUTH POND
100-YR MAX WL = 203.13

EMERGENCY SPILLWAY

MAX 3:1

MAINTENANCE ACCESS PATH = 204.3

5:1

PERMANENT POOL = 202.3

3:1

MAIN CELL BOTTOM = 200.3

OUTLET PIPE

TP121-22

FOREBAY BOTTOM = 199.8

BH10

202

203

204

205

206

207

MW/BH105-22
GW = 199.4
BR = 197.7

SHELF
202.3

INLET PIPE

0+100 205.24
0+120 206.12
0+140 206.00
0+160 205.88
0+180 205.76
0+200 205.64
0+220 205.58
0+240 205.70
0+260 205.82
0+280 205.94
0+300 206.06
0+320 206.18
0+340 206.43
0+360 206.81
0+380 207.19

STREET A

TP119-22

TP1

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GEOMETRIC NOTE:

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** DRAWINGS ARE NOT TO BE SCALED **

REVISIONS

NO.	DATE	DESCRIPTION	BY

W N S E

JEWELL ENGINEERING

UPPER MILL POND PARK GATE DEVELOPMENT

NORWOOD, ONTARIO

TOWNSHIP OF ASPHODEL-NORWOOD

STORMWATER MANAGEMENT FACILITY

DRAWN BY: JH
PROJECT NO: 210-5049
DESIGNED BY:
DATE: November 2023
CHECKED BY: AMR
SCALE: HORIZONTAL -1:750 VERTICAL -N/A
APPROVED BY:
CONTRACT NO:
DRAWING NO: B-2

11/09/2023

GR-3

GR-2

PRELIMINARY

STREET A

STREET H

STREET B

STREET C

STREET E

LANE

MILL STREET

PROPOSED RETAINING WALL

GENERAL NOTES:

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** DRAWINGS ARE NOT TO BE SCALED **

REVISIONS

NO.	DATE	DESCRIPTION	BY

KEY PLAN
SCALE - N.T.S.

LEGEND

SYMBOL	DESCRIPTION
	ROAD GRADING - HIGH POINT
	ROAD GRADING - LOW POINT
	ROAD GRADING - GRADE CHANGE
	LOT DRAINAGE
	OVERLAND FLOW ROUTE
	REAR YARD SWALE

JEWELL ENGINEERING

MILL STREET SUBDIVISION
PARK GATE DEVELOPMENT

NORWOOD, ONTARIO
TOWNSHIP OF ASPHODEL-NORWOOD

PRELIMINARY
GRADING PLAN
1 of 4

DRAWN BY: JH	PROJECT NO: 210-5049		
DESIGNED BY:	DATE: November 2023		
CHECKED BY: AMR	SCALE: HORIZONTAL - 1:600 VERTICAL - N/A		
APPROVED BY:	CONTRACT NO:	DRAWING NO: GR-1	

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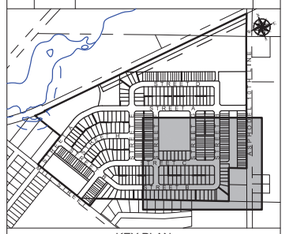
REVISIONS

NO.	DATE	DESCRIPTION	BY



KEY PLAN
SCALE - N.T.S.

LEGEND

SYMBOL	DESCRIPTION
	ROAD GRADING - HIGH POINT
	ROAD GRADING - LOW POINT
	ROAD GRADING - GRADE CHANGE
	LOT DRAINAGE
	OVERLAND FLOW ROUTE
	REAR YARD SWALE

N W E S

JEWELL ENGINEERING

MILL STREET SUBDIVISION
PARK GATE DEVELOPMENT

NORWOOD, ONTARIO
TOWNSHIP OF ASPHODEL-NORWOOD

PRELIMINARY
GRADING PLAN
2 of 4

DRAWN BY: JH	PROJECT NO: 210-5049		
DESIGNED BY:	DATE: November 2023		
CHECKED BY: AMR	SCALE: HORIZONTAL - 1:600 VERTICAL - N/A		
APPROVED BY:	CONTRACT NO:	DRAWING NO: GR-2	

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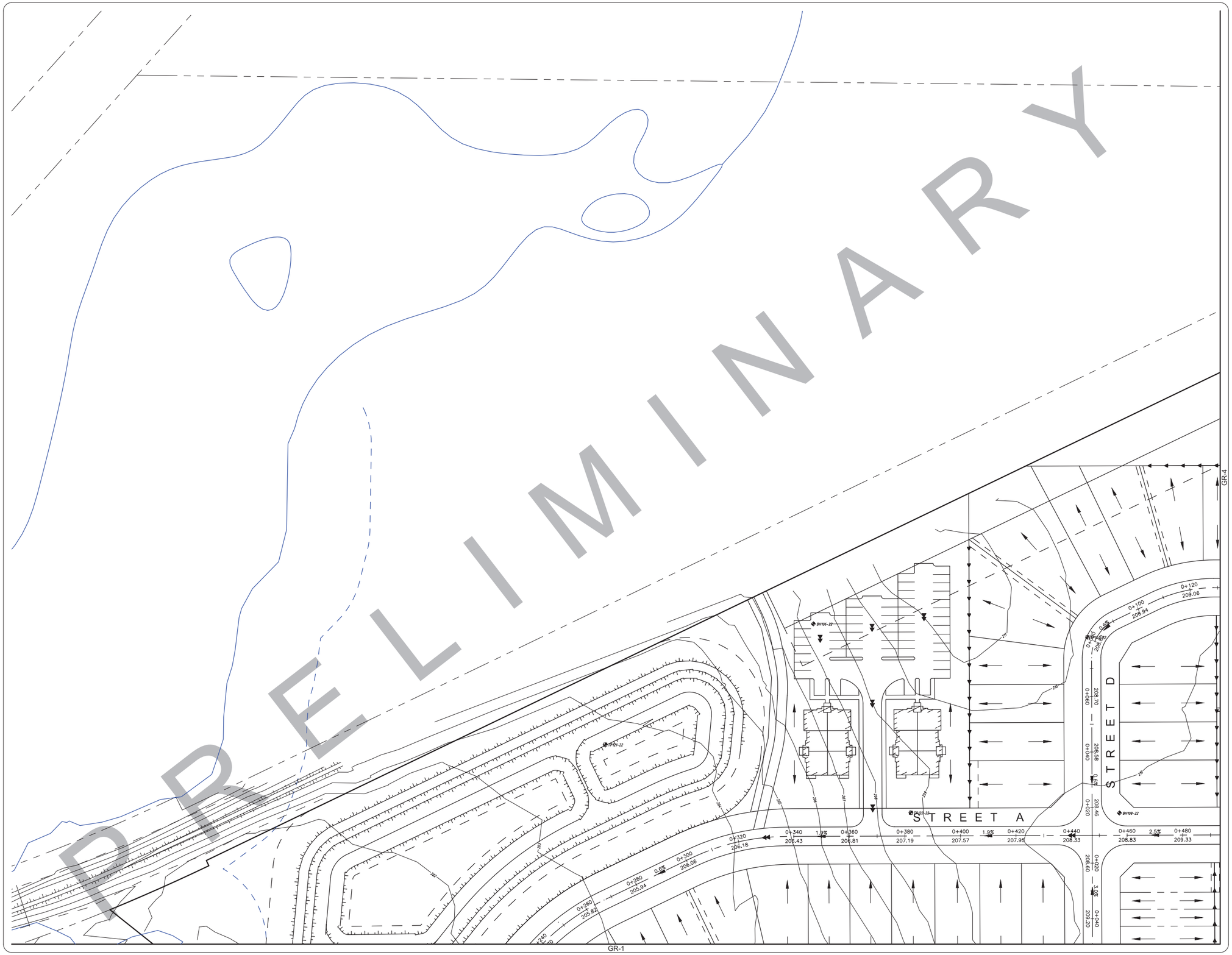

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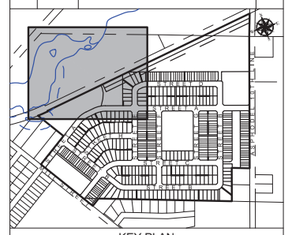
REVISIONS

NO.	DATE	DESCRIPTION	BY



KEY PLAN
SCALE - N.T.S.

LEGEND

SYMBOL	DESCRIPTION
	ROAD GRADING - HIGH POINT
	ROAD GRADING - LOW POINT
	ROAD GRADING - GRADE CHANGE
	LOT DRAINAGE
	OVERLAND FLOW ROUTE
	REAR YARD SWALE

JEWELL ENGINEERING

MILL STREET SUBDIVISION
PARK GATE DEVELOPMENT

NORWOOD, ONTARIO
TOWNSHIP OF ASPHODEL-NORWOOD

PRELIMINARY
GRADING PLAN
3 of 4

DRAWN BY: JH	PROJECT NO: 210-5049
DESIGNED BY:	DATE: November 2023
CHECKED BY: AMR	SCALE: HORIZONTAL - 1:600, VERTICAL - N/A
APPROVED BY:	CONTRACT NO:
	DRAWING NO: GR-3

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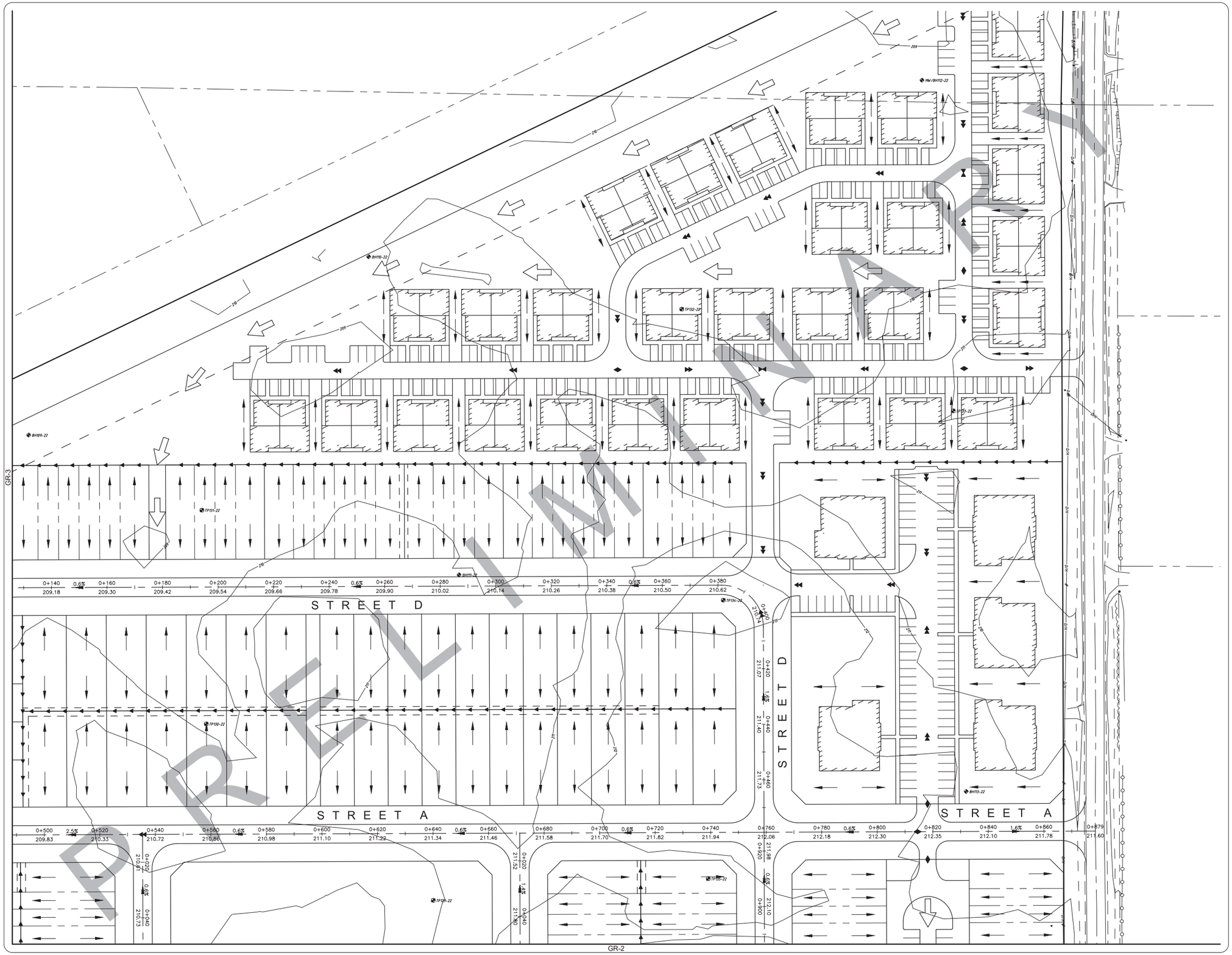

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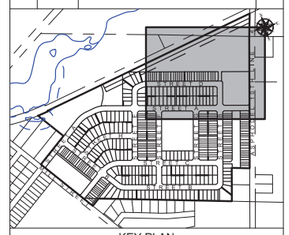
REVISIONS

NO.	DATE	DESCRIPTION	BY



KEY PLAN
SCALE - N.T.S.

LEGEND

SYMBOL	DESCRIPTION
	ROAD GRADING - HIGH POINT
	ROAD GRADING - LOW POINT
	ROAD GRADING - GRADE CHANGE
	LOT DRAINAGE
	OVERLAND FLOW ROUTE
	REAR YARD SWALE

N W E S

JEWELL ENGINEERING

MILL STREET SUBDIVISION
PARK GATE DEVELOPMENT

NORWOOD, ONTARIO
TOWNSHIP OF ASPHODEL-NORWOOD

PRELIMINARY
GRADING PLAN
4 of 4

DRAWN BY: JH	PROJECT NO: 210-5049
DESIGNED BY:	DATE: November 2023
CHECKED BY: AMR	SCALE: HORIZONTAL - 1:600 VERTICAL - N/A
APPROVED BY:	CONTRACT NO:
	DRAWING NO: GR-4

APPENDIX C

Pre-Development Model Inputs

Design Chart 1.07: Runoff Coefficients (Continued)

- Rural

Land Use & Topography[3]	Soil Texture		
	Open Sand Loam	Loam or Silt Loam	Clay Loam or Clay
CULTIVATED			
Flat 0 - 5% Slopes	0.22	0.35	0.55
Rolling 5 - 10% Slopes	0.30	0.45	0.60
Hilly 10- 30% Slopes	0.40	0.65	0.70
PASTURE			
Flat 0 - 5% Slopes	0.10	0.28	0.40
Rolling 5 - 10% Slopes	0.15	0.35	0.45
Hilly 10- 30% Slopes	0.22	0.40	0.55
WOODLAND OR CUTOVER			
Flat 0 - 5% Slopes	0.08	0.25	0.35
Rolling 5 - 10% Slopes	0.12	0.30	0.42
Hilly 10- 30% Slopes	0.18	0.35	0.52
BARE ROCK	COVERAGE[3]		
	30%	50%	70%
Flat 0 - 5% Slopes	0.40	0.55	0.75
Rolling 5 - 10% Slopes	0.50	0.65	0.80
Hilly 10- 30% Slopes	0.55	0.70	0.85
LAKES AND WETLANDS	0.05		

Selected pre-development runoff coefficient = 0.22

Longest flow length: 750m

85% elevation: 212.3m

10% elevation: 201.7m

Slope = 0.019 (1.9%)

APPENDIX D

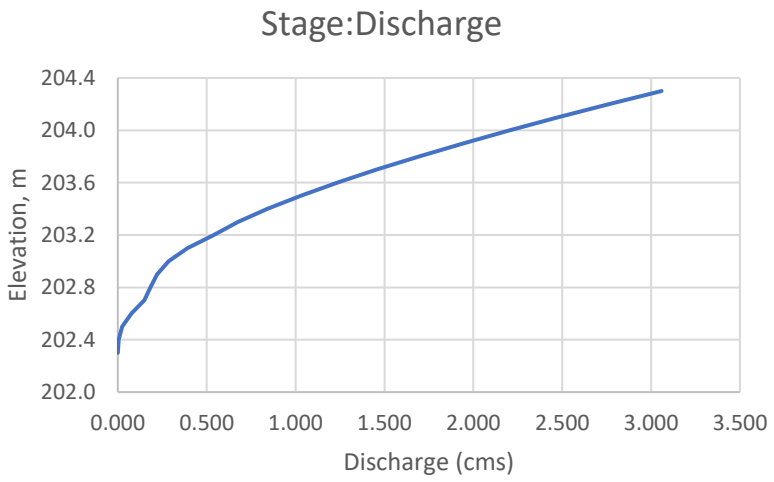
Facility Sizing – Wet Pond SWMF

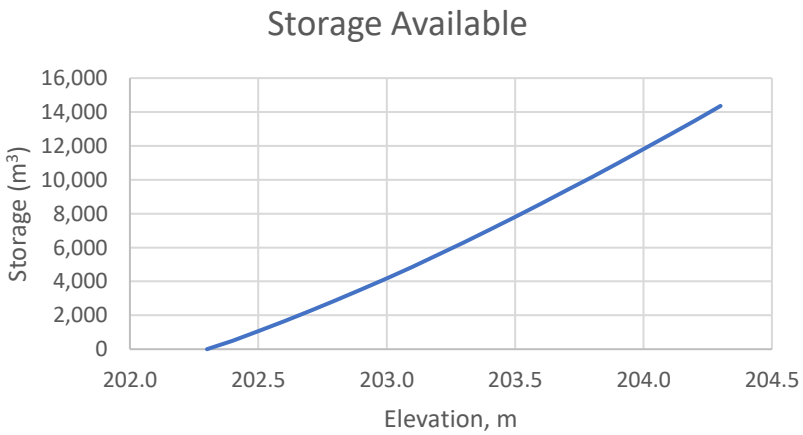
Proposed outlets:

- 400mm diam. orifice, invert at 202.30m
- Two, 420mm diam orifices, inverts at 202.80m
- 1.0m broad-crested weir, invert at 203.20m

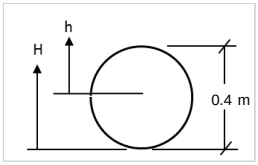
Stage, masl	Storage, m^3	Discharge, m^3/s
199.8	0	-
202.3	5,882	0
202.8	2,868	0.183
203.2	5,572	0.539
204.0	11,802	2.204
204.3	14,359*	3.059

*Total volume 20,241 incl. PP vol.





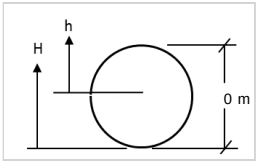
	Outlet 1	Outlet 2	Outlet 3
Use Outet ?	Yes	Yes	Yes
Select Stage Increment (m)	0.1		
(not less than 0.01 m)			
	Orifice	Orifice	Broad Crested Weir
Formula	$Q = CA_o(2gh)^{0.5}$	Q = CAo(2gh)^(0.5)	Q = 1.67LH^(3/2)
Invert =	202.30 m	202.80 m	203.20 m
Coeff =	0.60	0.60	Length 1.00 m
Orifice Dia =	0.40 m	0.42 m	
Circular?	Yes (Select Yes or No)		(No End Contractions)
Area =	0.126 m^2	0.113	
Obvert =	202.70 m	203.22	



2x orifice Q

	Low Flow Outlet (Orifice)				Orifice			Emergency Spillway		Total
Elevation	Length	Width	Incr Vol	Cum vol	Weir (H)	Head (h)	Flow (Q)	Head (H)	Head (h)	Flow (Q)	Head (H)	Flow (Q)	Discharge
m	m	m	m3	m3	m	m	cms	m	m	cms	m	cms	cms
202.3			0	0	0.000	-0.200	0.000	0.000	-0.210	0.000	0.000	0.000	0.000
202.4			498	498	0.100	-0.100	0.004	0.000	-0.210	0.000	0.000	0.000	0.004
202.5			562	1,060	0.200	0.000	0.025	0.000	-0.210	0.000	0.000	0.000	0.025
202.6			582	1,642	0.300	0.100	0.076	0.000	-0.210	0.000	0.000	0.000	0.076
202.7			603	2,245	0.400	0.200	0.149	0.000	-0.210	0.000	0.000	0.000	0.149
202.8			623	2,868	0.500	0.300	0.183	0.000	-0.210	0.000	0.000	0.000	0.183
202.9			644	3,512	0.600	0.400	0.211	0.100	-0.110	0.004	0.000	0.000	0.220
203.0			665	4,177	0.700	0.500	0.236	0.200	-0.010	0.025	0.000	0.000	0.286
203.1			686	4,864	0.800	0.600	0.259	0.300	0.090	0.066	0.000	0.000	0.392
203.2			708	5,572	0.900	0.700	0.279	0.400	0.190	0.130	0.000	0.000	0.539
203.3			729	6,301	1.000	0.800	0.299	0.500	0.290	0.162	0.100	0.053	0.676
203.4			746	7,047	1.100	0.900	0.317	0.600	0.390	0.188	0.200	0.149	0.843
203.5			759	7,807	1.200	1.000	0.334	0.700	0.490	0.211	0.300	0.274	1.030
203.6			773	8,579	1.300	1.100	0.350	0.800	0.590	0.231	0.400	0.422	1.236
203.7			786	9,365	1.400	1.200	0.366	0.900	0.690	0.250	0.500	0.590	1.457
203.8			799	10,164	1.500	1.300	0.381	1.000	0.790	0.268	0.600	0.776	1.693
203.9			812	10,976	1.600	1.400	0.395	1.100	0.890	0.284	0.700	0.978	1.942
204			826	11,802	1.700	1.500	0.409	1.200	0.990	0.300	0.800	1.195	2.204
204.1			839	12,641	1.800	1.600	0.422	1.300	1.090	0.315	0.900	1.426	2.477
204.2			852	13,493	1.900	1.700	0.435	1.400	1.190	0.329	1.000	1.670	2.763
204.3			866	14,359	2.000	1.800	0.448	1.500	1.290	0.342	1.100	1.927	3.059

	Outlet 1	Outlet 2	Outlet 3
Use Outet 1 ?	Yes	Yes	Yes
Select Stage Increment (m)	0.1		
(not less than 0.01 m)			
	Orifice	Orifice	Broad Crested Weir
Formula	$Q = CA_o(2gh)^{0.5}$	Q = CAo(2gh)^(0.5)	Q = 1.67LH^(3/2)
Invert =	202.30 m	202.80 m	203.20 m
Coeff =	0.60	0.60	Length 1.00 m
Orifice Dia =	m	0.42 m	
Circular?	Yes (Select Yes or No)		(No End Contractions)
Area =	0.000 m^2	0.113	
Obvert =	202.30 m	203.22	



2x orifice Q

	Low Flow Outlet (Orifice)				Orifice			Emergency Spillway		Total
Elevation	Length	Width	Incr Vol	Cum vol	Weir (H)	Head (h)	Flow (Q)	Head (H)	Head (h)	Flow (Q)	Head (H)	Flow (Q)	Discharge
m	m	m	m3	m3	m	m	cms	m	m	cms	m	cms	cms
202.3			0	0	0.000	0.000	0.000		-0.210	0.000	0.000	0.000	0.000
202.4			0	0	0.100	0.100	0.000		-0.210	0.000	0.000	0.000	0.000
202.5			0	0	0.200	0.200	0.000		-0.210	0.000	0.000	0.000	0.000
202.6			0	0	0.300	0.300	0.000		-0.210	0.000	0.000	0.000	0.000
202.7			603	603	0.400	0.400	0.000		-0.210	0.000	0.000	0.000	0.000
202.8			623	1,226	0.500	0.500	0.000		-0.210	0.000	0.000	0.000	0.000
202.9			644	1,870	0.600	0.600	0.000		-0.210	0.000	0.000	0.000	0.000
203.0			665	2,536	0.700	0.700	0.000		-0.210	0.000	0.000	0.000	0.000
203.1			686	3,222	0.800	0.800	0.000		-0.210	0.000	0.000	0.000	0.000
203.2			708	3,930	0.900	0.900	0.000	0.000	-0.210	0.000	0.000	0.000	0.000
203.3			729	4,659	1.000	1.000	0.000	0.100	-0.110	0.004	0.100	0.053	0.062
203.4			746	5,405	1.100	1.100	0.000	0.200	-0.010	0.025	0.200	0.149	0.199
203.5			759	6,165	1.200	1.200	0.000	0.300	0.090	0.078	0.300	0.274	0.430
203.6			773	6,937	1.300	1.300	0.000	0.400	0.190	0.132	0.400	0.422	0.687
203.7			786	7,723	1.400	1.400	0.000	0.500	0.290	0.162	0.500	0.590	0.915
203.8			799	8,522	1.500	1.500	0.000	0.600	0.390	0.188	0.600	0.776	1.152
203.9			812	9,334	1.600	1.600	0.000	0.700	0.490	0.211	0.700	0.978	1.400
204			826	10,160	1.700	1.700	0.000	0.800	0.590	0.231	0.800	1.195	1.658
204.1			839	10,999	1.800	1.800	0.000	0.900	0.690	0.250	0.900	1.426	1.926
204.2			852	11,851	1.900	1.900	0.000	1.000	0.790	0.268	1.000	1.670	2.206
204.3			866	12,717	2.000	2.000	0.000	1.100	0.890	0.284	1.100	1.927	2.495

Check on Quality Drawdown Time

Top of Extended Detention	**202.7**	**Pond Control =**	**Orifice**
Top of Permanent Pool	**202.3**	**Orifice Size =**	**0.4 m**

Select Time Step (min)	**5**	**Results**	
Select Depth at "Empty" (m)	**0.05**	**Drawdown Time (min)**	**2465**
		or	**41.1 hrs**
Starting Volume (m^3)	**2832**		

Time	WSEL	Extended Detention	Depth	Outflow	Volume Released	Volume Remaining
min	m	m^3	m	cms	m^3	m^3
0	202.79	2832.0	0.494	0.181	54.3	2777.7
5	202.79	2777.7	0.486	0.178	53.4	2724.3
10	202.78	2724.3	0.477	0.175	52.6	2671.7
15	202.77	2671.7	0.469	0.172	51.7	2620.0
20	202.76	2620.0	0.460	0.170	50.9	2569.2
25	202.75	2569.2	0.452	0.167	50.0	2519.1
30	202.74	2519.1	0.444	0.164	49.2	2469.9
35	202.74	2469.9	0.436	0.161	48.4	2421.4
40	202.73	2421.4	0.428	0.159	47.7	2373.8
		.	.	.	.	.	
2430	202.35	254.2	0.051	0.002	0.7	253.5
2435	202.35	253.5	0.051	0.002	0.7	252.9
2440	202.35	252.9	0.051	0.002	0.7	252.2
2445	202.35	252.2	0.051	0.002	0.7	251.5
2450	202.35	251.5	0.051	0.002	0.7	250.9
2455	202.35	250.9	0.050	0.002	0.7	250.2
2460	202.35	250.2	0.050	0.002	0.7	249.6
2465	202.35	249.6	0.050	0.002	0.7	248.9

Year	Forebay Volume m^3	P.P. Storage Available m^3	P.P. % of Req'd %	Removal Efficiency %	Sediment Removal m^3/ha	Sediment Deposition in year m^3	Total Sediment Accum. m^3	Volume of Forebay Remaining m^3	Volume of P.P. Remaining m^3	Sediment Depth in Forebay m
1	1,212	5,882	102%	80.0%	1.76	62.7	62.7	1,149	5,819	0.35
2	1,149	5,819	101%	80.0%	1.76	62.7	125.3	1,087	5,757	0.56
3	1,087	5,757	100%	80.0%	1.76	62.7	188.0	1,024	5,694	0.72
4	1,024	5,694	99%	79.8%	1.76	62.5	250.5	961	5,631	0.86
5	961	5,631	98%	79.6%	1.75	62.3	312.9	899	5,569	0.98
6	899	5,569	97%	79.4%	1.75	62.2	375.1	837	5,507	1.09
7	837	5,507	96%	79.2%	1.74	62.0	437.1	775	5,445	1.18
8	775	5,445	95%	79.0%	1.74	61.9	499.0	713	5,383	1.27
9	713	5,383	94%	78.8%	1.73	61.7	560.7	651	5,321	1.35
10	651	5,321	92%	78.6%	1.73	61.5	622.2	590	5,260	1.43
11	590	5,260	91%	78.4%	1.72	61.4	683.6	528	5,198	1.50
12	528	5,198	90%	78.2%	1.72	61.2	744.8	467	5,137	1.57
13	467	5,137	89%	78.0%	1.71	61.1	805.9	406	5,076	1.64
14	406	5,076	88%	77.8%	1.71	60.9	866.8	345	5,015	1.70
15	345	5,015	87%	77.5%	1.71	60.8	927.6	284	4,954	1.76
16	284	4,954	86%	77.3%	1.70	60.6	988.2	224	4,894	1.82
17	224	4,894	85%	77.1%	1.70	60.4	1048.6	163	4,833	1.88
18	163	4,833	84%	76.9%	1.69	60.3	1108.9	103	4,773	1.93
19	103	4,773	83%	76.7%	1.69	60.1	1169.0	43	4,713	1.98
20	43	4,713	82%	76.6%	1.68	60.0	1229.0	-17	4,653	2.03
21	-17	4,653	81%	76.4%	1.68	59.8	1288.8	-77	4,593	2.08
22	-77	4,593	80%	76.2%	1.68	59.7	1348.5	-136	4,534	2.13
23	-136	4,534	79%	76.0%	1.67	59.5	1408.0	-196	4,474	2.17
24	-196	4,474	78%	75.8%	1.67	59.4	1467.3	-255	4,415	2.22
25	-255	4,415	77%	75.6%	1.66	59.2	1526.5	-315	4,355	2.26
26	-315	4,355	76%	75.4%	1.66	59.0	1585.6	-374	4,296	2.30
27	-374	4,296	75%	75.2%	1.65	58.9	1644.5	-432	4,238	2.35
28	-432	4,238	74%	75.0%	1.65	58.7	1703.2	-491	4,179	2.39

APPENDIX E

Culvert Hydraulics

Downstream 100Yr WSEL – 202.22m

Maximum design flow in culvert (100Yr pre-development) – 1.62m^3/s

$$H = \frac{V^2}{2g}\left[1 + k_e + \frac{19.6n^2L}{R^{4/3}}\right]$$

$$\mathrm{V} = \frac{\mathrm{Q}}{\mathrm{A}} = \frac{1.62\mathrm{m}^3/\mathrm{s}}{1.22\mathrm{m} * 0.455\mathrm{m}} = 2.92m/s$$

$$R = A/P = 0.166m$$

$$H = \frac{2.92^2}{2g}\left[1 + 0.5 + \frac{19.6 * 0.013^2 * 16}{0.166^{4/3}}\right] = 0.91m$$

Max design WSEL upstream of culvert = 203.13m

OTTHYMO model – Backwater conditions:

Head = 202.6 – 202.22 = 0.38m

$$0.38m = \frac{V^2}{2g}\left[1 + 0.5 + \frac{19.6 * 0.013^2 * 16}{0.166^{4/3}}\right], \qquad V = 1.89m/s$$

$$Q = VA = 1.89m/s * 0.556m^2 = 1.05m^3/s$$

APPENDIX F

OTTHYMO – Quality Event

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

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    I N T E R H Y M O
       O   O    T      T    H   H   Y Y   MM MM  O   O   * * * 1989a * * *
       O   O    T      T    HHHHH    Y    M M M  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO             00002

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  Input   filename: nwdq.dat
  Output  filename: nwdq.out
  Summary filename: nwdq.sum



DATE: 11-06-2023                      TIME: 09:44:19


COMMENTS: _____________________________________________________________


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

*
*                   Norwood Subdivision
*
*                   Quality Event
*                   November 6, 2023
*                   Andrew Rosenthal, EIT
*
*                   LGI, LGP from L=SQRT(A/1.5)
*
*                   November Pond SSD (R6)
*
*******************************************************************************
*                   25mm Event
*******************************************************************************

--------------------
|    READ STORM    |    Filename: QUALITY.STM
| Ptotal= 25.00 mm |    Comments: 4 Hr Chicago 25mm
--------------------
                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                 .08    1.73 |  1.08    7.10 |  2.08    4.61 |  3.08    2.28
                 .17    1.83 |  1.17   10.69 |  2.17    4.21 |  3.17    2.19
                 .25    1.94 |  1.25   23.51 |  2.25    3.88 |  3.25    2.11
                 .33    2.07 |  1.33   68.86 |  2.33    3.61 |  3.33    2.04
                 .42    2.23 |  1.42   29.90 |  2.42    3.38 |  3.42    1.97
                 .50    2.41 |  1.50   17.13 |  2.50    3.18 |  3.50    1.91
                 .58    2.64 |  1.58   12.05 |  2.58    3.00 |  3.58    1.86
                 .67    2.92 |  1.67    9.35 |  2.67    2.84 |  3.67    1.80
                 .75    3.28 |  1.75    7.68 |  2.75    2.70 |  3.75    1.75
                 .83    3.74 |  1.83    6.55 |  2.83    2.58 |  3.83    1.70
                 .92    4.41 |  1.92    5.73 |  2.92    2.47 |  3.92    1.66
                1.00    5.41 |  2.00    5.10 |  3.00    2.37 |  4.00    1.62
```

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

*                   Post-Development
--------------------
| CALIB            |
| STANDHYD  (0001) |   Area    (ha)=  35.61
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  50.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      21.37         14.24
     Dep. Storage     (mm)=       2.00          5.00
     Average Slope     (%)=       2.00          2.00
     Length            (m)=     487.00        487.00
     Mannings n             =       .013          .250

     Max.eff.Inten.(mm/hr)=      49.38          2.47
                over (min)       10.00        140.00
     Storage Coeff.  (min)=       7.11 (ii)   146.06 (ii)
     Unit Hyd. Tpeak (min)=       5.00        150.00
     Unit Hyd. peak  (cms)=        .17           .01
                                                      *TOTALS*
     PEAK FLOW       (cms)=       2.11           .05          2.11 (iii)
     TIME TO PEAK    (hrs)=       1.75          4.67          1.75
     RUNOFF VOLUME    (mm)=      23.00          4.97         13.96
     TOTAL RAINFALL   (mm)=      25.00         25.00         25.00
     RUNOFF COEFFICIENT   =        .92           .20           .56


       (i) CN PROCEDURE SELECTED FOR RAINFALL LOSSES:
            CN*  =  75.0    Ia = Dep. Storage  (Above)
      (ii) COMPUTATIONAL TIME STEP SHOULD BE SMALL OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  35.61
| ID= 1   PCYC=184 |   QPEAK     (cms)=   2.11 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   1.75
--------------------   VOLUME     (mm)=  13.96
  Filename: NRWDUNQ.TXT
  Comments:

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

--------------------------------------------------------------------------------
*                   Route through SWMF
--------------------
| RESERVOIR (0001) |
| IN= 1---> OUT= 2 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                           .000        .000    |     .149        .225
                           .004        .050    |     .183        .287
                           .025        .106    |     .220        .351
                           .076        .164    |     .000        .000

                                  AREA     QPEAK     TPEAK       R.V.
                                  (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 1 (0001)     35.61      2.11      1.75      13.96
     OUTFLOW: ID= 2 (0001)     35.61       .18      3.00      13.69

                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=  8.59
                    TIME SHIFT OF PEAK FLOW         (min)= 75.00
```

```
                    MAXIMUM  STORAGE   USED       (ha.m.)=   .28

--------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  35.61
| ID= 2   PCYC=890 |   QPEAK     (cms)=    .18 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   3.00
--------------------   VOLUME     (mm)=  13.69
  Filename: NRWDCNQ.TXT
  Comments:

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

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

 FINISH
================================================================================
```

APPENDIX G

OTTHYMO – 2 to 100Yr Event – Base Conditions

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

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    I N T E R H Y M O
       O   O    T      T    H   H   Y Y   MM MM  O   O   * * * 1989a * * *
       O   O    T      T    HHHHH    Y    M M M  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO             00002

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  Input   filename: nwd.dat
  Output  filename: nwd.out
  Summary filename: nwd.sum



DATE: 11-06-2023                      TIME: 09:44:19


COMMENTS: _____________________________________________________________


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

*
*                   Norwood Subdivision
*
*                   Environment Canada Peterborough STP Station
*
*                   2 to 100-Yr Return Period
*                   November 6, 2023
*                   Andrew Rosenthal, EIT
*
*                   LGI, LGP from L=SQRT(A/1.5)
*
*                   November SWMF R6
*
*******************************************************************************
*                   2 to 100 Year Storm
*******************************************************************************
--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 814.343
| Ptotal= 44.49 mm |                          B=   9.596
--------------------                          C=    .836
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  = 24.00 hrs
                        Storm time step    =  5.00 min
                        Time to peak ratio =   .33

                    The CORRELATION coefficient is =  .9998

                     TIME       INPUT INT.           TAB. INT.
                    (min)        (mm/hr)              (mm/hr)
                       5.          86.80                86.60
                      10.          68.20                67.69
                      15.          56.60                55.98
                      30.          36.60                37.60
```

60.	22.80	23.46
120.	14.00	13.95
360.	6.10	5.81
720.	3.30	3.29
1440.	1.80	1.85

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.08	.32	6.08	1.13	12.08	1.06	18.08	.47
.17	.32	6.17	1.18	12.17	1.04	18.17	.47
.25	.32	6.25	1.23	12.25	1.02	18.25	.46
.33	.33	6.33	1.29	12.33	1.00	18.33	.46
.42	.33	6.42	1.35	12.42	.98	18.42	.46
.50	.33	6.50	1.43	12.50	.97	18.50	.45
.58	.34	6.58	1.51	12.58	.95	18.58	.45
.67	.34	6.67	1.60	12.67	.93	18.67	.45
.75	.34	6.75	1.70	12.75	.92	18.75	.44
.83	.35	6.83	1.82	12.83	.90	18.83	.44
.92	.35	6.92	1.96	12.92	.89	18.92	.44
1.00	.35	7.00	2.12	13.00	.88	19.00	.43
1.08	.36	7.08	2.32	13.08	.86	19.08	.43
1.17	.36	7.17	2.55	13.17	.85	19.17	.43
1.25	.36	7.25	2.85	13.25	.84	19.25	.43
1.33	.37	7.33	3.22	13.33	.83	19.33	.42
1.42	.37	7.42	3.71	13.42	.82	19.42	.42
1.50	.38	7.50	4.39	13.50	.80	19.50	.42
1.58	.38	7.58	5.37	13.58	.79	19.58	.42
1.67	.39	7.67	6.90	13.67	.78	19.67	.41
1.75	.39	7.75	9.61	13.75	.77	19.75	.41
1.83	.39	7.83	15.47	13.83	.76	19.83	.41
1.92	.40	7.92	35.06	13.92	.75	19.92	.41
2.00	.40	8.00	86.60	14.00	.74	20.00	.40
2.08	.41	8.08	44.32	14.08	.73	20.08	.40
2.17	.41	8.17	25.85	14.17	.73	20.17	.40
2.25	.42	8.25	17.71	14.25	.72	20.25	.40
2.33	.42	8.33	13.27	14.33	.71	20.33	.39
2.42	.43	8.42	10.54	14.42	.70	20.42	.39
2.50	.44	8.50	8.70	14.50	.69	20.50	.39
2.58	.44	8.58	7.39	14.58	.68	20.58	.39
2.67	.45	8.67	6.42	14.67	.68	20.67	.38
2.75	.45	8.75	5.67	14.75	.67	20.75	.38
2.83	.46	8.83	5.08	14.83	.66	20.83	.38
2.92	.47	8.92	4.59	14.92	.65	20.92	.38
3.00	.47	9.00	4.20	15.00	.65	21.00	.38
3.08	.48	9.08	3.86	15.08	.64	21.08	.37
3.17	.49	9.17	3.58	15.17	.63	21.17	.37
3.25	.50	9.25	3.33	15.25	.63	21.25	.37
3.33	.50	9.33	3.12	15.33	.62	21.33	.37
3.42	.51	9.42	2.94	15.42	.62	21.42	.37
3.50	.52	9.50	2.77	15.50	.61	21.50	.36
3.58	.53	9.58	2.62	15.58	.60	21.58	.36
3.67	.54	9.67	2.49	15.67	.60	21.67	.36
3.75	.55	9.75	2.37	15.75	.59	21.75	.36
3.83	.56	9.83	2.27	15.83	.59	21.83	.36
3.92	.57	9.92	2.17	15.92	.58	21.92	.35
4.00	.58	10.00	2.08	16.00	.58	22.00	.35
4.08	.59	10.08	2.00	16.08	.57	22.08	.35
4.17	.60	10.17	1.92	16.17	.56	22.17	.35
4.25	.61	10.25	1.86	16.25	.56	22.25	.35
4.33	.62	10.33	1.79	16.33	.55	22.33	.35
4.42	.64	10.42	1.73	16.42	.55	22.42	.34
4.50	.65	10.50	1.68	16.50	.55	22.50	.34
4.58	.66	10.58	1.62	16.58	.54	22.58	.34

4.67	.68	10.67	1.58	16.67	.54	22.67	.34
4.75	.70	10.75	1.53	16.75	.53	22.75	.34
4.83	.71	10.83	1.49	16.83	.53	22.83	.34
4.92	.73	10.92	1.45	16.92	.52	22.92	.33
5.00	.75	11.00	1.41	17.00	.52	23.00	.33
5.08	.77	11.08	1.37	17.08	.51	23.08	.33
5.17	.79	11.17	1.34	17.17	.51	23.17	.33
5.25	.81	11.25	1.31	17.25	.51	23.25	.33
5.33	.83	11.33	1.28	17.33	.50	23.33	.33
5.42	.86	11.42	1.25	17.42	.50	23.42	.32
5.50	.88	11.50	1.22	17.50	.49	23.50	.32
5.58	.91	11.58	1.19	17.58	.49	23.58	.32
5.67	.94	11.67	1.17	17.67	.49	23.67	.32
5.75	.97	11.75	1.14	17.75	.48	23.75	.32
5.83	1.01	11.83	1.12	17.83	.48	23.83	.32
5.92	1.04	11.92	1.10	17.92	.48	23.92	.32
6.00	1.09	12.00	1.08	18.00	.47	24.00	.31

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* Pre-Development, 88 acre area (=35.61ha)

CALIB					
NASHYD (0001)	Area (ha)=	35.61	Curve Number (CN)=	72.0	
ID= 1 DT= 5.0 min	Ia (mm)=	5.00	# of Linear Res.(N)=	3.00	
	U.H. Tp(hrs)=	.71			

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

Unit Hyd Qpeak (cms)= 1.92

PEAK FLOW (cms)= .37 (i)
TIME TO PEAK (hrs)= 8.92
RUNOFF VOLUME (mm)= 11.26
TOTAL RAINFALL (mm)= 44.49
RUNOFF COEFFICIENT = .25

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

SAVE HYD (0001)	AREA (ha)=	35.61
ID= 1 PCYC=312	QPEAK (cms)=	.37 (i)
DT= 5.0 min	TPEAK (hrs)=	8.92
	VOLUME (mm)=	11.26

Filename: NRWDPR2.TXT
Comments:

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

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* Post-Development

CALIB					
STANDHYD (0001)	Area (ha)=	35.61			
ID= 1 DT= 5.0 min	Total Imp(%)=	60.00	Dir. Conn.(%)=	50.00	

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	21.37	14.24
Dep. Storage	(mm)=	2.00	5.00
Average Slope	(%)=	2.00	2.00
Length	(m)=	487.00	487.00
Mannings n	=	.013	.250

```
     Max.eff.Inten.(mm/hr)=      65.46         6.91
               over (min)        10.00        95.00
     Storage Coeff.  (min)=       6.36 (ii)   98.45 (ii)
     Unit Hyd. Tpeak (min)=       5.00       100.00
     Unit Hyd. peak  (cms)=        .19          .01
                                                        *TOTALS*
     PEAK FLOW       (cms)=       2.89          .15          2.89 (iii)
     TIME TO PEAK    (hrs)=       8.33        10.08          8.33
     RUNOFF VOLUME    (mm)=      42.46        15.13         28.78
     TOTAL RAINFALL   (mm)=      44.49        44.49         44.49
     RUNOFF COEFFICIENT   =        .95          .34           .65


       (i) CN PROCEDURE SELECTED FOR RAINFALL LOSSES:
            CN*  =  75.0    Ia = Dep. Storage  (Above)
      (ii) COMPUTATIONAL TIME STEP SHOULD BE SMALL OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  35.61
| ID= 1   PCYC=349 |   QPEAK     (cms)=   2.89 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   8.33
--------------------   VOLUME     (mm)=  28.78
  Filename: NRWDUN2.TXT
  Comments:

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

--------------------------------------------------------------------------------
*                    Route through SWMF
--------------------
| RESERVOIR (0001) |
| IN= 1---> OUT= 2 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                            .000       .000    |     .843       .705
                            .025       .106    |    1.457       .937
                            .076       .164    |    1.693      1.016
                            .183       .287    |    2.204      1.180
                            .286       .418    |    3.059      1.436
                            .539       .557    |     .000       .000

                                 AREA     QPEAK     TPEAK       R.V.
                                 (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 1 (0001)     35.61      2.89      8.33       28.78
     OUTFLOW: ID= 2 (0001)     35.61       .32      9.25       28.75

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 11.23
                   TIME SHIFT OF PEAK FLOW         (min)= 55.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=   .44

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--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  35.61
| ID= 2   PCYC=776 |   QPEAK     (cms)=    .32 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   9.25
--------------------   VOLUME     (mm)=  28.75
  Filename: NRWDCN2.TXT
  Comments:

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

CHICAGO STORM Ptotal= 59.75 mm	IDF curve parameters: A= 958.292 B= 7.538 C= .818 used in: INTENSITY = A / (t + B)^C Duration of storm = 24.00 hrs Storm time step = 5.00 min Time to peak ratio = .33

The CORRELATION coefficient is = .9999

TIME (min)	INPUT INT. (mm/hr)	TAB. INT. (mm/hr)
5.	122.50	121.10
10.	93.80	92.03
15.	74.80	74.96
30.	48.90	49.38
60.	29.50	30.54
120.	18.10	18.16
360.	8.00	7.64
720.	4.30	4.37
1440.	2.50	2.49

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.08	.47	6.08	1.59	12.08	1.49	18.08	.68
.17	.47	6.17	1.65	12.17	1.46	18.17	.68
.25	.48	6.25	1.72	12.25	1.44	18.25	.67
.33	.48	6.33	1.80	12.33	1.41	18.33	.67
.42	.49	6.42	1.88	12.42	1.39	18.42	.66
.50	.49	6.50	1.98	12.50	1.37	18.50	.66
.58	.49	6.58	2.08	12.58	1.34	18.58	.66
.67	.50	6.67	2.20	12.67	1.32	18.67	.65
.75	.50	6.75	2.34	12.75	1.30	18.75	.65
.83	.51	6.83	2.49	12.83	1.28	18.83	.64
.92	.51	6.92	2.67	12.92	1.26	18.92	.64
1.00	.52	7.00	2.88	13.00	1.25	19.00	.63
1.08	.52	7.08	3.13	13.08	1.23	19.08	.63
1.17	.53	7.17	3.43	13.17	1.21	19.17	.63
1.25	.54	7.25	3.80	13.25	1.19	19.25	.62
1.33	.54	7.33	4.27	13.33	1.18	19.33	.62
1.42	.55	7.42	4.88	13.42	1.16	19.42	.62
1.50	.55	7.50	5.71	13.50	1.15	19.50	.61
1.58	.56	7.58	6.91	13.58	1.13	19.58	.61
1.67	.56	7.67	8.76	13.67	1.12	19.67	.60
1.75	.57	7.75	12.04	13.75	1.10	19.75	.60
1.83	.58	7.83	19.17	13.83	1.09	19.83	.60
1.92	.58	7.92	44.45	13.92	1.08	19.92	.59
2.00	.59	8.00	121.10	14.00	1.06	20.00	.59
2.08	.60	8.08	56.81	14.08	1.05	20.08	.59
2.17	.61	8.17	32.14	14.17	1.04	20.17	.58
2.25	.61	8.25	21.91	14.25	1.03	20.25	.58
2.33	.62	8.33	16.48	14.33	1.02	20.33	.58
2.42	.63	8.42	13.16	14.42	1.00	20.42	.57
2.50	.64	8.50	10.95	14.50	.99	20.50	.57
2.58	.64	8.58	9.37	14.58	.98	20.58	.57
2.67	.65	8.67	8.19	14.67	.97	20.67	.56
2.75	.66	8.75	7.28	14.75	.96	20.75	.56
2.83	.67	8.83	6.55	14.83	.95	20.83	.56
2.92	.68	8.92	5.96	14.92	.94	20.92	.55
3.00	.69	9.00	5.48	15.00	.93	21.00	.55

3.08	.70	9.08	5.06	15.08	.92	21.08	.55
3.17	.71	9.17	4.71	15.17	.91	21.17	.55
3.25	.72	9.25	4.41	15.25	.90	21.25	.54
3.33	.73	9.33	4.14	15.33	.90	21.33	.54
3.42	.74	9.42	3.91	15.42	.89	21.42	.54
3.50	.75	9.50	3.70	15.50	.88	21.50	.53
3.58	.77	9.58	3.52	15.58	.87	21.58	.53
3.67	.78	9.67	3.35	15.67	.86	21.67	.53
3.75	.79	9.75	3.20	15.75	.85	21.75	.53
3.83	.81	9.83	3.07	15.83	.85	21.83	.52
3.92	.82	9.92	2.94	15.92	.84	21.92	.52
4.00	.83	10.00	2.83	16.00	.83	22.00	.52
4.08	.85	10.08	2.73	16.08	.82	22.08	.52
4.17	.87	10.17	2.63	16.17	.82	22.17	.51
4.25	.88	10.25	2.54	16.25	.81	22.25	.51
4.33	.90	10.33	2.46	16.33	.80	22.33	.51
4.42	.92	10.42	2.38	16.42	.80	22.42	.51
4.50	.94	10.50	2.31	16.50	.79	22.50	.50
4.58	.96	10.58	2.24	16.58	.78	22.58	.50
4.67	.98	10.67	2.18	16.67	.78	22.67	.50
4.75	1.00	10.75	2.12	16.75	.77	22.75	.50
4.83	1.02	10.83	2.06	16.83	.76	22.83	.49
4.92	1.04	10.92	2.01	16.92	.76	22.92	.49
5.00	1.07	11.00	1.96	17.00	.75	23.00	.49
5.08	1.10	11.08	1.91	17.08	.75	23.08	.49
5.17	1.12	11.17	1.86	17.17	.74	23.17	.48
5.25	1.15	11.25	1.82	17.25	.74	23.25	.48
5.33	1.18	11.33	1.78	17.33	.73	23.33	.48
5.42	1.22	11.42	1.74	17.42	.72	23.42	.48
5.50	1.25	11.50	1.70	17.50	.72	23.50	.48
5.58	1.29	11.58	1.67	17.58	.71	23.58	.47
5.67	1.33	11.67	1.64	17.67	.71	23.67	.47
5.75	1.38	11.75	1.60	17.75	.70	23.75	.47
5.83	1.42	11.83	1.57	17.83	.70	23.83	.47
5.92	1.47	11.92	1.54	17.92	.69	23.92	.47
6.00	1.53	12.00	1.51	18.00	.69	24.00	.46

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* Pre-Development, 88 acre area (=35.61ha)

CALIB NASHYD (0001) ID= 1 DT= 5.0 min	Area (ha)= 35.61	Curve Number (CN)= 72.0	
	Ia (mm)= 5.00	# of Linear Res.(N)= 3.00	
	U.H. Tp(hrs)= .71		

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

Unit Hyd Qpeak (cms)= 1.92

PEAK FLOW (cms)= .65 (i)
TIME TO PEAK (hrs)= 8.92
RUNOFF VOLUME (mm)= 19.50
TOTAL RAINFALL (mm)= 59.75
RUNOFF COEFFICIENT = .33

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

SAVE HYD (0001) ID= 1 PCYC=316 DT= 5.0 min	AREA (ha)= 35.61	
	QPEAK (cms)= .65 (i)	
	TPEAK (hrs)= 8.92	
	VOLUME (mm)= 19.50	

```
  Filename: NRWDPR5.TXT
  Comments:

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

--------------------------------------------------------------------------------
*                   Post-Development
--------------------
| CALIB             |
| STANDHYD  (0001)  |   Area    (ha)=  35.61
|ID= 1 DT= 5.0 min  |   Total Imp(%)=  60.00   Dir. Conn.(%)=  50.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      21.37         14.24
     Dep. Storage     (mm)=       2.00          5.00
     Average Slope     (%)=       2.00          2.00
     Length            (m)=     487.00        487.00
     Mannings n             =       .013          .250

     Max.eff.Inten.(mm/hr)=      88.96         14.10
               over (min)        10.00         70.00
     Storage Coeff.  (min)=       5.62 (ii)    74.84 (ii)
     Unit Hyd. Tpeak (min)=       5.00         75.00
     Unit Hyd. peak  (cms)=        .20           .02
                                                          *TOTALS*
     PEAK FLOW       (cms)=       4.19           .31          4.21 (iii)
     TIME TO PEAK    (hrs)=       8.25          9.58          8.25
     RUNOFF VOLUME    (mm)=      57.71         25.14         41.41
     TOTAL RAINFALL   (mm)=      59.75         59.75         59.75
     RUNOFF COEFFICIENT   =        .97           .42           .69


       (i) CN PROCEDURE SELECTED FOR RAINFALL LOSSES:
            CN*  =  75.0    Ia = Dep. Storage  (Above)
      (ii) COMPUTATIONAL TIME STEP SHOULD BE SMALL OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  35.61
| ID= 1   PCYC=342 |   QPEAK     (cms)=   4.21 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   8.25
--------------------   VOLUME     (mm)=  41.41
  Filename: NRWDUN5.TXT
  Comments:

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

--------------------------------------------------------------------------------
*                   Route through SWMF
--------------------
| RESERVOIR (0001) |
| IN= 1---> OUT= 2 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                           .000        .000    |     .843       .705
                           .025        .106    |    1.457       .937
                           .076        .164    |    1.693      1.016
                           .183        .287    |    2.204      1.180
                           .286        .418    |    3.059      1.436
                           .539        .557    |     .000       .000

                               AREA     QPEAK     TPEAK       R.V.
```

	(ha)	(cms)	(hrs)	(mm)
INFLOW : ID= 1 (0001)	35.61	4.21	8.25	41.41
OUTFLOW: ID= 2 (0001)	35.61	.56	9.17	41.38

PEAK FLOW REDUCTION [Qout/Qin](%)= 13.40
TIME SHIFT OF PEAK FLOW (min)= 55.00
MAXIMUM STORAGE USED (ha.m.)= .57

SAVE HYD (0001)	AREA	(ha)= 35.61
ID= 2 PCYC=787	QPEAK	(cms)= .56 (i)
DT= 5.0 min	TPEAK	(hrs)= 9.17
	VOLUME	(mm)= 41.38

Filename: NRWDCN5.TXT
Comments:

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

CHICAGO STORM
Ptotal= 70.31 mm

IDF curve parameters: A=1025.220
B= 6.188
C= .805
used in: INTENSITY = A / (t + B)^C

Duration of storm = 24.00 hrs
Storm time step = 5.00 min
Time to peak ratio = .33

The CORRELATION coefficient is = .9999

TIME (min)	INPUT INT. (mm/hr)	TAB. INT. (mm/hr)
5.	146.10	146.75
10.	110.80	109.00
15.	86.90	87.76
30.	57.10	57.04
60.	34.00	35.08
120.	20.90	20.87
360.	9.20	8.85
720.	5.00	5.10
1440.	2.90	2.93

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.08	.59	6.08	1.93	12.08	1.81	18.08	.85
.17	.59	6.17	2.00	12.17	1.78	18.17	.84
.25	.60	6.25	2.08	12.25	1.75	18.25	.84
.33	.60	6.33	2.17	12.33	1.72	18.33	.83
.42	.61	6.42	2.27	12.42	1.69	18.42	.83
.50	.61	6.50	2.38	12.50	1.67	18.50	.82
.58	.62	6.58	2.51	12.58	1.64	18.58	.82
.67	.62	6.67	2.65	12.67	1.62	18.67	.81
.75	.63	6.75	2.80	12.75	1.59	18.75	.81
.83	.64	6.83	2.98	12.83	1.57	18.83	.80
.92	.64	6.92	3.19	12.92	1.55	18.92	.80
1.00	.65	7.00	3.43	13.00	1.52	19.00	.79
1.08	.66	7.08	3.71	13.08	1.50	19.08	.79
1.17	.66	7.17	4.05	13.17	1.48	19.17	.78
1.25	.67	7.25	4.47	13.25	1.46	19.25	.78
1.33	.68	7.33	4.99	13.33	1.44	19.33	.77
1.42	.68	7.42	5.67	13.42	1.42	19.42	.77

1.50	.69	7.50	6.59	13.50	1.41	19.50	.76
1.58	.70	7.58	7.90	13.58	1.39	19.58	.76
1.67	.70	7.67	9.94	13.67	1.37	19.67	.75
1.75	.71	7.75	13.49	13.75	1.36	19.75	.75
1.83	.72	7.83	21.24	13.83	1.34	19.83	.74
1.92	.73	7.92	49.73	13.92	1.32	19.92	.74
2.00	.74	8.00	146.75	14.00	1.31	20.00	.74
2.08	.75	8.08	64.01	14.08	1.29	20.08	.73
2.17	.75	8.17	35.52	14.17	1.28	20.17	.73
2.25	.76	8.25	24.22	14.25	1.26	20.25	.72
2.33	.77	8.33	18.30	14.33	1.25	20.33	.72
2.42	.78	8.42	14.71	14.42	1.24	20.42	.72
2.50	.79	8.50	12.30	14.50	1.22	20.50	.71
2.58	.80	8.58	10.59	14.58	1.21	20.58	.71
2.67	.81	8.67	9.31	14.67	1.20	20.67	.70
2.75	.82	8.75	8.31	14.75	1.18	20.75	.70
2.83	.83	8.83	7.52	14.83	1.17	20.83	.70
2.92	.85	8.92	6.87	14.92	1.16	20.92	.69
3.00	.86	9.00	6.33	15.00	1.15	21.00	.69
3.08	.87	9.08	5.88	15.08	1.14	21.08	.69
3.17	.88	9.17	5.48	15.17	1.13	21.17	.68
3.25	.89	9.25	5.15	15.25	1.12	21.25	.68
3.33	.91	9.33	4.85	15.33	1.11	21.33	.67
3.42	.92	9.42	4.59	15.42	1.10	21.42	.67
3.50	.94	9.50	4.36	15.50	1.09	21.50	.67
3.58	.95	9.58	4.15	15.58	1.08	21.58	.66
3.67	.97	9.67	3.96	15.67	1.07	21.67	.66
3.75	.98	9.75	3.79	15.75	1.06	21.75	.66
3.83	1.00	9.83	3.64	15.83	1.05	21.83	.65
3.92	1.01	9.92	3.49	15.92	1.04	21.92	.65
4.00	1.03	10.00	3.36	16.00	1.03	22.00	.65
4.08	1.05	10.08	3.24	16.08	1.02	22.08	.65
4.17	1.07	10.17	3.13	16.17	1.01	22.17	.64
4.25	1.09	10.25	3.03	16.25	1.00	22.25	.64
4.33	1.11	10.33	2.94	16.33	.99	22.33	.64
4.42	1.13	10.42	2.85	16.42	.99	22.42	.63
4.50	1.15	10.50	2.76	16.50	.98	22.50	.63
4.58	1.18	10.58	2.69	16.58	.97	22.58	.63
4.67	1.20	10.67	2.61	16.67	.96	22.67	.62
4.75	1.23	10.75	2.54	16.75	.95	22.75	.62
4.83	1.26	10.83	2.48	16.83	.95	22.83	.62
4.92	1.28	10.92	2.42	16.92	.94	22.92	.62
5.00	1.31	11.00	2.36	17.00	.93	23.00	.61
5.08	1.35	11.08	2.30	17.08	.93	23.08	.61
5.17	1.38	11.17	2.25	17.17	.92	23.17	.61
5.25	1.41	11.25	2.20	17.25	.91	23.25	.60
5.33	1.45	11.33	2.15	17.33	.91	23.33	.60
5.42	1.49	11.42	2.11	17.42	.90	23.42	.60
5.50	1.53	11.50	2.06	17.50	.89	23.50	.60
5.58	1.58	11.58	2.02	17.58	.89	23.58	.59
5.67	1.63	11.67	1.98	17.67	.88	23.67	.59
5.75	1.68	11.75	1.95	17.75	.87	23.75	.59
5.83	1.73	11.83	1.91	17.83	.87	23.83	.59
5.92	1.79	11.92	1.88	17.92	.86	23.92	.58
6.00	1.86	12.00	1.84	18.00	.86	24.00	.58

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* Pre-Development, 88 acre area (=35.61ha)

CALIB NASHYD (0001)	Area (ha)= 35.61	Curve Number (CN)= 72.0
ID= 1 DT= 5.0 min	Ia (mm)= 5.00	# of Linear Res.(N)= 3.00
	U.H. Tp(hrs)= .71	

```
         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.

     Unit Hyd Qpeak  (cms)=   1.92

     PEAK FLOW       (cms)=    .86 (i)
     TIME TO PEAK    (hrs)=   8.83
     RUNOFF VOLUME    (mm)=  25.96
     TOTAL RAINFALL   (mm)=  70.31
     RUNOFF COEFFICIENT   =    .37

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

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--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  35.61
| ID= 1   PCYC=317 |   QPEAK     (cms)=    .86 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   8.83
--------------------   VOLUME     (mm)=  25.96
  Filename: NRWDPR10.TXT
  Comments:

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

--------------------------------------------------------------------------------
*                   Post-Development
--------------------
| CALIB            |
| STANDHYD  (0001) |   Area    (ha)=  35.61
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  50.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      21.37         14.24
     Dep. Storage     (mm)=       2.00          5.00
     Average Slope     (%)=       2.00          2.00
     Length            (m)=     487.00        487.00
     Mannings n           =       .013          .250

     Max.eff.Inten.(mm/hr)=     105.38         20.21
               over (min)        10.00         60.00
     Storage Coeff.  (min)=       5.25 (ii)    65.19 (ii)
     Unit Hyd. Tpeak (min)=       5.00         70.00
     Unit Hyd. peak  (cms)=        .21           .02
                                                      *TOTALS*
     PEAK FLOW       (cms)=       5.17           .44          5.21 (iii)
     TIME TO PEAK    (hrs)=       8.25          9.42          8.25
     RUNOFF VOLUME    (mm)=      68.27         32.77         50.51
     TOTAL RAINFALL   (mm)=      70.31         70.31         70.31
     RUNOFF COEFFICIENT   =        .97           .47           .72


       (i) CN PROCEDURE SELECTED FOR RAINFALL LOSSES:
            CN*  =  75.0    Ia = Dep. Storage  (Above)
      (ii) COMPUTATIONAL TIME STEP SHOULD BE SMALL OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  35.61
| ID= 1   PCYC=339 |   QPEAK     (cms)=   5.21 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   8.25
--------------------   VOLUME     (mm)=  50.51
  Filename: NRWDUN10.TXT
```

Comments:

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

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* Route through SWMF

RESERVOIR (0001)	IN= 1---> OUT= 2	DT= 5.0 min

OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
.000	.000	.843	.705
.025	.106	1.457	.937
.076	.164	1.693	1.016
.183	.287	2.204	1.180
.286	.418	3.059	1.436
.539	.557	.000	.000

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 1 (0001)	35.61	5.21	8.25	50.51
OUTFLOW: ID= 2 (0001)	35.61	.74	9.33	50.48

PEAK FLOW REDUCTION [Qout/Qin](%)= 14.15
TIME SHIFT OF PEAK FLOW (min)= 65.00
MAXIMUM STORAGE USED (ha.m.)= .65

SAVE HYD (0001)	ID= 2 PCYC=795	DT= 5.0 min

AREA (ha)= 35.61
QPEAK (cms)= .74 (i)
TPEAK (hrs)= 9.33
VOLUME (mm)= 50.48

Filename: NRWDCN10.TXT
Comments:

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

CHICAGO STORM	Ptotal= 81.51 mm

IDF curve parameters: A=1214.495
B= 6.007
C= .808
used in: INTENSITY = A / (t + B)^C

Duration of storm = 24.00 hrs
Storm time step = 5.00 min
Time to peak ratio = .33

The CORRELATION coefficient is = .9998

TIME (min)	INPUT INT. (mm/hr)	TAB. INT. (mm/hr)
5.	175.90	174.87
10.	132.20	129.22
15.	102.10	103.74
30.	67.40	67.12
60.	39.60	41.13
120.	24.40	24.39
360.	10.80	10.31
720.	5.80	5.93
1440.	3.40	3.40

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.08	.67	6.08	2.21	12.08	2.07	18.08	.97
.17	.68	6.17	2.29	12.17	2.04	18.17	.96
.25	.68	6.25	2.39	12.25	2.00	18.25	.96
.33	.69	6.33	2.49	12.33	1.97	18.33	.95
.42	.69	6.42	2.61	12.42	1.94	18.42	.94
.50	.70	6.50	2.73	12.50	1.91	18.50	.94
.58	.71	6.58	2.88	12.58	1.88	18.58	.93
.67	.71	6.67	3.03	12.67	1.85	18.67	.93
.75	.72	6.75	3.21	12.75	1.82	18.75	.92
.83	.73	6.83	3.42	12.83	1.80	18.83	.91
.92	.73	6.92	3.66	12.92	1.77	18.92	.91
1.00	.74	7.00	3.93	13.00	1.75	19.00	.90
1.08	.75	7.08	4.26	13.08	1.72	19.08	.90
1.17	.76	7.17	4.65	13.17	1.70	19.17	.89
1.25	.76	7.25	5.13	13.25	1.67	19.25	.89
1.33	.77	7.33	5.74	13.33	1.65	19.33	.88
1.42	.78	7.42	6.52	13.42	1.63	19.42	.88
1.50	.79	7.50	7.58	13.50	1.61	19.50	.87
1.58	.80	7.58	9.10	13.58	1.59	19.58	.87
1.67	.80	7.67	11.45	13.67	1.57	19.67	.86
1.75	.81	7.75	15.56	13.75	1.55	19.75	.86
1.83	.82	7.83	24.57	13.83	1.53	19.83	.85
1.92	.83	7.92	58.08	13.92	1.51	19.92	.85
2.00	.84	8.00	174.87	14.00	1.50	20.00	.84
2.08	.85	8.08	74.96	14.08	1.48	20.08	.84
2.17	.86	8.17	41.28	14.17	1.46	20.17	.83
2.25	.87	8.25	28.05	14.25	1.45	20.25	.83
2.33	.88	8.33	21.16	14.33	1.43	20.33	.82
2.42	.89	8.42	16.98	14.42	1.41	20.42	.82
2.50	.90	8.50	14.19	14.50	1.40	20.50	.81
2.58	.92	8.58	12.20	14.58	1.38	20.58	.81
2.67	.93	8.67	10.72	14.67	1.37	20.67	.80
2.75	.94	8.75	9.57	14.75	1.36	20.75	.80
2.83	.95	8.83	8.65	14.83	1.34	20.83	.80
2.92	.97	8.92	7.90	14.92	1.33	20.92	.79
3.00	.98	9.00	7.28	15.00	1.31	21.00	.79
3.08	.99	9.08	6.76	15.08	1.30	21.08	.78
3.17	1.01	9.17	6.31	15.17	1.29	21.17	.78
3.25	1.02	9.25	5.91	15.25	1.28	21.25	.77
3.33	1.04	9.33	5.57	15.33	1.26	21.33	.77
3.42	1.05	9.42	5.27	15.42	1.25	21.42	.77
3.50	1.07	9.50	5.00	15.50	1.24	21.50	.76
3.58	1.09	9.58	4.76	15.58	1.23	21.58	.76
3.67	1.10	9.67	4.55	15.67	1.22	21.67	.76
3.75	1.12	9.75	4.35	15.75	1.21	21.75	.75
3.83	1.14	9.83	4.17	15.83	1.20	21.83	.75
3.92	1.16	9.92	4.01	15.92	1.19	21.92	.74
4.00	1.18	10.00	3.86	16.00	1.18	22.00	.74
4.08	1.20	10.08	3.72	16.08	1.17	22.08	.74
4.17	1.22	10.17	3.60	16.17	1.16	22.17	.73
4.25	1.25	10.25	3.48	16.25	1.15	22.25	.73
4.33	1.27	10.33	3.37	16.33	1.14	22.33	.73
4.42	1.29	10.42	3.27	16.42	1.13	22.42	.72
4.50	1.32	10.50	3.17	16.50	1.12	22.50	.72
4.58	1.35	10.58	3.08	16.58	1.11	22.58	.72
4.67	1.38	10.67	3.00	16.67	1.10	22.67	.71
4.75	1.40	10.75	2.92	16.75	1.09	22.75	.71
4.83	1.44	10.83	2.84	16.83	1.08	22.83	.71
4.92	1.47	10.92	2.77	16.92	1.07	22.92	.70
5.00	1.50	11.00	2.70	17.00	1.07	23.00	.70
5.08	1.54	11.08	2.64	17.08	1.06	23.08	.70
5.17	1.58	11.17	2.58	17.17	1.05	23.17	.69

5.25	1.62	11.25	2.52	17.25	1.04	23.25	.69
5.33	1.66	11.33	2.47	17.33	1.03	23.33	.69
5.42	1.71	11.42	2.42	17.42	1.03	23.42	.68
5.50	1.76	11.50	2.37	17.50	1.02	23.50	.68
5.58	1.81	11.58	2.32	17.58	1.01	23.58	.68
5.67	1.86	11.67	2.27	17.67	1.01	23.67	.67
5.75	1.92	11.75	2.23	17.75	1.00	23.75	.67
5.83	1.98	11.83	2.19	17.83	.99	23.83	.67
5.92	2.05	11.92	2.15	17.92	.98	23.92	.67
6.00	2.13	12.00	2.11	18.00	.98	24.00	.66

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* Pre-Development, 88 acre area (=35.61ha)

CALIB			
NASHYD (0001)	Area (ha)= 35.61	Curve Number (CN)= 72.0	
ID= 1 DT= 5.0 min	Ia (mm)= 5.00	# of Linear Res.(N)= 3.00	
	U.H. Tp(hrs)= .71		

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

Unit Hyd Qpeak (cms)= 1.92

PEAK FLOW (cms)= 1.14 (i)
TIME TO PEAK (hrs)= 8.83
RUNOFF VOLUME (mm)= 33.35
TOTAL RAINFALL (mm)= 81.51
RUNOFF COEFFICIENT = .41

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

SAVE HYD (0001)	AREA (ha)= 35.61
ID= 1 PCYC=319	QPEAK (cms)= 1.14 (i)
DT= 5.0 min	TPEAK (hrs)= 8.83
	VOLUME (mm)= 33.35

Filename: NRWDPR25.TXT
Comments:

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

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* Post-Development

CALIB			
STANDHYD (0001)	Area (ha)= 35.61		
ID= 1 DT= 5.0 min	Total Imp(%)= 60.00	Dir. Conn.(%)= 50.00	

		IMPERVIOUS	PERVIOUS (i)	
Surface Area	(ha)=	21.37	14.24	
Dep. Storage	(mm)=	2.00	5.00	
Average Slope	(%)=	2.00	2.00	
Length	(m)=	487.00	487.00	
Mannings n	=	.013	.250	
Max.eff.Inten.(mm/hr)=		124.92	27.76	
over (min)		10.00	55.00	
Storage Coeff. (min)=		4.91 (ii)	57.70 (ii)	
Unit Hyd. Tpeak (min)=		5.00	60.00	
Unit Hyd. peak (cms)=		.22	.02	
			TOTALS	
PEAK FLOW (cms)=		6.32	.63	6.39 (iii)

```
     TIME TO PEAK    (hrs)=       8.25         9.25          8.25
     RUNOFF VOLUME    (mm)=      79.45        41.32         60.37
     TOTAL RAINFALL   (mm)=      81.51        81.51         81.51
     RUNOFF COEFFICIENT   =        .97          .51           .74

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

       (i) CN PROCEDURE SELECTED FOR RAINFALL LOSSES:
            CN*  =  75.0    Ia = Dep. Storage  (Above)
      (ii) COMPUTATIONAL TIME STEP SHOULD BE SMALL OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  35.61
| ID= 1   PCYC=335 |   QPEAK     (cms)=   6.39 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   8.25
--------------------   VOLUME     (mm)=  60.37
  Filename: NRWDUN25.TXT
  Comments:

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

--------------------------------------------------------------------------------
*                    Route through SWMF
--------------------
| RESERVOIR (0001) |
| IN= 1---> OUT= 2 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                            .000       .000    |     .843       .705
                            .025       .106    |    1.457       .937
                            .076       .164    |    1.693      1.016
                            .183       .287    |    2.204      1.180
                            .286       .418    |    3.059      1.436
                            .539       .557    |     .000       .000

                                  AREA     QPEAK     TPEAK       R.V.
                                  (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 1 (0001)     35.61      6.39      8.25      60.37
     OUTFLOW: ID= 2 (0001)     35.61      1.00      9.25      60.34

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 15.58
                   TIME SHIFT OF PEAK FLOW         (min)= 60.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=   .76

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--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  35.61
| ID= 2   PCYC=799 |   QPEAK     (cms)=   1.00 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   9.25
--------------------   VOLUME     (mm)=  60.34
  Filename: NRWDCN25.TXT
  Comments:

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

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--------------------
| CHICAGO STORM    |    IDF curve parameters: A=1275.807
| Ptotal= 91.45 mm |                          B=   5.262
--------------------                          C=    .799
                        used in:   INTENSITY =  A / (t + B)^C
```

Duration of storm = 24.00 hrs
Storm time step = 5.00 min
Time to peak ratio = .33

The CORRELATION coefficient is = .9999

TIME (min)	INPUT INT. (mm/hr)	TAB. INT. (mm/hr)
5.	198.10	198.52
10.	148.10	144.57
15.	113.40	115.28
30.	75.00	74.04
60.	43.80	45.28
120.	27.00	26.89
360.	12.00	11.44
720.	6.50	6.61
1440.	3.80	3.81

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.08	.78	6.08	2.53	12.08	2.38	18.08	1.13
.17	.79	6.17	2.63	12.17	2.34	18.17	1.12
.25	.80	6.25	2.74	12.25	2.30	18.25	1.12
.33	.80	6.33	2.85	12.33	2.27	18.33	1.11
.42	.81	6.42	2.98	12.42	2.23	18.42	1.10
.50	.82	6.50	3.12	12.50	2.20	18.50	1.09
.58	.83	6.58	3.28	12.58	2.16	18.58	1.09
.67	.83	6.67	3.46	12.67	2.13	18.67	1.08
.75	.84	6.75	3.66	12.75	2.10	18.75	1.07
.83	.85	6.83	3.89	12.83	2.07	18.83	1.07
.92	.86	6.92	4.15	12.92	2.04	18.92	1.06
1.00	.87	7.00	4.45	13.00	2.01	19.00	1.05
1.08	.88	7.08	4.81	13.08	1.99	19.08	1.05
1.17	.88	7.17	5.24	13.17	1.96	19.17	1.04
1.25	.89	7.25	5.77	13.25	1.93	19.25	1.03
1.33	.90	7.33	6.43	13.33	1.91	19.33	1.03
1.42	.91	7.42	7.28	13.42	1.88	19.42	1.02
1.50	.92	7.50	8.43	13.50	1.86	19.50	1.02
1.58	.93	7.58	10.07	13.58	1.84	19.58	1.01
1.67	.94	7.67	12.58	13.67	1.81	19.67	1.00
1.75	.95	7.75	16.96	13.75	1.79	19.75	1.00
1.83	.96	7.83	26.51	13.83	1.77	19.83	.99
1.92	.97	7.92	62.67	13.92	1.75	19.92	.99
2.00	.98	8.00	198.52	14.00	1.73	20.00	.98
2.08	.99	8.08	81.11	14.08	1.71	20.08	.98
2.17	1.01	8.17	44.31	14.17	1.69	20.17	.97
2.25	1.02	8.25	30.19	14.25	1.67	20.25	.96
2.33	1.03	8.33	22.89	14.33	1.65	20.33	.96
2.42	1.04	8.42	18.46	14.42	1.64	20.42	.95
2.50	1.05	8.50	15.50	14.50	1.62	20.50	.95
2.58	1.07	8.58	13.39	14.58	1.60	20.58	.94
2.67	1.08	8.67	11.80	14.67	1.59	20.67	.94
2.75	1.10	8.75	10.57	14.75	1.57	20.75	.93
2.83	1.11	8.83	9.59	14.83	1.55	20.83	.93
2.92	1.13	8.92	8.78	14.92	1.54	20.92	.92
3.00	1.14	9.00	8.11	15.00	1.52	21.00	.92
3.08	1.16	9.08	7.54	15.08	1.51	21.08	.91
3.17	1.17	9.17	7.05	15.17	1.49	21.17	.91
3.25	1.19	9.25	6.63	15.25	1.48	21.25	.91
3.33	1.21	9.33	6.25	15.33	1.47	21.33	.90
3.42	1.22	9.42	5.92	15.42	1.45	21.42	.90
3.50	1.24	9.50	5.63	15.50	1.44	21.50	.89

3.58	1.26	9.58	5.37	15.58	1.43	21.58	.89
3.67	1.28	9.67	5.13	15.67	1.41	21.67	.88
3.75	1.30	9.75	4.92	15.75	1.40	21.75	.88
3.83	1.32	9.83	4.72	15.83	1.39	21.83	.87
3.92	1.35	9.92	4.54	15.92	1.38	21.92	.87
4.00	1.37	10.00	4.38	16.00	1.37	22.00	.87
4.08	1.39	10.08	4.22	16.08	1.35	22.08	.86
4.17	1.42	10.17	4.08	16.17	1.34	22.17	.86
4.25	1.44	10.25	3.95	16.25	1.33	22.25	.85
4.33	1.47	10.33	3.83	16.33	1.32	22.33	.85
4.42	1.50	10.42	3.72	16.42	1.31	22.42	.85
4.50	1.53	10.50	3.61	16.50	1.30	22.50	.84
4.58	1.56	10.58	3.51	16.58	1.29	22.58	.84
4.67	1.59	10.67	3.42	16.67	1.28	22.67	.83
4.75	1.63	10.75	3.33	16.75	1.27	22.75	.83
4.83	1.66	10.83	3.24	16.83	1.26	22.83	.83
4.92	1.70	10.92	3.16	16.92	1.25	22.92	.82
5.00	1.74	11.00	3.09	17.00	1.24	23.00	.82
5.08	1.78	11.08	3.02	17.08	1.23	23.08	.81
5.17	1.82	11.17	2.95	17.17	1.22	23.17	.81
5.25	1.87	11.25	2.89	17.25	1.21	23.25	.81
5.33	1.92	11.33	2.83	17.33	1.20	23.33	.80
5.42	1.97	11.42	2.77	17.42	1.20	23.42	.80
5.50	2.02	11.50	2.71	17.50	1.19	23.50	.80
5.58	2.08	11.58	2.66	17.58	1.18	23.58	.79
5.67	2.14	11.67	2.61	17.67	1.17	23.67	.79
5.75	2.21	11.75	2.56	17.75	1.16	23.75	.79
5.83	2.28	11.83	2.51	17.83	1.15	23.83	.78
5.92	2.36	11.92	2.47	17.92	1.15	23.92	.78
6.00	2.44	12.00	2.42	18.00	1.14	24.00	.78

---

* Pre-Development, 88 acre area (=35.61ha)

CALIB		
NASHYD (0001)	Area (ha)= 35.61	Curve Number (CN)= 72.0
ID= 1 DT= 5.0 min	Ia (mm)= 5.00	# of Linear Res.(N)= 3.00
	U.H. Tp(hrs)= .71	

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

Unit Hyd Qpeak (cms)= 1.92

PEAK FLOW (cms)= 1.37 (i)
TIME TO PEAK (hrs)= 8.83
RUNOFF VOLUME (mm)= 40.30
TOTAL RAINFALL (mm)= 91.45
RUNOFF COEFFICIENT = .44

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

SAVE HYD (0001)	AREA (ha)= 35.61	
ID= 1 PCYC=320	QPEAK (cms)= 1.37 (i)	
DT= 5.0 min	TPEAK (hrs)= 8.83	
	VOLUME (mm)= 40.30	

Filename: NRWDPR50.TXT
Comments:

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

```
*                   Post-Development
--------------------
| CALIB            |
| STANDHYD  (0001) |   Area    (ha)=  35.61
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  50.00
--------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      21.37         14.24
     Dep. Storage     (mm)=       2.00          5.00
     Average Slope     (%)=       2.00          2.00
     Length            (m)=     487.00        487.00
     Mannings n             =      .013          .250

     Max.eff.Inten.(mm/hr)=     139.82         34.95
                over (min)       10.00         50.00
     Storage Coeff.  (min)=       4.69 (ii)    52.84 (ii)
     Unit Hyd. Tpeak (min)=       5.00         55.00
     Unit Hyd. peak  (cms)=        .22           .02
                                                          *TOTALS*
     PEAK FLOW       (cms)=       7.27           .79          7.36 (iii)
     TIME TO PEAK    (hrs)=       8.25          9.17          8.25
     RUNOFF VOLUME    (mm)=      89.39         49.23         69.30
     TOTAL RAINFALL   (mm)=      91.45         91.45         91.45
     RUNOFF COEFFICIENT   =        .98           .54           .76

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

       (i) CN PROCEDURE SELECTED FOR RAINFALL LOSSES:
            CN*  =  75.0    Ia = Dep. Storage  (Above)
      (ii) COMPUTATIONAL TIME STEP SHOULD BE SMALL OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  35.61
| ID= 1   PCYC=333 |   QPEAK     (cms)=   7.36 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   8.25
--------------------   VOLUME     (mm)=  69.30
  Filename: NRWDUN50.TXT
  Comments:

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

--------------------------------------------------------------------------------
*                   Route through SWMF
--------------------
| RESERVOIR (0001) |
| IN= 1---> OUT= 2 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                           .000        .000    |     .843       .705
                           .025        .106    |    1.457       .937
                           .076        .164    |    1.693      1.016
                           .183        .287    |    2.204      1.180
                           .286        .418    |    3.059      1.436
                           .539        .557    |     .000       .000

                                  AREA     QPEAK     TPEAK       R.V.
                                  (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 1 (0001)     35.61      7.36      8.25      69.30
     OUTFLOW: ID= 2 (0001)     35.61      1.21      9.25      69.27

                    PEAK   FLOW   REDUCTION [Qout/Qin](%)= 16.46
```

TIME SHIFT OF PEAK FLOW (min)= 60.00
MAXIMUM STORAGE USED (ha.m.)= .84

SAVE HYD (0001)	AREA (ha)=	35.61
ID= 2 PCYC=804	QPEAK (cms)=	1.21 (i)
DT= 5.0 min	TPEAK (hrs)=	9.25
	VOLUME (mm)=	69.27

Filename: NRWDCN50.TXT
Comments:

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

CHICAGO STORM
Ptotal=100.59 mm

IDF curve parameters: A=1413.537
B= 5.262
C= .800
used in: INTENSITY = A / (t + B)^C

Duration of storm = 24.00 hrs
Storm time step = 5.00 min
Time to peak ratio = .33

The CORRELATION coefficient is = .9998

TIME (min)	INPUT INT. (mm/hr)	TAB. INT. (mm/hr)
5.	220.00	219.44
10.	163.80	159.74
15.	124.70	127.34
30.	82.60	81.75
60.	47.90	49.95
120.	29.60	29.65
360.	13.10	12.60
720.	7.10	7.28
1440.	4.20	4.19

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.08	.86	6.08	2.78	12.08	2.61	18.08	1.24
.17	.87	6.17	2.88	12.17	2.57	18.17	1.23
.25	.87	6.25	3.00	12.25	2.53	18.25	1.22
.33	.88	6.33	3.13	12.33	2.49	18.33	1.21
.42	.89	6.42	3.27	12.42	2.45	18.42	1.21
.50	.90	6.50	3.43	12.50	2.41	18.50	1.20
.58	.91	6.58	3.60	12.58	2.37	18.58	1.19
.67	.91	6.67	3.79	12.67	2.34	18.67	1.18
.75	.92	6.75	4.01	12.75	2.30	18.75	1.17
.83	.93	6.83	4.26	12.83	2.27	18.83	1.17
.92	.94	6.92	4.55	12.92	2.24	18.92	1.16
1.00	.95	7.00	4.89	13.00	2.21	19.00	1.15
1.08	.96	7.08	5.28	13.08	2.18	19.08	1.15
1.17	.97	7.17	5.76	13.17	2.15	19.17	1.14
1.25	.98	7.25	6.34	13.25	2.12	19.25	1.13
1.33	.99	7.33	7.06	13.33	2.09	19.33	1.13
1.42	1.00	7.42	8.00	13.42	2.06	19.42	1.12
1.50	1.01	7.50	9.27	13.50	2.04	19.50	1.11
1.58	1.02	7.58	11.06	13.58	2.01	19.58	1.11
1.67	1.03	7.67	13.83	13.67	1.99	19.67	1.10
1.75	1.04	7.75	18.66	13.75	1.96	19.75	1.09
1.83	1.05	7.83	29.20	13.83	1.94	19.83	1.09

1.92	1.06	7.92	69.14	13.92	1.92	19.92	1.08
2.00	1.08	8.00	219.44	14.00	1.90	20.00	1.07
2.08	1.09	8.08	89.53	14.08	1.87	20.08	1.07
2.17	1.10	8.17	48.85	14.17	1.85	20.17	1.06
2.25	1.11	8.25	33.26	14.25	1.83	20.25	1.06
2.33	1.13	8.33	25.20	14.33	1.81	20.33	1.05
2.42	1.14	8.42	20.31	14.42	1.79	20.42	1.04
2.50	1.16	8.50	17.05	14.50	1.77	20.50	1.04
2.58	1.17	8.58	14.72	14.58	1.76	20.58	1.03
2.67	1.18	8.67	12.98	14.67	1.74	20.67	1.03
2.75	1.20	8.75	11.62	14.75	1.72	20.75	1.02
2.83	1.22	8.83	10.54	14.83	1.70	20.83	1.02
2.92	1.23	8.92	9.65	14.92	1.69	20.92	1.01
3.00	1.25	9.00	8.91	15.00	1.67	21.00	1.01
3.08	1.27	9.08	8.28	15.08	1.65	21.08	1.00
3.17	1.28	9.17	7.74	15.17	1.64	21.17	1.00
3.25	1.30	9.25	7.28	15.25	1.62	21.25	.99
3.33	1.32	9.33	6.87	15.33	1.61	21.33	.99
3.42	1.34	9.42	6.51	15.42	1.59	21.42	.98
3.50	1.36	9.50	6.18	15.50	1.58	21.50	.98
3.58	1.38	9.58	5.89	15.58	1.56	21.58	.97
3.67	1.40	9.67	5.63	15.67	1.55	21.67	.97
3.75	1.43	9.75	5.40	15.75	1.54	21.75	.96
3.83	1.45	9.83	5.18	15.83	1.52	21.83	.96
3.92	1.48	9.92	4.98	15.92	1.51	21.92	.95
4.00	1.50	10.00	4.80	16.00	1.50	22.00	.95
4.08	1.53	10.08	4.63	16.08	1.48	22.08	.94
4.17	1.55	10.17	4.48	16.17	1.47	22.17	.94
4.25	1.58	10.25	4.34	16.25	1.46	22.25	.93
4.33	1.61	10.33	4.20	16.33	1.45	22.33	.93
4.42	1.64	10.42	4.08	16.42	1.43	22.42	.93
4.50	1.68	10.50	3.96	16.50	1.42	22.50	.92
4.58	1.71	10.58	3.85	16.58	1.41	22.58	.92
4.67	1.74	10.67	3.75	16.67	1.40	22.67	.91
4.75	1.78	10.75	3.65	16.75	1.39	22.75	.91
4.83	1.82	10.83	3.56	16.83	1.38	22.83	.90
4.92	1.86	10.92	3.47	16.92	1.37	22.92	.90
5.00	1.90	11.00	3.39	17.00	1.36	23.00	.90
5.08	1.95	11.08	3.31	17.08	1.35	23.08	.89
5.17	2.00	11.17	3.24	17.17	1.34	23.17	.89
5.25	2.05	11.25	3.17	17.25	1.33	23.25	.88
5.33	2.10	11.33	3.10	17.33	1.32	23.33	.88
5.42	2.16	11.42	3.04	17.42	1.31	23.42	.88
5.50	2.22	11.50	2.97	17.50	1.30	23.50	.87
5.58	2.28	11.58	2.92	17.58	1.29	23.58	.87
5.67	2.35	11.67	2.86	17.67	1.28	23.67	.86
5.75	2.42	11.75	2.81	17.75	1.27	23.75	.86
5.83	2.50	11.83	2.75	17.83	1.26	23.83	.86
5.92	2.59	11.92	2.71	17.92	1.25	23.92	.85
6.00	2.68	12.00	2.66	18.00	1.25	24.00	.85

---

* Pre-Development, 88 acre area (=35.61ha)

CALIB			
NASHYD (0001)	Area (ha)= 35.61	Curve Number (CN)= 72.0	
ID= 1 DT= 5.0 min	Ia (mm)= 5.00	# of Linear Res.(N)= 3.00	
	U.H. Tp(hrs)= .71		

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

Unit Hyd Qpeak (cms)= 1.92

```
     PEAK FLOW       (cms)=   1.62 (i)
     TIME TO PEAK    (hrs)=   8.83
     RUNOFF VOLUME    (mm)=  46.95
     TOTAL RAINFALL   (mm)= 100.59
     RUNOFF COEFFICIENT   =    .47

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

--------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  35.61
| ID= 1   PCYC=320 |   QPEAK     (cms)=   1.62 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   8.83
--------------------   VOLUME     (mm)=  46.95
  Filename: NRWDPR00.TXT
  Comments:

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

--------------------------------------------------------------------------------
*                   Post-Development
--------------------
| CALIB            |
| STANDHYD  (0001) |   Area    (ha)=  35.61
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  50.00
--------------------
                            IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      21.37         14.24
     Dep. Storage     (mm)=       2.00          5.00
     Average Slope     (%)=       2.00          2.00
     Length            (m)=     487.00        487.00
     Mannings n             =       .013          .250

     Max.eff.Inten.(mm/hr)=     154.49         43.81
               over (min)       10.00         45.00
     Storage Coeff.  (min)=       4.51 (ii)    48.49 (ii)
     Unit Hyd. Tpeak (min)=       5.00         50.00
     Unit Hyd. peak  (cms)=        .23           .02
                                                      *TOTALS*
     PEAK FLOW       (cms)=       8.16           .99          8.30 (iii)
     TIME TO PEAK    (hrs)=       8.25          9.08          8.25
     RUNOFF VOLUME    (mm)=      98.52         56.72         77.61
     TOTAL RAINFALL   (mm)=     100.59        100.59        100.59
     RUNOFF COEFFICIENT   =        .98           .56           .77

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

       (i) CN PROCEDURE SELECTED FOR RAINFALL LOSSES:
            CN*  =  75.0    Ia = Dep. Storage  (Above)
      (ii) COMPUTATIONAL TIME STEP SHOULD BE SMALL OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  35.61
| ID= 1   PCYC=331 |   QPEAK     (cms)=   8.30 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   8.25
--------------------   VOLUME     (mm)=  77.61
  Filename: NRWDUN00.TXT
  Comments:

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

```
--------------------------------------------------------------------------------
*                    Route through SWMF
--------------------
| RESERVOIR (0001) |
| IN= 1---> OUT= 2 |
| DT=  5.0 min     |      OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
--------------------       (cms)     (ha.m.)    |   (cms)     (ha.m.)
                            .000        .000     |     .843       .705
                            .025        .106     |    1.457       .937
                            .076        .164     |    1.693      1.016
                            .183        .287     |    2.204      1.180
                            .286        .418     |    3.059      1.436
                            .539        .557     |     .000       .000

                                    AREA     QPEAK     TPEAK       R.V.
                                    (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 1 (0001)     35.61      8.30      8.25      77.61
     OUTFLOW: ID= 2 (0001)     35.61      1.45      9.17      77.58

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 17.50
                   TIME SHIFT OF PEAK FLOW         (min)= 55.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=   .93

--------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  35.61
| ID= 2   PCYC=807 |   QPEAK     (cms)=   1.45 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   9.17
--------------------   VOLUME     (mm)=  77.58
  Filename: NRWDCN00.TXT
  Comments:

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

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

 FINISH
================================================================================
```

APPENDIX H

OTTHYMO – 2 to 100Yr Event – Backwater Conditions

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

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    I N T E R H Y M O
       O   O    T      T    H   H   Y Y   MM MM  O   O   * * * 1989a * * *
       O   O    T      T    HHHHH    Y    M M M  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO             00002

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  Input   filename: nwdb.dat
  Output  filename: nwdb.out
  Summary filename: nwdb.sum



DATE: 11-06-2023                      TIME: 09:44:19


COMMENTS: _____________________________________________________________


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

*
*                   Norwood Subdivision
*
*                   Environment Canada Peterborough STP Station
*
*                   2 to 100-Yr Return Period
*                   November 6, 2023
*                   Andrew Rosenthal, EIT
*
*                   LGI, LGP from L=SQRT(A/1.5)
*
*                   November SWMF R6
*                    Backwater conditions
*
*******************************************************************************
*                   2 to 100 Year Storm
*******************************************************************************
--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 814.343
| Ptotal= 44.49 mm |                          B=   9.596
--------------------                          C=    .836
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  = 24.00 hrs
                        Storm time step    =  5.00 min
                        Time to peak ratio =   .33

                    The CORRELATION coefficient is =  .9998

                     TIME       INPUT INT.           TAB. INT.
                    (min)        (mm/hr)              (mm/hr)
                       5.          86.80                86.60
                      10.          68.20                67.69
                      15.          56.60                55.98
```

30.	36.60	37.60
60.	22.80	23.46
120.	14.00	13.95
360.	6.10	5.81
720.	3.30	3.29
1440.	1.80	1.85

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.08	.32	6.08	1.13	12.08	1.06	18.08	.47
.17	.32	6.17	1.18	12.17	1.04	18.17	.47
.25	.32	6.25	1.23	12.25	1.02	18.25	.46
.33	.33	6.33	1.29	12.33	1.00	18.33	.46
.42	.33	6.42	1.35	12.42	.98	18.42	.46
.50	.33	6.50	1.43	12.50	.97	18.50	.45
.58	.34	6.58	1.51	12.58	.95	18.58	.45
.67	.34	6.67	1.60	12.67	.93	18.67	.45
.75	.34	6.75	1.70	12.75	.92	18.75	.44
.83	.35	6.83	1.82	12.83	.90	18.83	.44
.92	.35	6.92	1.96	12.92	.89	18.92	.44
1.00	.35	7.00	2.12	13.00	.88	19.00	.43
1.08	.36	7.08	2.32	13.08	.86	19.08	.43
1.17	.36	7.17	2.55	13.17	.85	19.17	.43
1.25	.36	7.25	2.85	13.25	.84	19.25	.43
1.33	.37	7.33	3.22	13.33	.83	19.33	.42
1.42	.37	7.42	3.71	13.42	.82	19.42	.42
1.50	.38	7.50	4.39	13.50	.80	19.50	.42
1.58	.38	7.58	5.37	13.58	.79	19.58	.42
1.67	.39	7.67	6.90	13.67	.78	19.67	.41
1.75	.39	7.75	9.61	13.75	.77	19.75	.41
1.83	.39	7.83	15.47	13.83	.76	19.83	.41
1.92	.40	7.92	35.06	13.92	.75	19.92	.41
2.00	.40	8.00	86.60	14.00	.74	20.00	.40
2.08	.41	8.08	44.32	14.08	.73	20.08	.40
2.17	.41	8.17	25.85	14.17	.73	20.17	.40
2.25	.42	8.25	17.71	14.25	.72	20.25	.40
2.33	.42	8.33	13.27	14.33	.71	20.33	.39
2.42	.43	8.42	10.54	14.42	.70	20.42	.39
2.50	.44	8.50	8.70	14.50	.69	20.50	.39
2.58	.44	8.58	7.39	14.58	.68	20.58	.39
2.67	.45	8.67	6.42	14.67	.68	20.67	.38
2.75	.45	8.75	5.67	14.75	.67	20.75	.38
2.83	.46	8.83	5.08	14.83	.66	20.83	.38
2.92	.47	8.92	4.59	14.92	.65	20.92	.38
3.00	.47	9.00	4.20	15.00	.65	21.00	.38
3.08	.48	9.08	3.86	15.08	.64	21.08	.37
3.17	.49	9.17	3.58	15.17	.63	21.17	.37
3.25	.50	9.25	3.33	15.25	.63	21.25	.37
3.33	.50	9.33	3.12	15.33	.62	21.33	.37
3.42	.51	9.42	2.94	15.42	.62	21.42	.37
3.50	.52	9.50	2.77	15.50	.61	21.50	.36
3.58	.53	9.58	2.62	15.58	.60	21.58	.36
3.67	.54	9.67	2.49	15.67	.60	21.67	.36
3.75	.55	9.75	2.37	15.75	.59	21.75	.36
3.83	.56	9.83	2.27	15.83	.59	21.83	.36
3.92	.57	9.92	2.17	15.92	.58	21.92	.35
4.00	.58	10.00	2.08	16.00	.58	22.00	.35
4.08	.59	10.08	2.00	16.08	.57	22.08	.35
4.17	.60	10.17	1.92	16.17	.56	22.17	.35
4.25	.61	10.25	1.86	16.25	.56	22.25	.35
4.33	.62	10.33	1.79	16.33	.55	22.33	.35
4.42	.64	10.42	1.73	16.42	.55	22.42	.34
4.50	.65	10.50	1.68	16.50	.55	22.50	.34

4.58	.66	10.58	1.62	16.58	.54	22.58	.34
4.67	.68	10.67	1.58	16.67	.54	22.67	.34
4.75	.70	10.75	1.53	16.75	.53	22.75	.34
4.83	.71	10.83	1.49	16.83	.53	22.83	.34
4.92	.73	10.92	1.45	16.92	.52	22.92	.33
5.00	.75	11.00	1.41	17.00	.52	23.00	.33
5.08	.77	11.08	1.37	17.08	.51	23.08	.33
5.17	.79	11.17	1.34	17.17	.51	23.17	.33
5.25	.81	11.25	1.31	17.25	.51	23.25	.33
5.33	.83	11.33	1.28	17.33	.50	23.33	.33
5.42	.86	11.42	1.25	17.42	.50	23.42	.32
5.50	.88	11.50	1.22	17.50	.49	23.50	.32
5.58	.91	11.58	1.19	17.58	.49	23.58	.32
5.67	.94	11.67	1.17	17.67	.49	23.67	.32
5.75	.97	11.75	1.14	17.75	.48	23.75	.32
5.83	1.01	11.83	1.12	17.83	.48	23.83	.32
5.92	1.04	11.92	1.10	17.92	.48	23.92	.32
6.00	1.09	12.00	1.08	18.00	.47	24.00	.31

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* Pre-Development, 88 acre area (=35.61ha)

CALIB				
NASHYD (0001)	Area (ha)= 35.61	Curve Number (CN)= 72.0		
ID= 1 DT= 5.0 min	Ia (mm)= 5.00	# of Linear Res.(N)= 3.00		
	U.H. Tp(hrs)= .71			

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

Unit Hyd Qpeak (cms)= 1.92

PEAK FLOW (cms)= .37 (i)
TIME TO PEAK (hrs)= 8.92
RUNOFF VOLUME (mm)= 11.26
TOTAL RAINFALL (mm)= 44.49
RUNOFF COEFFICIENT = .25

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

SAVE HYD (0001)	AREA (ha)= 35.61
ID= 1 PCYC=312	QPEAK (cms)= .37 (i)
DT= 5.0 min	TPEAK (hrs)= 8.92
	VOLUME (mm)= 11.26

Filename: NRWDPR2.TXT
Comments:

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

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* Post-Development

CALIB		
STANDHYD (0001)	Area (ha)= 35.61	
ID= 1 DT= 5.0 min	Total Imp(%)= 60.00	Dir. Conn.(%)= 50.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	21.37	14.24
Dep. Storage	(mm)=	2.00	5.00
Average Slope	(%)=	2.00	2.00
Length	(m)=	487.00	487.00
Mannings n	=	.013	.250

```
     Max.eff.Inten.(mm/hr)=      65.46         6.91
               over (min)        10.00        95.00
     Storage Coeff.  (min)=       6.36 (ii)   98.45 (ii)
     Unit Hyd. Tpeak (min)=       5.00       100.00
     Unit Hyd. peak  (cms)=        .19          .01
                                                          *TOTALS*
     PEAK FLOW       (cms)=       2.89          .15          2.89 (iii)
     TIME TO PEAK    (hrs)=       8.33        10.08          8.33
     RUNOFF VOLUME    (mm)=      42.46        15.13         28.78
     TOTAL RAINFALL   (mm)=      44.49        44.49         44.49
     RUNOFF COEFFICIENT   =        .95          .34           .65


       (i) CN PROCEDURE SELECTED FOR RAINFALL LOSSES:
            CN*  =  75.0    Ia = Dep. Storage  (Above)
      (ii) COMPUTATIONAL TIME STEP SHOULD BE SMALL OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  35.61
| ID= 1   PCYC=349 |   QPEAK     (cms)=   2.89 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   8.33
--------------------   VOLUME     (mm)=  28.78
  Filename: NRWDUN2.TXT
  Comments:

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

--------------------------------------------------------------------------------
*                    Route through SWMF
--------------------
| RESERVOIR (0001) |
| IN= 1---> OUT= 2 |
| DT=  5.0 min     |     OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)    |   (cms)     (ha.m.)
                            .000       .000     |     .915       .772
                            .001       .393     |    1.152       .852
                            .062       .466     |    1.400       .934
                            .199       .541     |    1.658      1.016
                            .430       .617     |    1.926      1.100
                            .687       .694     |    2.206      1.185

                                  AREA     QPEAK     TPEAK       R.V.
                                  (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 1 (0001)     35.61      2.89      8.33       28.78
     OUTFLOW: ID= 2 (0001)     35.61       .23     10.58       18.20

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=  8.10
                   TIME SHIFT OF PEAK FLOW         (min)=135.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=   .55

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--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  35.61
| ID= 2   PCYC=459 |   QPEAK     (cms)=    .23 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=  10.58
--------------------   VOLUME     (mm)=  18.20
  Filename: NRWDCN2.TXT
  Comments:

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

CHICAGO STORM Ptotal= 59.75 mm

IDF curve parameters: A= 958.292
B= 7.538
C= .818
used in: INTENSITY = A / (t + B)^C

Duration of storm = 24.00 hrs
Storm time step = 5.00 min
Time to peak ratio = .33

The CORRELATION coefficient is = .9999

TIME (min)	INPUT INT. (mm/hr)	TAB. INT. (mm/hr)
5.	122.50	121.10
10.	93.80	92.03
15.	74.80	74.96
30.	48.90	49.38
60.	29.50	30.54
120.	18.10	18.16
360.	8.00	7.64
720.	4.30	4.37
1440.	2.50	2.49

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.08	.47	6.08	1.59	12.08	1.49	18.08	.68
.17	.47	6.17	1.65	12.17	1.46	18.17	.68
.25	.48	6.25	1.72	12.25	1.44	18.25	.67
.33	.48	6.33	1.80	12.33	1.41	18.33	.67
.42	.49	6.42	1.88	12.42	1.39	18.42	.66
.50	.49	6.50	1.98	12.50	1.37	18.50	.66
.58	.49	6.58	2.08	12.58	1.34	18.58	.66
.67	.50	6.67	2.20	12.67	1.32	18.67	.65
.75	.50	6.75	2.34	12.75	1.30	18.75	.65
.83	.51	6.83	2.49	12.83	1.28	18.83	.64
.92	.51	6.92	2.67	12.92	1.26	18.92	.64
1.00	.52	7.00	2.88	13.00	1.25	19.00	.63
1.08	.52	7.08	3.13	13.08	1.23	19.08	.63
1.17	.53	7.17	3.43	13.17	1.21	19.17	.63
1.25	.54	7.25	3.80	13.25	1.19	19.25	.62
1.33	.54	7.33	4.27	13.33	1.18	19.33	.62
1.42	.55	7.42	4.88	13.42	1.16	19.42	.62
1.50	.55	7.50	5.71	13.50	1.15	19.50	.61
1.58	.56	7.58	6.91	13.58	1.13	19.58	.61
1.67	.56	7.67	8.76	13.67	1.12	19.67	.60
1.75	.57	7.75	12.04	13.75	1.10	19.75	.60
1.83	.58	7.83	19.17	13.83	1.09	19.83	.60
1.92	.58	7.92	44.45	13.92	1.08	19.92	.59
2.00	.59	8.00	121.10	14.00	1.06	20.00	.59
2.08	.60	8.08	56.81	14.08	1.05	20.08	.59
2.17	.61	8.17	32.14	14.17	1.04	20.17	.58
2.25	.61	8.25	21.91	14.25	1.03	20.25	.58
2.33	.62	8.33	16.48	14.33	1.02	20.33	.58
2.42	.63	8.42	13.16	14.42	1.00	20.42	.57
2.50	.64	8.50	10.95	14.50	.99	20.50	.57
2.58	.64	8.58	9.37	14.58	.98	20.58	.57
2.67	.65	8.67	8.19	14.67	.97	20.67	.56
2.75	.66	8.75	7.28	14.75	.96	20.75	.56
2.83	.67	8.83	6.55	14.83	.95	20.83	.56
2.92	.68	8.92	5.96	14.92	.94	20.92	.55

3.00	.69	9.00	5.48	15.00	.93	21.00	.55
3.08	.70	9.08	5.06	15.08	.92	21.08	.55
3.17	.71	9.17	4.71	15.17	.91	21.17	.55
3.25	.72	9.25	4.41	15.25	.90	21.25	.54
3.33	.73	9.33	4.14	15.33	.90	21.33	.54
3.42	.74	9.42	3.91	15.42	.89	21.42	.54
3.50	.75	9.50	3.70	15.50	.88	21.50	.53
3.58	.77	9.58	3.52	15.58	.87	21.58	.53
3.67	.78	9.67	3.35	15.67	.86	21.67	.53
3.75	.79	9.75	3.20	15.75	.85	21.75	.53
3.83	.81	9.83	3.07	15.83	.85	21.83	.52
3.92	.82	9.92	2.94	15.92	.84	21.92	.52
4.00	.83	10.00	2.83	16.00	.83	22.00	.52
4.08	.85	10.08	2.73	16.08	.82	22.08	.52
4.17	.87	10.17	2.63	16.17	.82	22.17	.51
4.25	.88	10.25	2.54	16.25	.81	22.25	.51
4.33	.90	10.33	2.46	16.33	.80	22.33	.51
4.42	.92	10.42	2.38	16.42	.80	22.42	.51
4.50	.94	10.50	2.31	16.50	.79	22.50	.50
4.58	.96	10.58	2.24	16.58	.78	22.58	.50
4.67	.98	10.67	2.18	16.67	.78	22.67	.50
4.75	1.00	10.75	2.12	16.75	.77	22.75	.50
4.83	1.02	10.83	2.06	16.83	.76	22.83	.49
4.92	1.04	10.92	2.01	16.92	.76	22.92	.49
5.00	1.07	11.00	1.96	17.00	.75	23.00	.49
5.08	1.10	11.08	1.91	17.08	.75	23.08	.49
5.17	1.12	11.17	1.86	17.17	.74	23.17	.48
5.25	1.15	11.25	1.82	17.25	.74	23.25	.48
5.33	1.18	11.33	1.78	17.33	.73	23.33	.48
5.42	1.22	11.42	1.74	17.42	.72	23.42	.48
5.50	1.25	11.50	1.70	17.50	.72	23.50	.48
5.58	1.29	11.58	1.67	17.58	.71	23.58	.47
5.67	1.33	11.67	1.64	17.67	.71	23.67	.47
5.75	1.38	11.75	1.60	17.75	.70	23.75	.47
5.83	1.42	11.83	1.57	17.83	.70	23.83	.47
5.92	1.47	11.92	1.54	17.92	.69	23.92	.47
6.00	1.53	12.00	1.51	18.00	.69	24.00	.46

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* Pre-Development, 88 acre area (=35.61ha)

CALIB					
NASHYD (0001)	Area (ha)= 35.61	Curve Number (CN)= 72.0
ID= 1 DT= 5.0 min	Ia (mm)= 5.00	# of Linear Res.(N)= 3.00
	U.H. Tp(hrs)= .71	

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

Unit Hyd Qpeak (cms)= 1.92

PEAK FLOW (cms)= .65 (i)
TIME TO PEAK (hrs)= 8.92
RUNOFF VOLUME (mm)= 19.50
TOTAL RAINFALL (mm)= 59.75
RUNOFF COEFFICIENT = .33

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

SAVE HYD (0001)	AREA (ha)= 35.61
ID= 1 PCYC=316	QPEAK (cms)= .65 (i)
DT= 5.0 min	TPEAK (hrs)= 8.92

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--------------------   VOLUME     (mm)=  19.50
  Filename: NRWDPR5.TXT
  Comments:

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

--------------------------------------------------------------------------------
*                   Post-Development
--------------------
| CALIB            |
| STANDHYD  (0001) |   Area    (ha)=  35.61
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  50.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      21.37        14.24
     Dep. Storage     (mm)=       2.00         5.00
     Average Slope     (%)=       2.00         2.00
     Length            (m)=     487.00       487.00
     Mannings n             =       .013         .250

     Max.eff.Inten.(mm/hr)=      88.96        14.10
               over (min)        10.00        70.00
     Storage Coeff.  (min)=       5.62 (ii)   74.84 (ii)
     Unit Hyd. Tpeak (min)=       5.00        75.00
     Unit Hyd. peak  (cms)=        .20          .02
                                                      *TOTALS*
     PEAK FLOW       (cms)=       4.19          .31          4.21 (iii)
     TIME TO PEAK    (hrs)=       8.25         9.58          8.25
     RUNOFF VOLUME    (mm)=      57.71        25.14         41.41
     TOTAL RAINFALL   (mm)=      59.75        59.75         59.75
     RUNOFF COEFFICIENT   =        .97          .42           .69


       (i) CN PROCEDURE SELECTED FOR RAINFALL LOSSES:
            CN*  =  75.0    Ia = Dep. Storage  (Above)
      (ii) COMPUTATIONAL TIME STEP SHOULD BE SMALL OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  35.61
| ID= 1   PCYC=342 |   QPEAK     (cms)=   4.21 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   8.25
--------------------   VOLUME     (mm)=  41.41
  Filename: NRWDUN5.TXT
  Comments:

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

--------------------------------------------------------------------------------
*                   Route through SWMF
--------------------
| RESERVOIR (0001) |
| IN= 1---> OUT= 2 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          .000        .000    |     .915       .772
                          .001        .393    |    1.152       .852
                          .062        .466    |    1.400       .934
                          .199        .541    |    1.658      1.016
                          .430        .617    |    1.926      1.100
                          .687        .694    |    2.206      1.185
```

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 1 (0001)	35.61	4.21	8.25	41.41
OUTFLOW: ID= 2 (0001)	35.61	.52	9.58	30.82

PEAK FLOW REDUCTION [Qout/Qin](%)= 12.37
TIME SHIFT OF PEAK FLOW (min)= 80.00
MAXIMUM STORAGE USED (ha.m.)= .64

SAVE HYD (0001)	AREA (ha)= 35.61
ID= 2 PCYC=470	QPEAK (cms)= .52 (i)
DT= 5.0 min	TPEAK (hrs)= 9.58
	VOLUME (mm)= 30.82

Filename: NRWDCN5.TXT
Comments:

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

CHICAGO STORM
Ptotal= 70.31 mm

IDF curve parameters: A=1025.220
B= 6.188
C= .805
used in: INTENSITY = A / (t + B)^C

Duration of storm = 24.00 hrs
Storm time step = 5.00 min
Time to peak ratio = .33

The CORRELATION coefficient is = .9999

TIME (min)	INPUT INT. (mm/hr)	TAB. INT. (mm/hr)
5.	146.10	146.75
10.	110.80	109.00
15.	86.90	87.76
30.	57.10	57.04
60.	34.00	35.08
120.	20.90	20.87
360.	9.20	8.85
720.	5.00	5.10
1440.	2.90	2.93

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.08	.59	6.08	1.93	12.08	1.81	18.08	.85
.17	.59	6.17	2.00	12.17	1.78	18.17	.84
.25	.60	6.25	2.08	12.25	1.75	18.25	.84
.33	.60	6.33	2.17	12.33	1.72	18.33	.83
.42	.61	6.42	2.27	12.42	1.69	18.42	.83
.50	.61	6.50	2.38	12.50	1.67	18.50	.82
.58	.62	6.58	2.51	12.58	1.64	18.58	.82
.67	.62	6.67	2.65	12.67	1.62	18.67	.81
.75	.63	6.75	2.80	12.75	1.59	18.75	.81
.83	.64	6.83	2.98	12.83	1.57	18.83	.80
.92	.64	6.92	3.19	12.92	1.55	18.92	.80
1.00	.65	7.00	3.43	13.00	1.52	19.00	.79
1.08	.66	7.08	3.71	13.08	1.50	19.08	.79
1.17	.66	7.17	4.05	13.17	1.48	19.17	.78
1.25	.67	7.25	4.47	13.25	1.46	19.25	.78
1.33	.68	7.33	4.99	13.33	1.44	19.33	.77

1.42	.68	7.42	5.67	13.42	1.42	19.42	.77
1.50	.69	7.50	6.59	13.50	1.41	19.50	.76
1.58	.70	7.58	7.90	13.58	1.39	19.58	.76
1.67	.70	7.67	9.94	13.67	1.37	19.67	.75
1.75	.71	7.75	13.49	13.75	1.36	19.75	.75
1.83	.72	7.83	21.24	13.83	1.34	19.83	.74
1.92	.73	7.92	49.73	13.92	1.32	19.92	.74
2.00	.74	8.00	146.75	14.00	1.31	20.00	.74
2.08	.75	8.08	64.01	14.08	1.29	20.08	.73
2.17	.75	8.17	35.52	14.17	1.28	20.17	.73
2.25	.76	8.25	24.22	14.25	1.26	20.25	.72
2.33	.77	8.33	18.30	14.33	1.25	20.33	.72
2.42	.78	8.42	14.71	14.42	1.24	20.42	.72
2.50	.79	8.50	12.30	14.50	1.22	20.50	.71
2.58	.80	8.58	10.59	14.58	1.21	20.58	.71
2.67	.81	8.67	9.31	14.67	1.20	20.67	.70
2.75	.82	8.75	8.31	14.75	1.18	20.75	.70
2.83	.83	8.83	7.52	14.83	1.17	20.83	.70
2.92	.85	8.92	6.87	14.92	1.16	20.92	.69
3.00	.86	9.00	6.33	15.00	1.15	21.00	.69
3.08	.87	9.08	5.88	15.08	1.14	21.08	.69
3.17	.88	9.17	5.48	15.17	1.13	21.17	.68
3.25	.89	9.25	5.15	15.25	1.12	21.25	.68
3.33	.91	9.33	4.85	15.33	1.11	21.33	.67
3.42	.92	9.42	4.59	15.42	1.10	21.42	.67
3.50	.94	9.50	4.36	15.50	1.09	21.50	.67
3.58	.95	9.58	4.15	15.58	1.08	21.58	.66
3.67	.97	9.67	3.96	15.67	1.07	21.67	.66
3.75	.98	9.75	3.79	15.75	1.06	21.75	.66
3.83	1.00	9.83	3.64	15.83	1.05	21.83	.65
3.92	1.01	9.92	3.49	15.92	1.04	21.92	.65
4.00	1.03	10.00	3.36	16.00	1.03	22.00	.65
4.08	1.05	10.08	3.24	16.08	1.02	22.08	.65
4.17	1.07	10.17	3.13	16.17	1.01	22.17	.64
4.25	1.09	10.25	3.03	16.25	1.00	22.25	.64
4.33	1.11	10.33	2.94	16.33	.99	22.33	.64
4.42	1.13	10.42	2.85	16.42	.99	22.42	.63
4.50	1.15	10.50	2.76	16.50	.98	22.50	.63
4.58	1.18	10.58	2.69	16.58	.97	22.58	.63
4.67	1.20	10.67	2.61	16.67	.96	22.67	.62
4.75	1.23	10.75	2.54	16.75	.95	22.75	.62
4.83	1.26	10.83	2.48	16.83	.95	22.83	.62
4.92	1.28	10.92	2.42	16.92	.94	22.92	.62
5.00	1.31	11.00	2.36	17.00	.93	23.00	.61
5.08	1.35	11.08	2.30	17.08	.93	23.08	.61
5.17	1.38	11.17	2.25	17.17	.92	23.17	.61
5.25	1.41	11.25	2.20	17.25	.91	23.25	.60
5.33	1.45	11.33	2.15	17.33	.91	23.33	.60
5.42	1.49	11.42	2.11	17.42	.90	23.42	.60
5.50	1.53	11.50	2.06	17.50	.89	23.50	.60
5.58	1.58	11.58	2.02	17.58	.89	23.58	.59
5.67	1.63	11.67	1.98	17.67	.88	23.67	.59
5.75	1.68	11.75	1.95	17.75	.87	23.75	.59
5.83	1.73	11.83	1.91	17.83	.87	23.83	.59
5.92	1.79	11.92	1.88	17.92	.86	23.92	.58
6.00	1.86	12.00	1.84	18.00	.86	24.00	.58

---

* Pre-Development, 88 acre area (=35.61ha)

CALIB			
NASHYD (0001)	Area (ha)= 35.61	Curve Number (CN)= 72.0	
ID= 1 DT= 5.0 min	Ia (mm)= 5.00	# of Linear Res.(N)= 3.00	

```
--------------------   U.H. Tp(hrs)=    .71

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.

     Unit Hyd Qpeak  (cms)=   1.92

     PEAK FLOW       (cms)=    .86 (i)
     TIME TO PEAK    (hrs)=   8.83
     RUNOFF VOLUME    (mm)=  25.96
     TOTAL RAINFALL   (mm)=  70.31
     RUNOFF COEFFICIENT   =    .37

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

-------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  35.61
| ID= 1   PCYC=317 |   QPEAK     (cms)=    .86 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   8.83
--------------------   VOLUME     (mm)=  25.96
  Filename: NRWDPR10.TXT
  Comments:

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

-------------------------------------------------------------------------------
*                   Post-Development
--------------------
| CALIB            |
| STANDHYD  (0001) |   Area    (ha)=  35.61
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  50.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      21.37        14.24
     Dep. Storage     (mm)=       2.00         5.00
     Average Slope     (%)=       2.00         2.00
     Length            (m)=     487.00       487.00
     Mannings n           =       .013         .250

     Max.eff.Inten.(mm/hr)=     105.38        20.21
               over (min)        10.00        60.00
     Storage Coeff.  (min)=       5.25 (ii)   65.19 (ii)
     Unit Hyd. Tpeak (min)=       5.00        70.00
     Unit Hyd. peak  (cms)=        .21          .02
                                                      *TOTALS*
     PEAK FLOW       (cms)=       5.17          .44          5.21 (iii)
     TIME TO PEAK    (hrs)=       8.25         9.42          8.25
     RUNOFF VOLUME    (mm)=      68.27        32.77         50.51
     TOTAL RAINFALL   (mm)=      70.31        70.31         70.31
     RUNOFF COEFFICIENT   =        .97          .47           .72


       (i) CN PROCEDURE SELECTED FOR RAINFALL LOSSES:
            CN*  =  75.0    Ia = Dep. Storage  (Above)
      (ii) COMPUTATIONAL TIME STEP SHOULD BE SMALL OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  35.61
| ID= 1   PCYC=339 |   QPEAK     (cms)=   5.21 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   8.25
--------------------   VOLUME     (mm)=  50.51
```

```
  Filename: NRWDUN10.TXT
  Comments:

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

--------------------------------------------------------------------------------
*                    Route through SWMF
--------------------
| RESERVOIR (0001) |
| IN= 1---> OUT= 2 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                           .000       .000    |     .915       .772
                           .001       .393    |    1.152       .852
                           .062       .466    |    1.400       .934
                           .199       .541    |    1.658      1.016
                           .430       .617    |    1.926      1.100
                           .687       .694    |    2.206      1.185

                                  AREA     QPEAK     TPEAK       R.V.
                                  (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 1 (0001)     35.61      5.21      8.25      50.51
     OUTFLOW: ID= 2 (0001)     35.61       .73      9.42      39.91

                    PEAK   FLOW   REDUCTION [Qout/Qin](%)= 14.07
                    TIME SHIFT OF PEAK FLOW         (min)= 70.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=   .71

--------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  35.61
| ID= 2   PCYC=476 |   QPEAK     (cms)=    .73 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   9.42
--------------------   VOLUME     (mm)=  39.91
  Filename: NRWDCN10.TXT
  Comments:

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

--------------------------------------------------------------------------------
--------------------
| CHICAGO STORM    |    IDF curve parameters: A=1214.495
| Ptotal= 81.51 mm |                          B=   6.007
--------------------                          C=    .808
                         used in:   INTENSITY =  A / (t + B)^C

                         Duration of storm  = 24.00 hrs
                         Storm time step    =  5.00 min
                         Time to peak ratio =   .33

                    The CORRELATION coefficient is =  .9998

                     TIME       INPUT INT.           TAB. INT.
                    (min)        (mm/hr)              (mm/hr)
                       5.         175.90               174.87
                      10.         132.20               129.22
                      15.         102.10               103.74
                      30.          67.40                67.12
                      60.          39.60                41.13
                     120.          24.40                24.39
                     360.          10.80                10.31
                     720.           5.80                 5.93
                    1440.           3.40                 3.40
```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.08	.67	6.08	2.21	12.08	2.07	18.08	.97
.17	.68	6.17	2.29	12.17	2.04	18.17	.96
.25	.68	6.25	2.39	12.25	2.00	18.25	.96
.33	.69	6.33	2.49	12.33	1.97	18.33	.95
.42	.69	6.42	2.61	12.42	1.94	18.42	.94
.50	.70	6.50	2.73	12.50	1.91	18.50	.94
.58	.71	6.58	2.88	12.58	1.88	18.58	.93
.67	.71	6.67	3.03	12.67	1.85	18.67	.93
.75	.72	6.75	3.21	12.75	1.82	18.75	.92
.83	.73	6.83	3.42	12.83	1.80	18.83	.91
.92	.73	6.92	3.66	12.92	1.77	18.92	.91
1.00	.74	7.00	3.93	13.00	1.75	19.00	.90
1.08	.75	7.08	4.26	13.08	1.72	19.08	.90
1.17	.76	7.17	4.65	13.17	1.70	19.17	.89
1.25	.76	7.25	5.13	13.25	1.67	19.25	.89
1.33	.77	7.33	5.74	13.33	1.65	19.33	.88
1.42	.78	7.42	6.52	13.42	1.63	19.42	.88
1.50	.79	7.50	7.58	13.50	1.61	19.50	.87
1.58	.80	7.58	9.10	13.58	1.59	19.58	.87
1.67	.80	7.67	11.45	13.67	1.57	19.67	.86
1.75	.81	7.75	15.56	13.75	1.55	19.75	.86
1.83	.82	7.83	24.57	13.83	1.53	19.83	.85
1.92	.83	7.92	58.08	13.92	1.51	19.92	.85
2.00	.84	8.00	174.87	14.00	1.50	20.00	.84
2.08	.85	8.08	74.96	14.08	1.48	20.08	.84
2.17	.86	8.17	41.28	14.17	1.46	20.17	.83
2.25	.87	8.25	28.05	14.25	1.45	20.25	.83
2.33	.88	8.33	21.16	14.33	1.43	20.33	.82
2.42	.89	8.42	16.98	14.42	1.41	20.42	.82
2.50	.90	8.50	14.19	14.50	1.40	20.50	.81
2.58	.92	8.58	12.20	14.58	1.38	20.58	.81
2.67	.93	8.67	10.72	14.67	1.37	20.67	.80
2.75	.94	8.75	9.57	14.75	1.36	20.75	.80
2.83	.95	8.83	8.65	14.83	1.34	20.83	.80
2.92	.97	8.92	7.90	14.92	1.33	20.92	.79
3.00	.98	9.00	7.28	15.00	1.31	21.00	.79
3.08	.99	9.08	6.76	15.08	1.30	21.08	.78
3.17	1.01	9.17	6.31	15.17	1.29	21.17	.78
3.25	1.02	9.25	5.91	15.25	1.28	21.25	.77
3.33	1.04	9.33	5.57	15.33	1.26	21.33	.77
3.42	1.05	9.42	5.27	15.42	1.25	21.42	.77
3.50	1.07	9.50	5.00	15.50	1.24	21.50	.76
3.58	1.09	9.58	4.76	15.58	1.23	21.58	.76
3.67	1.10	9.67	4.55	15.67	1.22	21.67	.76
3.75	1.12	9.75	4.35	15.75	1.21	21.75	.75
3.83	1.14	9.83	4.17	15.83	1.20	21.83	.75
3.92	1.16	9.92	4.01	15.92	1.19	21.92	.74
4.00	1.18	10.00	3.86	16.00	1.18	22.00	.74
4.08	1.20	10.08	3.72	16.08	1.17	22.08	.74
4.17	1.22	10.17	3.60	16.17	1.16	22.17	.73
4.25	1.25	10.25	3.48	16.25	1.15	22.25	.73
4.33	1.27	10.33	3.37	16.33	1.14	22.33	.73
4.42	1.29	10.42	3.27	16.42	1.13	22.42	.72
4.50	1.32	10.50	3.17	16.50	1.12	22.50	.72
4.58	1.35	10.58	3.08	16.58	1.11	22.58	.72
4.67	1.38	10.67	3.00	16.67	1.10	22.67	.71
4.75	1.40	10.75	2.92	16.75	1.09	22.75	.71
4.83	1.44	10.83	2.84	16.83	1.08	22.83	.71
4.92	1.47	10.92	2.77	16.92	1.07	22.92	.70
5.00	1.50	11.00	2.70	17.00	1.07	23.00	.70
5.08	1.54	11.08	2.64	17.08	1.06	23.08	.70

5.17	1.58	11.17	2.58	17.17	1.05	23.17	.69
5.25	1.62	11.25	2.52	17.25	1.04	23.25	.69
5.33	1.66	11.33	2.47	17.33	1.03	23.33	.69
5.42	1.71	11.42	2.42	17.42	1.03	23.42	.68
5.50	1.76	11.50	2.37	17.50	1.02	23.50	.68
5.58	1.81	11.58	2.32	17.58	1.01	23.58	.68
5.67	1.86	11.67	2.27	17.67	1.01	23.67	.67
5.75	1.92	11.75	2.23	17.75	1.00	23.75	.67
5.83	1.98	11.83	2.19	17.83	.99	23.83	.67
5.92	2.05	11.92	2.15	17.92	.98	23.92	.67
6.00	2.13	12.00	2.11	18.00	.98	24.00	.66

---

* Pre-Development, 88 acre area (=35.61ha)

CALIB			
NASHYD (0001)	Area (ha)= 35.61	Curve Number (CN)= 72.0	
ID= 1 DT= 5.0 min	Ia (mm)= 5.00	# of Linear Res.(N)= 3.00	
	U.H. Tp(hrs)= .71		

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

Unit Hyd Qpeak (cms)= 1.92

PEAK FLOW (cms)= 1.14 (i)
TIME TO PEAK (hrs)= 8.83
RUNOFF VOLUME (mm)= 33.35
TOTAL RAINFALL (mm)= 81.51
RUNOFF COEFFICIENT = .41

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

SAVE HYD (0001)	AREA (ha)= 35.61
ID= 1 PCYC=319	QPEAK (cms)= 1.14 (i)
DT= 5.0 min	TPEAK (hrs)= 8.83
	VOLUME (mm)= 33.35

Filename: NRWDPR25.TXT
Comments:

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

---

* Post-Development

CALIB			
STANDHYD (0001)	Area (ha)= 35.61		
ID= 1 DT= 5.0 min	Total Imp(%)= 60.00	Dir. Conn.(%)= 50.00	

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	21.37	14.24
Dep. Storage	(mm)=	2.00	5.00
Average Slope	(%)=	2.00	2.00
Length	(m)=	487.00	487.00
Mannings n	=	.013	.250
Max.eff.Inten.(mm/hr)=		124.92	27.76
over (min)		10.00	55.00
Storage Coeff. (min)=		4.91 (ii)	57.70 (ii)
Unit Hyd. Tpeak (min)=		5.00	60.00
Unit Hyd. peak (cms)=		.22	.02
			TOTALS

```
     PEAK FLOW       (cms)=       6.32          .63           6.39 (iii)
     TIME TO PEAK    (hrs)=       8.25         9.25           8.25
     RUNOFF VOLUME    (mm)=      79.45        41.32          60.37
     TOTAL RAINFALL   (mm)=      81.51        81.51          81.51
     RUNOFF COEFFICIENT   =        .97          .51            .74

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

       (i) CN PROCEDURE SELECTED FOR RAINFALL LOSSES:
            CN*  =  75.0    Ia = Dep. Storage  (Above)
      (ii) COMPUTATIONAL TIME STEP SHOULD BE SMALL OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  35.61
| ID= 1   PCYC=335 |   QPEAK     (cms)=   6.39 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   8.25
--------------------   VOLUME     (mm)=  60.37
  Filename: NRWDUN25.TXT
  Comments:

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

--------------------------------------------------------------------------------
*                   Route through SWMF
--------------------
| RESERVOIR (0001) |
| IN= 1---> OUT= 2 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                           .000       .000    |     .915       .772
                           .001       .393    |    1.152       .852
                           .062       .466    |    1.400       .934
                           .199       .541    |    1.658      1.016
                           .430       .617    |    1.926      1.100
                           .687       .694    |    2.206      1.185

                                  AREA     QPEAK     TPEAK       R.V.
                                  (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 1 (0001)     35.61      6.39      8.25      60.37
     OUTFLOW: ID= 2 (0001)     35.61      1.02      9.25      49.78

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 15.96
                   TIME SHIFT OF PEAK FLOW         (min)= 60.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=   .81

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--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  35.61
| ID= 2   PCYC=478 |   QPEAK     (cms)=   1.02 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   9.25
--------------------   VOLUME     (mm)=  49.78
  Filename: NRWDCN25.TXT
  Comments:

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

--------------------------------------------------------------------------------
--------------------
| CHICAGO STORM    |    IDF curve parameters: A=1275.807
| Ptotal= 91.45 mm |                          B=   5.262
--------------------                          C=    .799
```

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

Duration of storm = 24.00 hrs
Storm time step = 5.00 min
Time to peak ratio = .33

The CORRELATION coefficient is = .9999

TIME (min)	INPUT INT. (mm/hr)	TAB. INT. (mm/hr)
5.	198.10	198.52
10.	148.10	144.57
15.	113.40	115.28
30.	75.00	74.04
60.	43.80	45.28
120.	27.00	26.89
360.	12.00	11.44
720.	6.50	6.61
1440.	3.80	3.81

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.08	.78	6.08	2.53	12.08	2.38	18.08	1.13
.17	.79	6.17	2.63	12.17	2.34	18.17	1.12
.25	.80	6.25	2.74	12.25	2.30	18.25	1.12
.33	.80	6.33	2.85	12.33	2.27	18.33	1.11
.42	.81	6.42	2.98	12.42	2.23	18.42	1.10
.50	.82	6.50	3.12	12.50	2.20	18.50	1.09
.58	.83	6.58	3.28	12.58	2.16	18.58	1.09
.67	.83	6.67	3.46	12.67	2.13	18.67	1.08
.75	.84	6.75	3.66	12.75	2.10	18.75	1.07
.83	.85	6.83	3.89	12.83	2.07	18.83	1.07
.92	.86	6.92	4.15	12.92	2.04	18.92	1.06
1.00	.87	7.00	4.45	13.00	2.01	19.00	1.05
1.08	.88	7.08	4.81	13.08	1.99	19.08	1.05
1.17	.88	7.17	5.24	13.17	1.96	19.17	1.04
1.25	.89	7.25	5.77	13.25	1.93	19.25	1.03
1.33	.90	7.33	6.43	13.33	1.91	19.33	1.03
1.42	.91	7.42	7.28	13.42	1.88	19.42	1.02
1.50	.92	7.50	8.43	13.50	1.86	19.50	1.02
1.58	.93	7.58	10.07	13.58	1.84	19.58	1.01
1.67	.94	7.67	12.58	13.67	1.81	19.67	1.00
1.75	.95	7.75	16.96	13.75	1.79	19.75	1.00
1.83	.96	7.83	26.51	13.83	1.77	19.83	.99
1.92	.97	7.92	62.67	13.92	1.75	19.92	.99
2.00	.98	8.00	198.52	14.00	1.73	20.00	.98
2.08	.99	8.08	81.11	14.08	1.71	20.08	.98
2.17	1.01	8.17	44.31	14.17	1.69	20.17	.97
2.25	1.02	8.25	30.19	14.25	1.67	20.25	.96
2.33	1.03	8.33	22.89	14.33	1.65	20.33	.96
2.42	1.04	8.42	18.46	14.42	1.64	20.42	.95
2.50	1.05	8.50	15.50	14.50	1.62	20.50	.95
2.58	1.07	8.58	13.39	14.58	1.60	20.58	.94
2.67	1.08	8.67	11.80	14.67	1.59	20.67	.94
2.75	1.10	8.75	10.57	14.75	1.57	20.75	.93
2.83	1.11	8.83	9.59	14.83	1.55	20.83	.93
2.92	1.13	8.92	8.78	14.92	1.54	20.92	.92
3.00	1.14	9.00	8.11	15.00	1.52	21.00	.92
3.08	1.16	9.08	7.54	15.08	1.51	21.08	.91
3.17	1.17	9.17	7.05	15.17	1.49	21.17	.91
3.25	1.19	9.25	6.63	15.25	1.48	21.25	.91
3.33	1.21	9.33	6.25	15.33	1.47	21.33	.90
3.42	1.22	9.42	5.92	15.42	1.45	21.42	.90

3.50	1.24	9.50	5.63	15.50	1.44	21.50	.89
3.58	1.26	9.58	5.37	15.58	1.43	21.58	.89
3.67	1.28	9.67	5.13	15.67	1.41	21.67	.88
3.75	1.30	9.75	4.92	15.75	1.40	21.75	.88
3.83	1.32	9.83	4.72	15.83	1.39	21.83	.87
3.92	1.35	9.92	4.54	15.92	1.38	21.92	.87
4.00	1.37	10.00	4.38	16.00	1.37	22.00	.87
4.08	1.39	10.08	4.22	16.08	1.35	22.08	.86
4.17	1.42	10.17	4.08	16.17	1.34	22.17	.86
4.25	1.44	10.25	3.95	16.25	1.33	22.25	.85
4.33	1.47	10.33	3.83	16.33	1.32	22.33	.85
4.42	1.50	10.42	3.72	16.42	1.31	22.42	.85
4.50	1.53	10.50	3.61	16.50	1.30	22.50	.84
4.58	1.56	10.58	3.51	16.58	1.29	22.58	.84
4.67	1.59	10.67	3.42	16.67	1.28	22.67	.83
4.75	1.63	10.75	3.33	16.75	1.27	22.75	.83
4.83	1.66	10.83	3.24	16.83	1.26	22.83	.83
4.92	1.70	10.92	3.16	16.92	1.25	22.92	.82
5.00	1.74	11.00	3.09	17.00	1.24	23.00	.82
5.08	1.78	11.08	3.02	17.08	1.23	23.08	.81
5.17	1.82	11.17	2.95	17.17	1.22	23.17	.81
5.25	1.87	11.25	2.89	17.25	1.21	23.25	.81
5.33	1.92	11.33	2.83	17.33	1.20	23.33	.80
5.42	1.97	11.42	2.77	17.42	1.20	23.42	.80
5.50	2.02	11.50	2.71	17.50	1.19	23.50	.80
5.58	2.08	11.58	2.66	17.58	1.18	23.58	.79
5.67	2.14	11.67	2.61	17.67	1.17	23.67	.79
5.75	2.21	11.75	2.56	17.75	1.16	23.75	.79
5.83	2.28	11.83	2.51	17.83	1.15	23.83	.78
5.92	2.36	11.92	2.47	17.92	1.15	23.92	.78
6.00	2.44	12.00	2.42	18.00	1.14	24.00	.78

---

* Pre-Development, 88 acre area (=35.61ha)

CALIB			
NASHYD (0001)	Area (ha)= 35.61	Curve Number (CN)= 72.0	
ID= 1 DT= 5.0 min	Ia (mm)= 5.00	# of Linear Res.(N)= 3.00	
	U.H. Tp(hrs)= .71		

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

Unit Hyd Qpeak (cms)= 1.92

PEAK FLOW (cms)= 1.37 (i)
TIME TO PEAK (hrs)= 8.83
RUNOFF VOLUME (mm)= 40.30
TOTAL RAINFALL (mm)= 91.45
RUNOFF COEFFICIENT = .44

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

SAVE HYD (0001)	AREA (ha)= 35.61
ID= 1 PCYC=320	QPEAK (cms)= 1.37 (i)
DT= 5.0 min	TPEAK (hrs)= 8.83
	VOLUME (mm)= 40.30

Filename: NRWDPR50.TXT
Comments:

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

```
--------------------------------------------------------------------------------
*                   Post-Development
--------------------
| CALIB            |
| STANDHYD  (0001) |   Area    (ha)=  35.61
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  50.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      21.37         14.24
     Dep. Storage     (mm)=       2.00          5.00
     Average Slope     (%)=       2.00          2.00
     Length            (m)=     487.00        487.00
     Mannings n             =       .013          .250

     Max.eff.Inten.(mm/hr)=     139.82         34.95
                 over (min)       10.00         50.00
     Storage Coeff.  (min)=       4.69 (ii)    52.84 (ii)
     Unit Hyd. Tpeak (min)=       5.00         55.00
     Unit Hyd. peak  (cms)=        .22           .02
                                                        *TOTALS*
     PEAK FLOW       (cms)=       7.27           .79          7.36 (iii)
     TIME TO PEAK    (hrs)=       8.25          9.17          8.25
     RUNOFF VOLUME    (mm)=      89.39         49.23         69.30
     TOTAL RAINFALL   (mm)=      91.45         91.45         91.45
     RUNOFF COEFFICIENT   =        .98           .54           .76

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

       (i) CN PROCEDURE SELECTED FOR RAINFALL LOSSES:
            CN*  =  75.0    Ia = Dep. Storage  (Above)
      (ii) COMPUTATIONAL TIME STEP SHOULD BE SMALL OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  35.61
| ID= 1   PCYC=333 |   QPEAK     (cms)=   7.36 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   8.25
--------------------   VOLUME     (mm)=  69.30
  Filename: NRWDUN50.TXT
  Comments:

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

--------------------------------------------------------------------------------
*                   Route through SWMF
--------------------
| RESERVOIR (0001) |
| IN= 1---> OUT= 2 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                           .000        .000    |     .915       .772
                           .001        .393    |    1.152       .852
                           .062        .466    |    1.400       .934
                           .199        .541    |    1.658      1.016
                           .430        .617    |    1.926      1.100
                           .687        .694    |    2.206      1.185

                                  AREA     QPEAK     TPEAK       R.V.
                                  (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 1 (0001)     35.61      7.36      8.25      69.30
     OUTFLOW: ID= 2 (0001)     35.61      1.26      9.17      58.70
```

PEAK FLOW REDUCTION [Qout/Qin](%)= 17.12
TIME SHIFT OF PEAK FLOW (min)= 55.00
MAXIMUM STORAGE USED (ha.m.)= .89

SAVE HYD (0001)	AREA (ha)=	35.61
ID= 2 PCYC=481	QPEAK (cms)=	1.26 (i)
DT= 5.0 min	TPEAK (hrs)=	9.17
	VOLUME (mm)=	58.70

Filename: NRWDCN50.TXT
Comments:

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

CHICAGO STORM	IDF curve parameters:	A=1413.537
Ptotal=100.59 mm		B= 5.262
		C= .800

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

Duration of storm = 24.00 hrs
Storm time step = 5.00 min
Time to peak ratio = .33

The CORRELATION coefficient is = .9998

TIME (min)	INPUT INT. (mm/hr)	TAB. INT. (mm/hr)
5.	220.00	219.44
10.	163.80	159.74
15.	124.70	127.34
30.	82.60	81.75
60.	47.90	49.95
120.	29.60	29.65
360.	13.10	12.60
720.	7.10	7.28
1440.	4.20	4.19

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.08	.86	6.08	2.78	12.08	2.61	18.08	1.24
.17	.87	6.17	2.88	12.17	2.57	18.17	1.23
.25	.87	6.25	3.00	12.25	2.53	18.25	1.22
.33	.88	6.33	3.13	12.33	2.49	18.33	1.21
.42	.89	6.42	3.27	12.42	2.45	18.42	1.21
.50	.90	6.50	3.43	12.50	2.41	18.50	1.20
.58	.91	6.58	3.60	12.58	2.37	18.58	1.19
.67	.91	6.67	3.79	12.67	2.34	18.67	1.18
.75	.92	6.75	4.01	12.75	2.30	18.75	1.17
.83	.93	6.83	4.26	12.83	2.27	18.83	1.17
.92	.94	6.92	4.55	12.92	2.24	18.92	1.16
1.00	.95	7.00	4.89	13.00	2.21	19.00	1.15
1.08	.96	7.08	5.28	13.08	2.18	19.08	1.15
1.17	.97	7.17	5.76	13.17	2.15	19.17	1.14
1.25	.98	7.25	6.34	13.25	2.12	19.25	1.13
1.33	.99	7.33	7.06	13.33	2.09	19.33	1.13
1.42	1.00	7.42	8.00	13.42	2.06	19.42	1.12
1.50	1.01	7.50	9.27	13.50	2.04	19.50	1.11
1.58	1.02	7.58	11.06	13.58	2.01	19.58	1.11
1.67	1.03	7.67	13.83	13.67	1.99	19.67	1.10
1.75	1.04	7.75	18.66	13.75	1.96	19.75	1.09

1.83	1.05	7.83	29.20	13.83	1.94	19.83	1.09
1.92	1.06	7.92	69.14	13.92	1.92	19.92	1.08
2.00	1.08	8.00	219.44	14.00	1.90	20.00	1.07
2.08	1.09	8.08	89.53	14.08	1.87	20.08	1.07
2.17	1.10	8.17	48.85	14.17	1.85	20.17	1.06
2.25	1.11	8.25	33.26	14.25	1.83	20.25	1.06
2.33	1.13	8.33	25.20	14.33	1.81	20.33	1.05
2.42	1.14	8.42	20.31	14.42	1.79	20.42	1.04
2.50	1.16	8.50	17.05	14.50	1.77	20.50	1.04
2.58	1.17	8.58	14.72	14.58	1.76	20.58	1.03
2.67	1.18	8.67	12.98	14.67	1.74	20.67	1.03
2.75	1.20	8.75	11.62	14.75	1.72	20.75	1.02
2.83	1.22	8.83	10.54	14.83	1.70	20.83	1.02
2.92	1.23	8.92	9.65	14.92	1.69	20.92	1.01
3.00	1.25	9.00	8.91	15.00	1.67	21.00	1.01
3.08	1.27	9.08	8.28	15.08	1.65	21.08	1.00
3.17	1.28	9.17	7.74	15.17	1.64	21.17	1.00
3.25	1.30	9.25	7.28	15.25	1.62	21.25	.99
3.33	1.32	9.33	6.87	15.33	1.61	21.33	.99
3.42	1.34	9.42	6.51	15.42	1.59	21.42	.98
3.50	1.36	9.50	6.18	15.50	1.58	21.50	.98
3.58	1.38	9.58	5.89	15.58	1.56	21.58	.97
3.67	1.40	9.67	5.63	15.67	1.55	21.67	.97
3.75	1.43	9.75	5.40	15.75	1.54	21.75	.96
3.83	1.45	9.83	5.18	15.83	1.52	21.83	.96
3.92	1.48	9.92	4.98	15.92	1.51	21.92	.95
4.00	1.50	10.00	4.80	16.00	1.50	22.00	.95
4.08	1.53	10.08	4.63	16.08	1.48	22.08	.94
4.17	1.55	10.17	4.48	16.17	1.47	22.17	.94
4.25	1.58	10.25	4.34	16.25	1.46	22.25	.93
4.33	1.61	10.33	4.20	16.33	1.45	22.33	.93
4.42	1.64	10.42	4.08	16.42	1.43	22.42	.93
4.50	1.68	10.50	3.96	16.50	1.42	22.50	.92
4.58	1.71	10.58	3.85	16.58	1.41	22.58	.92
4.67	1.74	10.67	3.75	16.67	1.40	22.67	.91
4.75	1.78	10.75	3.65	16.75	1.39	22.75	.91
4.83	1.82	10.83	3.56	16.83	1.38	22.83	.90
4.92	1.86	10.92	3.47	16.92	1.37	22.92	.90
5.00	1.90	11.00	3.39	17.00	1.36	23.00	.90
5.08	1.95	11.08	3.31	17.08	1.35	23.08	.89
5.17	2.00	11.17	3.24	17.17	1.34	23.17	.89
5.25	2.05	11.25	3.17	17.25	1.33	23.25	.88
5.33	2.10	11.33	3.10	17.33	1.32	23.33	.88
5.42	2.16	11.42	3.04	17.42	1.31	23.42	.88
5.50	2.22	11.50	2.97	17.50	1.30	23.50	.87
5.58	2.28	11.58	2.92	17.58	1.29	23.58	.87
5.67	2.35	11.67	2.86	17.67	1.28	23.67	.86
5.75	2.42	11.75	2.81	17.75	1.27	23.75	.86
5.83	2.50	11.83	2.75	17.83	1.26	23.83	.86
5.92	2.59	11.92	2.71	17.92	1.25	23.92	.85
6.00	2.68	12.00	2.66	18.00	1.25	24.00	.85

---

* Pre-Development, 88 acre area (=35.61ha)

CALIB			
NASHYD (0001)	Area (ha)= 35.61	Curve Number (CN)= 72.0	
ID= 1 DT= 5.0 min	Ia (mm)= 5.00	# of Linear Res.(N)= 3.00	
	U.H. Tp(hrs)= .71		

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

Unit Hyd Qpeak (cms)= 1.92

```
     PEAK FLOW       (cms)=   1.62 (i)
     TIME TO PEAK    (hrs)=   8.83
     RUNOFF VOLUME    (mm)=  46.95
     TOTAL RAINFALL   (mm)= 100.59
     RUNOFF COEFFICIENT   =    .47

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

--------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  35.61
| ID= 1   PCYC=320 |   QPEAK     (cms)=   1.62 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   8.83
--------------------   VOLUME     (mm)=  46.95
  Filename: NRWDPR00.TXT
  Comments:

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

--------------------------------------------------------------------------------
*                   Post-Development
--------------------
| CALIB            |
| STANDHYD  (0001) |   Area    (ha)=  35.61
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  50.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      21.37         14.24
     Dep. Storage     (mm)=       2.00          5.00
     Average Slope     (%)=       2.00          2.00
     Length            (m)=     487.00        487.00
     Mannings n           =       .013          .250

     Max.eff.Inten.(mm/hr)=     154.49         43.81
               over (min)       10.00         45.00
     Storage Coeff.  (min)=       4.51 (ii)   48.49 (ii)
     Unit Hyd. Tpeak (min)=       5.00         50.00
     Unit Hyd. peak  (cms)=        .23           .02
                                                      *TOTALS*
     PEAK FLOW       (cms)=       8.16           .99          8.30 (iii)
     TIME TO PEAK    (hrs)=       8.25          9.08          8.25
     RUNOFF VOLUME    (mm)=      98.52         56.72         77.61
     TOTAL RAINFALL   (mm)=     100.59        100.59        100.59
     RUNOFF COEFFICIENT   =        .98           .56           .77

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

       (i) CN PROCEDURE SELECTED FOR RAINFALL LOSSES:
            CN*  =  75.0    Ia = Dep. Storage  (Above)
      (ii) COMPUTATIONAL TIME STEP SHOULD BE SMALL OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  35.61
| ID= 1   PCYC=331 |   QPEAK     (cms)=   8.30 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   8.25
--------------------   VOLUME     (mm)=  77.61
  Filename: NRWDUN00.TXT
  Comments:

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

```
--------------------------------------------------------------------------------
*                    Route through SWMF
--------------------
| RESERVOIR (0001) |
| IN= 1---> OUT= 2 |
| DT=  5.0 min     |      OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
--------------------       (cms)     (ha.m.)    |   (cms)     (ha.m.)
                            .000        .000     |     .915       .772
                            .001        .393     |    1.152       .852
                            .062        .466     |    1.400       .934
                            .199        .541     |    1.658      1.016
                            .430        .617     |    1.926      1.100
                            .687        .694     |    2.206      1.185

                                    AREA     QPEAK     TPEAK       R.V.
                                    (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 1 (0001)     35.61      8.30      8.25      77.61
     OUTFLOW: ID= 2 (0001)     35.61      1.53      9.08      67.01

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 18.46
                   TIME SHIFT OF PEAK FLOW         (min)= 50.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=   .98

--------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  35.61
| ID= 2   PCYC=482 |   QPEAK     (cms)=   1.53 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   9.08
--------------------   VOLUME     (mm)=  67.01
  Filename: NRWDCN00.TXT
  Comments:

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

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

 FINISH
================================================================================
```

APPENDIX I

OTTHYMO – Timmins Event

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

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    I N T E R H Y M O
       O   O    T      T    H   H   Y Y   MM MM  O   O   * * * 1989a * * *
       O   O    T      T    HHHHH    Y    M M M  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO             00002

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  Input   filename: nwdt.dat
  Output  filename: nwdt.out
  Summary filename: nwdt.sum



DATE: 11-06-2023                      TIME: 09:44:19


COMMENTS: _____________________________________________________________


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

*
*                   Norwood Subdivision
*
*                   Environment Canada Peterborough STP Station
*
*                   Timmins Event
*                   November 6, 2023
*                   Andrew Rosenthal, EIT
*
*                   LGI, LGP from L=SQRT(A/1.5)
*
*                   November SWMF R6
*
********************************************************************************
*                   Timmins Event
********************************************************************************

--------------------
|    READ STORM    |    Filename: TIMMINS.STM
| Ptotal=193.00 mm |    Comments: *12 HOUR - Timmins STORM
--------------------
                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                1.00   15.00 |  4.00    3.00 |  7.00   43.00 | 10.00   13.00
                2.00   20.00 |  5.00    5.00 |  8.00   20.00 | 11.00   13.00
                3.00   10.00 |  6.00   20.00 |  9.00   23.00 | 12.00    8.00

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*                   Post-Development
--------------------
| CALIB            |
| STANDHYD  (0001) |   Area    (ha)=  35.61
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  50.00
```

```
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      21.37         14.24
     Dep. Storage     (mm)=       2.00          5.00
     Average Slope     (%)=       2.00          2.00
     Length            (m)=     487.00        487.00
     Mannings n           =       .013          .250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.

                              IMPERVIOUS    PERVIOUS (i)
     Max.eff.Inten.(mm/hr)=      43.00         44.45
               over (min)        10.00         45.00
     Storage Coeff.  (min)=       7.52 (ii)    51.25 (ii)
     Unit Hyd. Tpeak (min)=      10.00         55.00
     Unit Hyd. peak  (cms)=        .13           .02
                                                          *TOTALS*
     PEAK FLOW       (cms)=       2.13          1.26          3.17 (iii)
     TIME TO PEAK    (hrs)=       7.25          7.83          7.25
     RUNOFF VOLUME    (mm)=     190.33        138.51        164.42
     TOTAL RAINFALL   (mm)=     193.00        193.00        193.00
     RUNOFF COEFFICIENT   =        .99           .72           .85


       (i) CN PROCEDURE SELECTED FOR RAINFALL LOSSES:
            CN*  =  75.0    Ia = Dep. Storage  (Above)
      (ii) COMPUTATIONAL TIME STEP SHOULD BE SMALL OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  35.61
| ID= 1   PCYC=215 |   QPEAK     (cms)=   3.17 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   7.25
--------------------   VOLUME     (mm)= 164.42
  Filename: NRWDUNTE.TXT
  Comments:

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

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*                   Route through SWMF
--------------------
| RESERVOIR (0001) |
| IN= 1---> OUT= 2 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                           .000        .000    |     .843       .705
                           .025        .106    |    1.457       .937
                           .076        .164    |    1.693      1.016
                           .183        .287    |    2.204      1.180
                           .286        .418    |    3.059      1.436
                           .539        .557    |     .000       .000

                                  AREA     QPEAK     TPEAK       R.V.
                                  (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 1 (0001)      35.61      3.17      7.25     164.42
     OUTFLOW: ID= 2 (0001)      35.61      2.26      7.83     164.39

                    PEAK   FLOW   REDUCTION [Qout/Qin](%)= 71.07
                    TIME SHIFT OF PEAK FLOW         (min)= 35.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=  1.28
```

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--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  35.61
| ID= 2   PCYC=731 |   QPEAK     (cms)=   2.26 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   7.83
--------------------   VOLUME     (mm)= 164.39
  Filename: NRWDCNTE.TXT
  Comments:

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

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 FINISH
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```