PRELIMINARY STORMWATER MANAGEMENT REPORT

Upper Mill Pond Development

Norwood, ON

Revised

February 20, 2025

Belleville	**Kingston**	**Oakville**
1 – 71 Millennium Pkwy	208 – 4 Cataraqui St	214 – 231 Oak Park Blvd
Belleville, ON	Kingston, ON	Oakville, ON
K8N 4Z5	K7K 1Z7	L6H 7S8
Tel: 613-969-1111	Tel: 613-389-7250	Tel: 905-257-2880
info@jewelleng.ca	kingston@jewellweng.ca	oakville@jewelleng.ca

Revision Summary

December 1, 2023

Preliminary SWM Report issued for draft plan approval.

February 20, 2025

Updated SWM Report issued to address first submission comments.

Table of Contents

Table of Tables

Table of Figures

List of Appendices

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 403 single-detached and townhouse units (17ha), and 240 medium-density units (7ha).

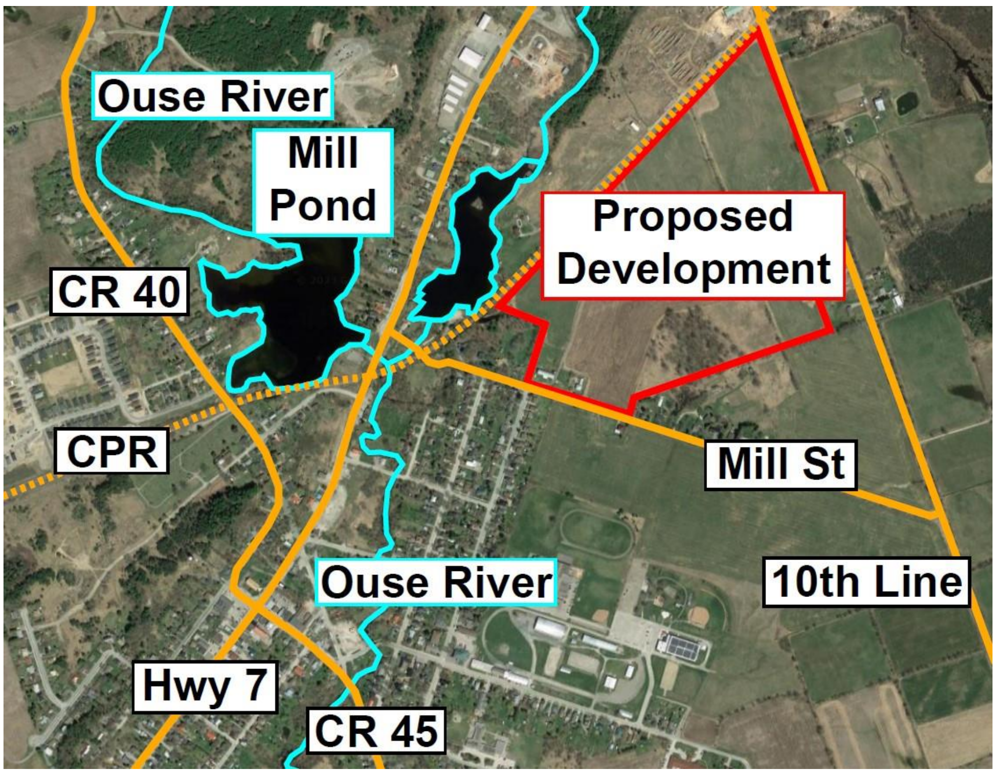


Figure 1-1: Development Site Location (Google, Maxar Tech 2018)

The development's post-development impervious cover will be ~50%.

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.

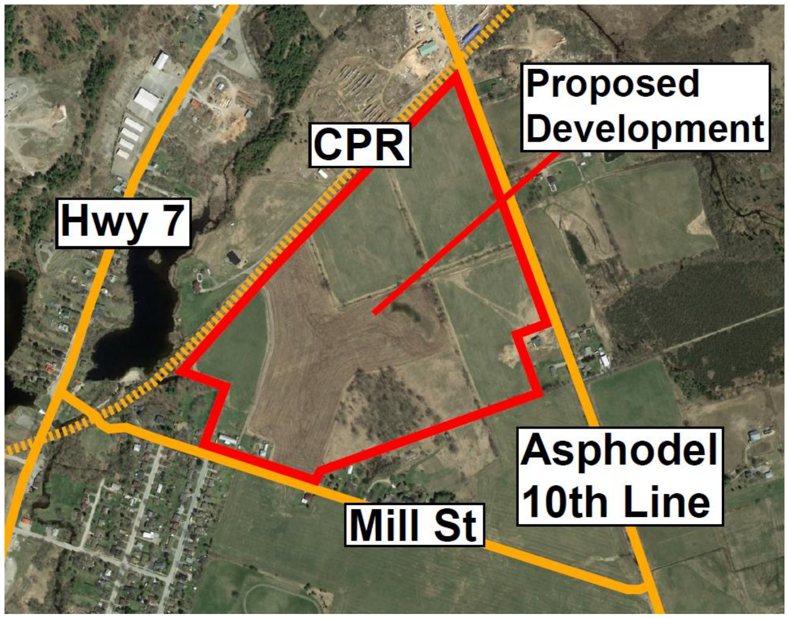


Figure 2-1: Existing Conditions (Google, Maxar Tech 2018)

2.1 Drainage Scheme

2.1.1 Ouse River System

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 where it discharges into the Ouse River and finally to the lower end of Rice Lake approximately 16km away (refer to Figure 1-1).

Jewell completed a hydraulic analysis of the east pond for Otonabee Region Conservation Authority (ORCA) 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 proposed 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.

2.1.2 Development Site and Surrounding Catchments

In existing conditions, the majority of the development site drains to the South Pond on the Ouse River via sheet flow – this area is shown as Catchment 100, which has an area of 22.7ha. Catchment 100 is separated from the north portion of the site – Catchments 101 and 102 – by a slight natural ridge. The catchment is comprised mostly of agricultural lands, with tree cover along the boundary lines between adjacent fields.

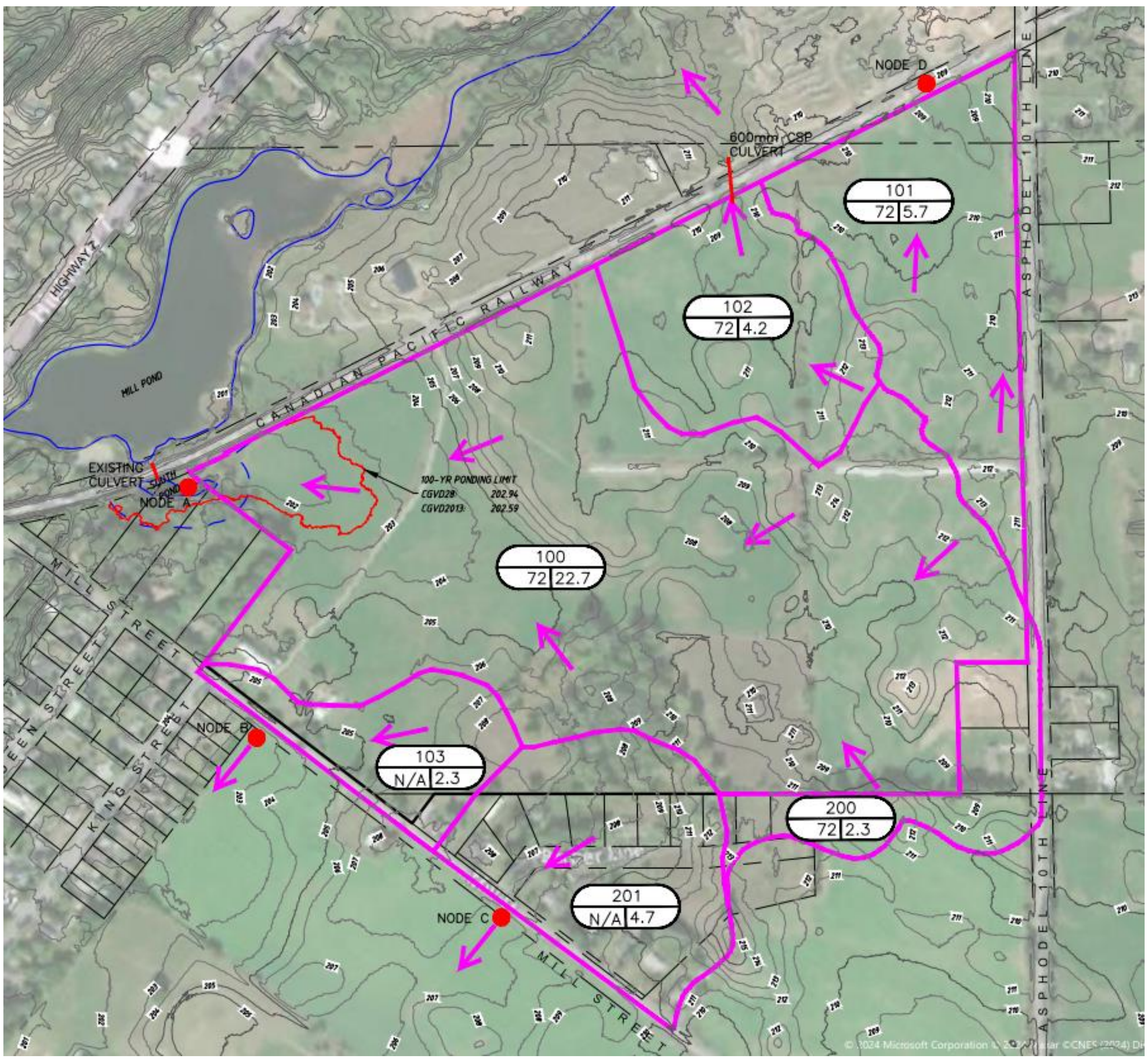


Figure 2-2: Post-Development Catchment Plan

The north portion of the site (Catchments 101 and 102) drains northwest towards the CP Rail Corridor. Catchment 102 drains across the railway towards the north through a 600mm culvert, ~310m southwest of the 10th Line level crossing. Catchment 101 similarly drains towards the railway, however no further culverts were identified along the portion of railway adjacent to the site. It is expected that portions of runoff infiltrate while others permeate through the rail bed – the snake grass along the tracks indicates the soil is frequently saturated (Figure 2-3).

Figure 2-3: CP Rail Corridor, from 10th Line Crossing facing Southwest

External catchment 200, amounting to 2.3ha along the southeast corner of the site, contributes runoff to Catchment 100. This area is comprised of two detached dwellings surrounded by additional agricultural lands.

A small portion of the site (Catchment 103) to the south, with an area of 2.3ha, drains uncontrolled towards Mill St (Node B) in pre-development conditions.

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 2-4 (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 2-4: 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 roof areas and front yards will drain towards the road network 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 SWM Pond is located at the southwest corner of the site, maintaining the existing drainage outlet of the larger pre-development catchment (the SWM block is located at the natural low point of the site). The facility has been sized to treat runoff from most of the development site (34.2ha – Catchment 300), plus the 2.3ha of external lands to the southeast (Catchment 200).

It should be noted that the post-development contributing area to Node D will be reduced, which will decrease runoff contribution to the region of standing water along the CP Tracks.

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 Railway. Therefore, there is potential for backwater from both the east pond and the CP railway culvert to the proposed SWM facility. The backwater effect was reviewed as part of this preliminary stormwater management investigation and the design is resilient to backwater conditions as is discussed in Section 4.2.

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 on behalf of ORCA 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, a 100-yr flood elevation of 202.22m was determined in the head pond (east pond) assuming all logs are left in place.

3.1.2 CP Railway Box 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 of up to 0.37m during the 100-yr event (see Appendix E).

3.1.3 Apartment/Commercial Block

The apartment/commercial block along Mill St and a small portion of Streets A & C (Catchments 301 and 302) will drain towards Mill St (Node B). Catchment 303 has an area of 1.08ha and will receive on-site quality and quantity treatment prior to draining to Mill St. Catchments 301 and 302 (0.32ha) will drain to Mill St uncontrolled.

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
199.80	0	-	Bottom of Pond
202.30	7,324	0	Permanent Pool
203.29	6,452	0.29	Top of Quality Storage
204.05	12,615	0.95	Full Storage
204.60	17,567	2.84*	Top of Berm

*Includes spillway discharge at H = 0.42m

The SWMF's proposed controls are as follows:

Table 4-2: Proposed SWMF - Controls

Invert, masl	Control Type	Number of Controls	Dimension
202.30	Orifice	2	275mm diam.
203.29	Orifice	2	320mm diam.
203.65	Broad-crested weir	1	0.36m
204.18	Broad-crested weir	1	4m length

4.1 Quality Treatment

4.1.1 Enhanced Swales

Although not relied upon for quality treatment, the rear-yard swales provide 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 5,477m^3 was conservatively based on 55% impervious cover for the development, and a contributing area of 36.51ha.

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 >40 years before treatment efficiency drops to 75%, and major maintenance is triggered (Appendix D).

Discharge during the quality event will be through two, 275mm-diameter orifice controls with invert set at the permanent pool elevation of 202.30m. 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

Flows below the obvert are resolved using a partially full orifice, using the discharge equation as follows:

Equation 5: Modified Orifice Equation (Rosenthal, 2024)

$$Q = 0.6 * \left(\left(arccos\left(\frac{r-h}{r}\right)\right) r^2 - (r-h)\left(r * sin\left(arccos\left(\frac{r-h}{r}\right)\right)\right)\right) * \sqrt{2g * \left(\frac{4r * sin^3\left(arccos\left(\frac{r-h}{r}\right)\right)}{3\left(2\left(arccos\left(\frac{r-h}{r}\right)\right) - sin\left(2\left(arccos\left(\frac{r-h}{r}\right)\right)\right)\right)} - (r-h)\right)}$$

Where

> r is the radius of the orifice (m)
> h is the head on the invert of 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 (2,537m^3) occurs at a stage of 202.73m, and drains over a period of 24hr (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)	5,477	7,323	✓
Drawdown Time (hours)	24	24	✓

4.1.3 Apartment/Commercial Block

Runoff from the apartment/commercial block (Catchment 303) will receive on-site quality treatment prior to discharging to Mill St. The quality treatment method will be designed at the time the development proceeds through the Site Plan Application stage. Options for quality treatment include enhanced swales, OGS Unit, Isolator Row, etc. Runoff from Catchments 301 and 302 will drain uncontrolled to Mill St.

4.2 Quantity Treatment

4.2.1 Wet Pond SWMF – Node A

The 24hr SCS Type II Event was used for recent floodplain modeling in Norwood as this event is the critical event. Jewell accordingly used the 24hr event for quantity sizing of the site's SWMF.

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 (Equations 4 and 5) was used to size two 320mm orifices at invert 203.29m for quantity control.

In backwater conditions, the pressure head **h** for the two lower (quality) outlets is calculated by subtracting the backwater elevation from the water surface elevation in the pond.

The top outlet and emergency spillway (0.36m and 4.0m broad-crested weirs, respectively) were sized using the broad-crested weir equation:

Equation 6: 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 0.37m. 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 202.59m (Appendix E).

As the top (quantity control) outlets are above the maximum backwater elevation, the quantity treatment flow through the top two orifice controls and two weirs 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.

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

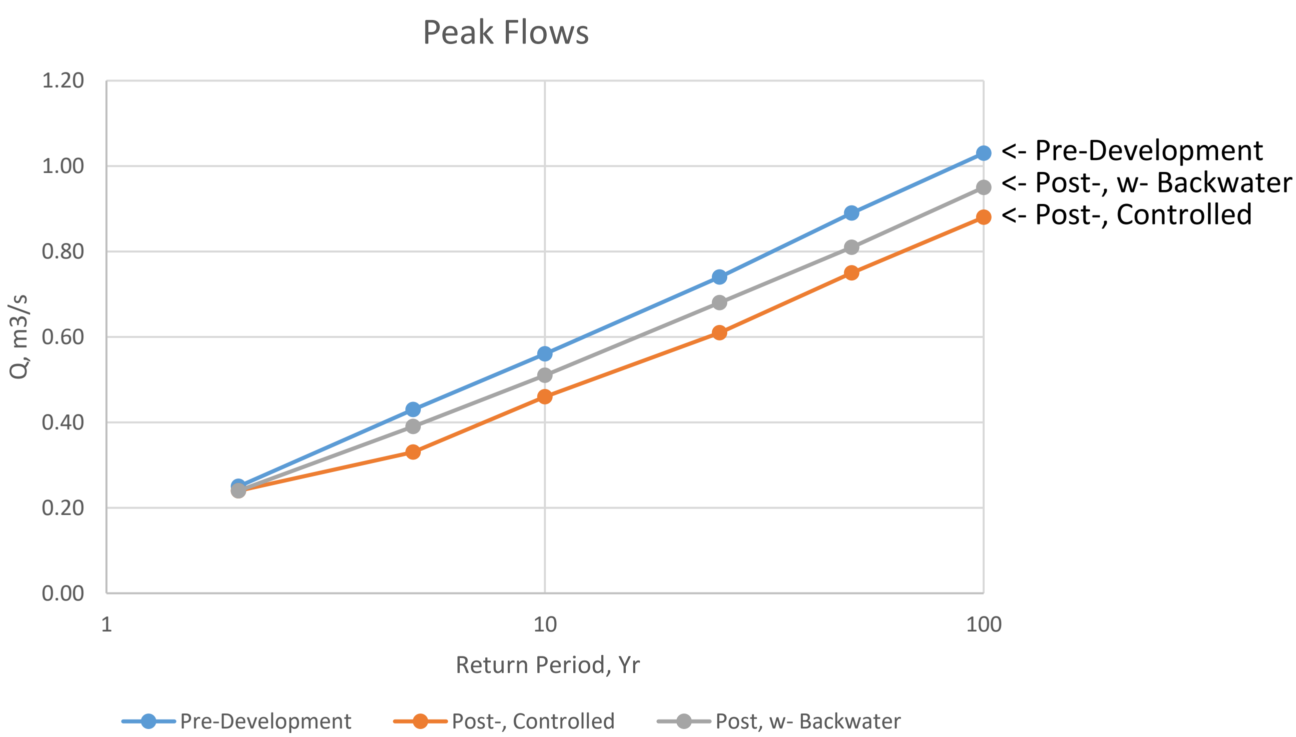


Figure 4-1: Pre- vs Post-Development Peak Flows

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 202.6m	
2	0.25	0.97	0.24	0.24	✓
5	0.43	1.37	0.33	0.39	✓
10	0.56	1.66	0.46	0.51	✓
25	0.74	2.06	0.61	0.68	✓
50	0.89	2.36	0.75	0.81	✓
100	1.03	2.70	0.88	0.95	✓
Timmins	-	3.05	2.22	2.25	N/A

4.2.1.1 Timmins Event

The proposed SWMF safely conveys the Timmins event and provides a controlled release of runoff at a peak discharge of 2.25m^3/s (max WSEL of 204.5m). 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.**

4.2.2 Mill St – Node B

Catchment 103 drains to Mill St (Node B) in pre-development conditions. The pre-development peak flows are calculated using a Runoff Coefficient of 0.25 (HSG B soils) and a flow length of 237m at 1.86% (85/10 method for flow length), resulting in a time of concentration of 35 minutes. The calculated 5- and 100-Yr event peak flows are as follows:

5Yr pre-development flowrate:

$$Q_5 = \frac{CiA}{360} = \frac{0.25 * \left[27.4 * \left(\frac{34.8}{60}\right)^{-0.675}\right] * 2.3ha}{360} = 63L/s$$

100Yr pre-development flowrate (100Yr R.C. increased 25% as per MOE design manual):

$$Q_{100} = \frac{CiA}{360} = \frac{0.25 \; * \; 1.25 * \left[46.1 * \left(\frac{34.8}{60}\right)^{-0.668}\right] * 2.3ha}{360} = 132 \; L/s$$

In post-development conditions, catchments 301, 302, and 303 drain to Mill St (Node B). The post-development, uncontrolled peaks in the 100Yr event are as follows:

Table 4-5: Apartment/Commercial Block - Post-Development Uncontrolled Peaks

Catchment	R.C.	t_c	i, mm/h	A, ha	Q, m^3/s
301, 302	0.60	20 min	96.1	0.32	0.064
303	0.65			1.08	0.234
				1.40	0.298

As the post-development, uncontrolled peak flows will exceed the pre-development target, quantity controls will be required for Catchment 303 (apartment/commercial block).

Jewell completed a preliminary on-site storage calculation using the Modified Rational Method. The allowable flowrate was set to the pre-development peak (target peak flow) minus the peak flow from the uncontrolled areas (Catchments 301 and 302). Conservatively, Jewell calculated the 100-Yr storage requirement based on the 5Yr allowable release rate. The required storage volumes are shown below in Table 4-6, where the Critical Event Duration is the event for each return period that requires the greatest storage to meet the pre-development target.

Table 4-6: Modified Rational Method - Summary Table

Return Period	Peak Flows, L/s			Storage Required, m^3	Critical Event Duration
	Pre-Dev	Ct. 301 & 302 Uncontrolled	Ct. 303 Allowable		
2Yr	47	23	24	72	30 min
5Yr	63	31	32	95	30 min
100Yr	~~132~~	~~64~~	↓	288	60 min

As demonstrated, a storage volume of 288m^3 is required for Catchment 303 to limit the post-development peaks to the pre-development targets at Node B.

Details of the Modified Rational Method calculations are included in Appendix D, and a detailed on-site storage design will be completed when the development proceeds through the Site Plan Application stage.

4.3 CLI-ECA Requirements

The consolidated linear infrastructure environmental compliance approval (CLI-ECA) stormwater management requirements are addressed as follows:

1) Water Balance - Water balance assessment is currently underway as of the writing of this report and if any specific design modifications are suggested they will be addressed during detailed design. Per the ECA, stormwater volumes generated are required to be controlled to meet pre-development conditions on property. Control is in the following hierarchical 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 24 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 – 202.73m
- Top of Active Storage – 204.05m (during 100Yr, 24hr event with no outlet backwater)
    - 204.14m with outlet backwater elevation of 202.6m
- Top of Berm – 204.60m

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 40 years (Appendix D).

The cleanout frequency is based on a contributing area imperviousness of 50%. This results in a sediment loading of 1.575m^3/ha, and an annual accumulation of 1.26m^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 204.05m (no backwater), 204.14m (with backwater). 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 403 low-density residential units and 240 medium-density units, with an estimated impervious cover of ~50%.

The majority of 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.

Jewell selected the 24hr SCS Type II event as the design event to align with recent floodplain modeling of the area.

Table 8-1: 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 202.6m	
2	0.25	1.00	0.24	0.25	✓
5	0.43	1.42	0.35	0.41	✓
10	0.56	1.71	0.48	0.53	✓
25	0.74	2.14	0.65	0.71	✓
50	0.89	2.48	0.79	0.85	✓
100	1.03	2.80	0.93	1.00	✓

The proposed SWMF will detain runoff from the quality event for 24hr, achieving the drawdown 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.

Several controls are proposed for the wet pond SWMF to achieve the desired discharge limits. These include:

Table 8-2: Summary of Wet Pond Controls

Control	Size (m)	# of outlets	Invert Elevation (m)
Quality Orifice	0.275	2	202.30
Quantity Orifice	0.320	2	203.29
Weir #1	0.36	1	203.65
Emergency Spillway Weir #2	4.0	1	204.18

Water surface elevations within the SWMF are determined with the assistance of the hydrologic model and are listed below for each event.

Table 8-3: SWMF Storage Summary

Description / Event	Volume Req'd (cu.m.)	Volume Provided (cu.m.)	Elevation (m)
Permanent Pool	5,477	7,323	202.30
Extended Detention	1,516	6,452	203.29
100-Yr	12,615	12,615	204.05
100-Yr with Backwater	13,396	13,396	204.14
Timmins	N/A	16,635	204.50
Top of Berm	-	17,567	204.60

Runoff from the apartment/commercial block will require quality and quantity controls on site to control post-development flows to Mill St (Node B). An estimated 288m^3 of onsite storage will be required, which will be designed as part of the future Site Plan Application process for that block.

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.

Prepared by

Andrew Rosenthal, P.Eng.
Jewell Engineering Inc.

Reviewed by

Bryon Keene, P.Eng.
Jewell Engineering Inc.

9 References

Ministry of the Environment. (2003). *Stormwater Management Planning and Design Manual.*

MTO. (2008). Highway Drainage Design Standards.

North Carolina Division of Water Quality. (2007). *Stormwater Best Management Best Practices Manual.*

Ontario Insitute of Pedology. (1981). *Soils of Peterborough County.*

Otonabee Region Conservation Authority. (2015). *Watershed Planning & Regulations Policy Manual.*

Toronto and Region Conservation Authority. (2010). *Low Impact Development Stormwater Management Planning and Design Guide, Version 1.0.*

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

==

PETERBOROUGH A ON 6166418

Latitude: 44 14'N Longitude: 78 22'W Elevation/Altitude: 191 m

Years/Années : 1971 - 2006 # Years/Années : 33

==

****

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

****

Year Année	5 min	10 min	15 min	30 min	1 h	2 h	6 h	12 h	24 h
1971	4.3	5.8	7.4	11.7	17.5	24.6	30.7	34.8	34.8
1972	5.8	6.1	8.1	10.2	13.2	16.5	22.9	41.4	44.2
1973	6.9	13.2	18.0	19.3	20.8	26.7	48.0	48.3	58.2
1974	7.6	13.5	14.0	16.0	20.1	25.7	43.9	49.8	49.8
1975	6.3	9.9	13.7	21.8	39.6	55.1	55.1	67.8	67.8
1976	5.3	8.4	11.9	15.0	16.3	16.5	22.6	24.6	37.6
1977	8.4	12.7	13.7	19.6	24.9	24.9	52.3	62.2	62.5
1978	7.2	12.4	17.3	19.2	21.7	27.7	43.9	45.6	45.8
1979	10.1	13.8	15.3	17.5	26.2	31.6	33.3	33.7	33.7
1980	8.8	16.0	21.6	29.0	32.0	48.3	61.8	62.2	83.2
1981	9.7	18.6	27.9	42.3	52.2	53.2	53.4	53.4	54.1
1982	5.3	7.6	7.8	9.9	11.7	15.4	30.3	34.1	34.1
1983	11.3	18.3	23.3	25.1	26.1	36.3	56.8	57.1	77.5
1984	8.9	14.2	17.3	18.9	25.3	29.4	35.5	37.8	39.2
1985	7.6	10.4	12.0	19.7	22.7	26.8	36.4	53.6	53.6
1986	12.5	15.8	19.3	19.7	19.7	23.2	35.8	42.0	44.8
1987	17.9	21.3	22.7	23.2	23.2	23.2	23.2	26.0	29.0
1988	7.8	11.5	14.5	20.7	23.2	24.4	27.0	28.8	30.4

1989	9.9	14.2	15.7	18.7	20.2	26.3	46.1	47.8	52.8
1990	8.9	13.4	17.8	23.2	23.7	23.7	42.2	43.4	44.8
1991	4.1	6.8	7.6	8.8	9.2	12.2	17.1	21.2	29.6
1992	8.6	9.3	12.8	20.4	25.8	31.7	38.9	45.0	51.2
1993	9.1	10.9	14.1	20.4	21.9	23.3	29.9	34.2	42.0
1994	8.8	14.4	17.4	19.8	22.2	24.1	24.1	33.6	41.5
1995	9.3	12.1	18.1	32.2	49.0	82.5	89.8	90.1	90.1
1996	6.8	8.6	10.5	13.9	16.5	22.0	38.3	40.8	41.0
1997	3.6	7.2	7.6	9.2	17.8	30.6	35.0	35.2	35.2
1998	11.4	15.7	16.5	18.7	28.1	32.4	60.0	65.1	76.2
1999	8.4	11.4	13.5	18.6	23.2	32.5	39.9	46.8	55.6
2000	6.4	10.0	12.7	16.6	18.8	23.5	47.8	61.2	61.2
2002	7.3	9.6	10.4	13.8	23.4	35.1	50.9	73.6	73.6
2004	6.2	10.9	15.2	22.0	26.5	41.6	65.9	80.1	97.8
2006	7.4	11.1	12.5	14.2	15.0	17.8	22.0	34.0	42.5
# Yrs. Années	33	33	33	33	33	33	33	33	33
Mean Moyenne	8.1	12.0	14.8	19.1	23.6	30.0	41.2	47.1	52.0
Std. Dev. Écart-type	2.7	3.7	4.8	6.7	9.1	13.7	15.5	16.4	18.1
Skew. Dissymétrie	1.33	0.45	0.55	1.30	1.66	2.13	0.92	0.75	0.92
Kurtosis	7.16	3.29	3.67	6.74	6.80	9.09	4.68	3.45	3.35

*-99.9 Indicates Missing Data/Données manquantes

Warning: annual maximum amount greater than 100-yr return period amount
Avertissement : la quantité maximale annuelle excède la quantité
pour une période de retour de 100 ans

Year/Année	Duration/Durée	Data/Données	100-yr/ans
1981	30 min	42.3	40.1
1981	1 h	52.2	52.0
1987	5 min	17.9	16.7
1995	2 h	82.5	72.9

****

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	7.7	10.1	11.7	13.7	15.2	16.7	33

10 min	11.4	14.6	16.8	19.5	21.5	23.5	33
15 min	14.0	18.3	21.1	24.7	27.4	30.0	33
30 min	18.0	23.9	27.8	32.8	36.4	40.1	33
1 h	22.1	30.1	35.4	42.1	47.1	52.0	33
2 h	27.7	39.8	47.8	57.9	65.4	72.9	33
6 h	38.7	52.4	61.5	72.9	81.4	89.9	33
12 h	44.4	58.9	68.5	80.6	89.5	98.4	33
24 h	49.0	65.0	75.6	88.9	98.9	108.7	33

****

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	92.0	121.0	140.2	164.4	182.3	200.2	33
	+/- 10.3	+/- 17.3	+/- 23.3	+/- 31.5	+/- 37.7	+/- 43.9	33
10 min	68.2	87.7	100.7	117.0	129.1	141.1	33
	+/- 6.9	+/- 11.7	+/- 15.7	+/- 21.2	+/- 25.4	+/- 29.6	33
15 min	56.0	73.1	84.5	98.8	109.4	120.0	33
	+/- 6.1	+/- 10.2	+/- 13.8	+/- 18.6	+/- 22.3	+/- 26.0	33
30 min	35.9	47.8	55.6	65.5	72.9	80.2	33
	+/- 4.2	+/- 7.1	+/- 9.6	+/- 12.9	+/- 15.4	+/- 18.0	33
1 h	22.1	30.1	35.4	42.1	47.1	52.0	33
	+/- 2.8	+/- 4.8	+/- 6.5	+/- 8.7	+/- 10.4	+/- 12.1	33
2 h	13.9	19.9	23.9	29.0	32.7	36.4	33
	+/- 2.1	+/- 3.6	+/- 4.9	+/- 6.6	+/- 7.9	+/- 9.2	33
6 h	6.4	8.7	10.2	12.2	13.6	15.0	33
	+/- 0.8	+/- 1.4	+/- 1.8	+/- 2.5	+/- 3.0	+/- 3.5	33
12 h	3.7	4.9	5.7	6.7	7.5	8.2	33
	+/- 0.4	+/- 0.7	+/- 1.0	+/- 1.3	+/- 1.6	+/- 1.8	33
24 h	2.0	2.7	3.1	3.7	4.1	4.5	33
	+/- 0.2	+/- 0.4	+/- 0.5	+/- 0.7	+/- 0.9	+/- 1.0	33

****

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

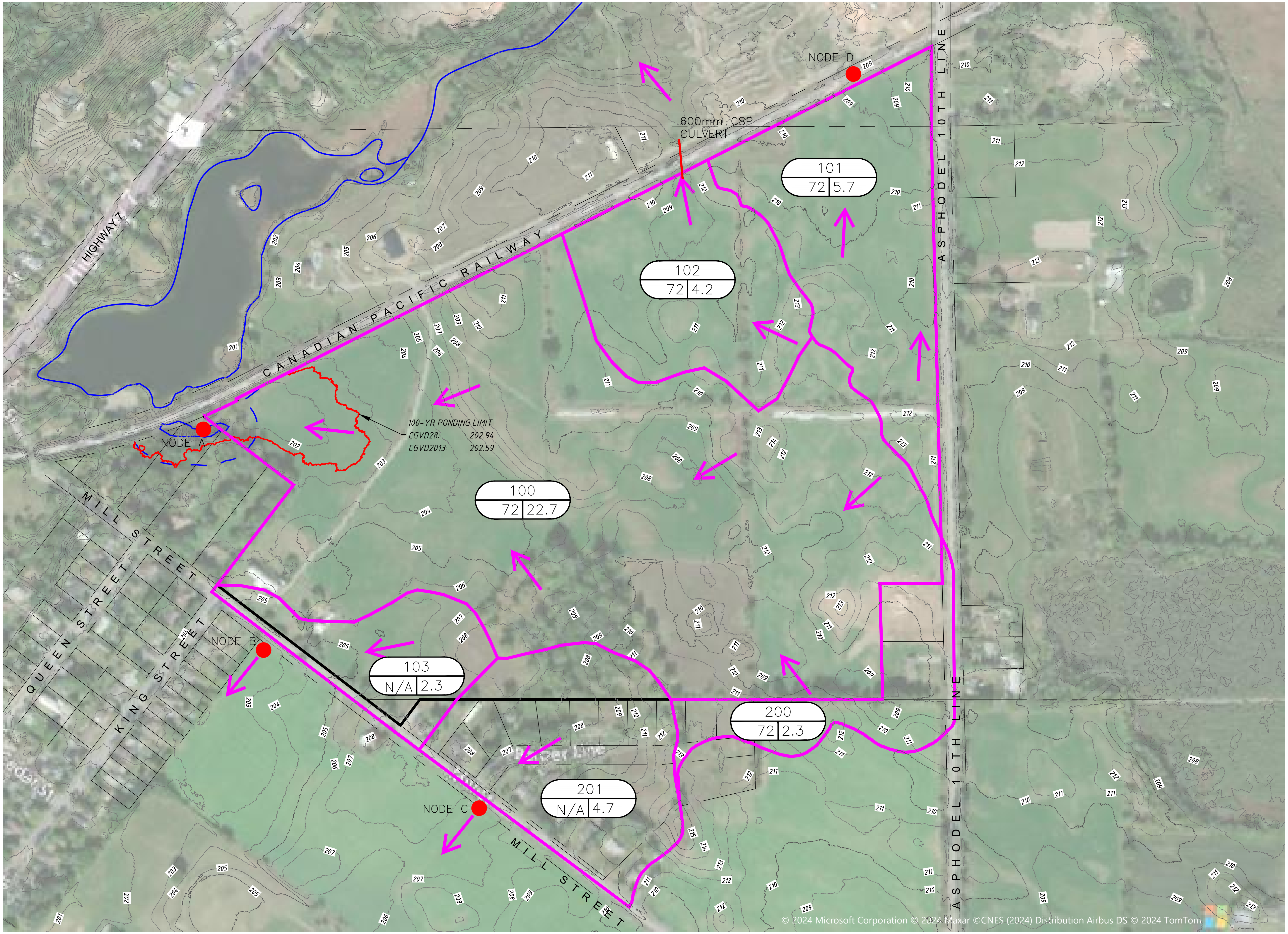
R = Interpolated Rainfall rate (mm/h)/Intensité interpolée de la pluie (mm/h)
RR = Rainfall rate (mm/h) / Intensité de la pluie (mm/h)
T = Rainfall duration (h) / Durée de la pluie (h)

****

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	33.4	44.0	51.0	59.9	66.5	73.1
Std. Dev. /Écart-type (RR)	32.1	41.8	48.1	56.2	62.2	68.1
Std. Error/Erreur-type	7.4	10.0	11.7	14.0	15.6	17.2
Coefficient (A)	20.5	27.4	31.9	37.7	41.9	46.1
Exponent/Exposant (B)	-0.680	-0.675	-0.672	-0.670	-0.669	-0.668
Mean % Error/% erreur moyenne	8.4	10.1	10.8	11.4	11.7	12.0

APPENDIX B

Drawings



10/09/2024

F:\FTP\PROJECT FILES\1 CIVIL 3D PROJECT FILES\2105049 - MILL ST NORWOOD\3 SHEETS\2105049 - B-1 - CATCHMENT PLAN - PRE

GENERAL NOTES:

- ALL INFORMATION TO BE VERIFIED ON SITE PRIOR TO COMMENCING ANY WORK. ANY DISCREPANCIES ARE TO BE REPORTED TO THE CONSULTANT IMMEDIATELY.
- 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.
- EXCLUDING THE BENCHMARK AND DESCRIPTION PROVIDED FOR THIS PROJECT, NO OTHER ELEVATIONS ARE TO BE USED AS A REFERENCE ELEVATION FOR ANY PURPOSE.

METRIC NOTE:

- ALL DIMENSIONS SHOWN ARE IN METRES OR MILLIMETRES, UNLESS OTHERWISE NOTED.

GEOMETRIC NOTE:

- ALL SURVEY DATA SHOWN ON THIS DRAWING WAS RECORDED USING REAL-TIME KINETIC (RTK) GPS OBSERVATIONS IN REFERENCE TO UTM 18 NORTH COORDINATE SYSTEM.
- ALL SURVEY ELEVATIONS ARE IN REFERENCE TO CGVD28.
- ALL LIDAR ELEVATIONS ARE IN REFERENCE TO CGVD2013.

* * DRAWINGS ARE NOT TO BE SCALED * *

REVISIONS

NO.	DATE	DESCRIPTION	BY

LEGEND

ID # / CN 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
(CONTOURS - CGVD2013)

DRAWN BY: JH

PROJECT NO: 210-5049

DESIGNED BY:

DATE: October 2024

CHECKED BY: AMR

SCALE: HORIZONTAL -1:4000 VERTICAL -N/A

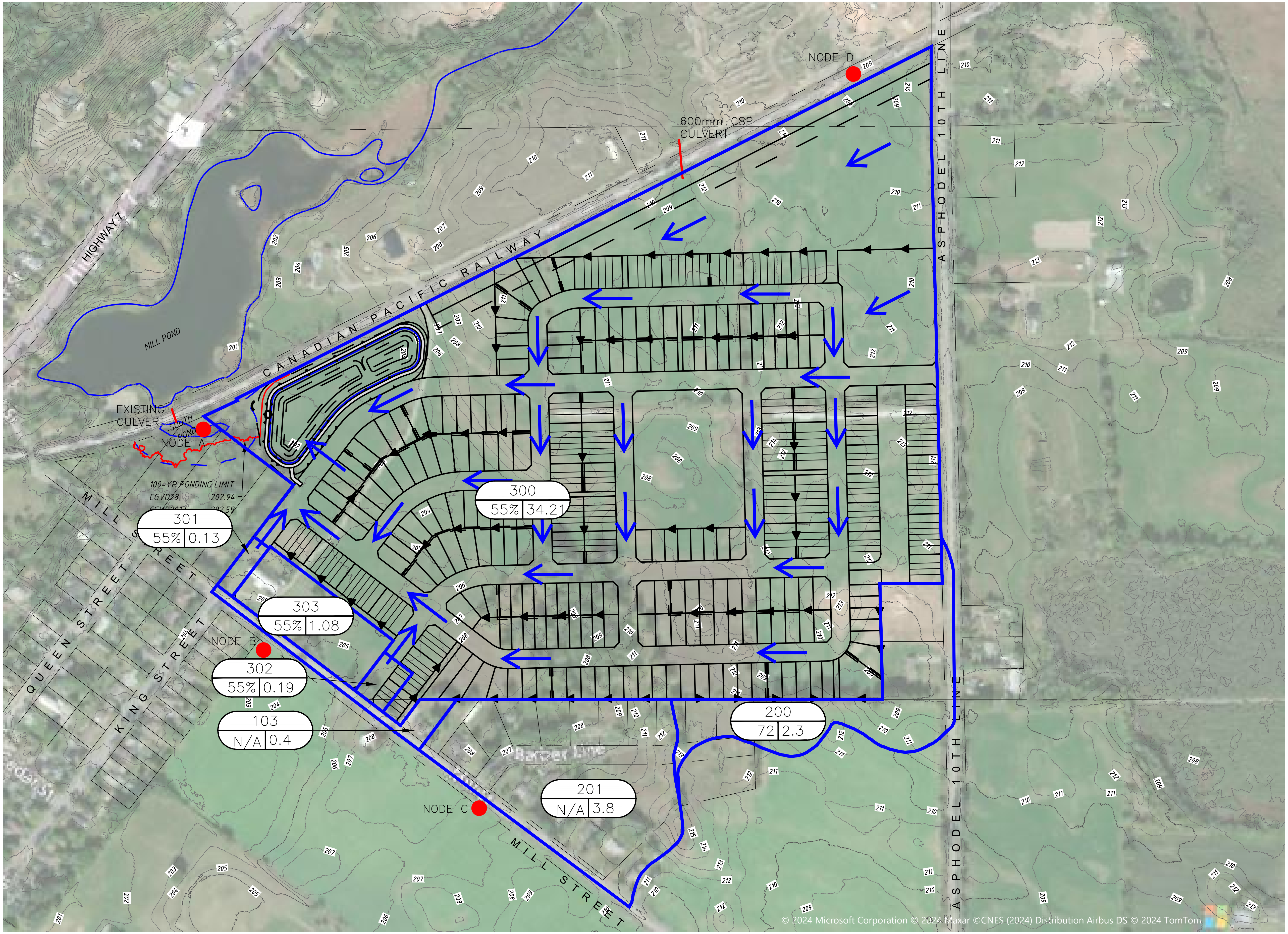
APPROVED BY:

CONTRACT NO:

DRAWING NO: B-1

01/15/2025

F:\FTP\PROJECT FILES\1 CIVIL 3D PROJECT FILES\2105049 - MILL ST NORWOOD\3 SHEETS\2105049 - B-2 - CATCHMENT PLAN - POST



GENERAL NOTES:

- ALL INFORMATION TO BE VERIFIED ON SITE PRIOR TO COMMENCING ANY WORK. ANY DISCREPANCIES ARE TO BE REPORTED TO THE CONSULTANT IMMEDIATELY.
- 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.
- EXCLUDING THE BENCHMARK AND DESCRIPTION PROVIDED FOR THIS PROJECT, NO OTHER ELEVATIONS ARE TO BE USED AS A REFERENCE ELEVATION FOR ANY PURPOSE.

METRIC NOTE:

- ALL DIMENSIONS SHOWN ARE IN METRES OR MILLIMETRES, UNLESS OTHERWISE NOTED.

GEOMETRIC NOTE:

- ALL SURVEY DATA SHOWN ON THIS DRAWING WAS RECORDED USING REAL-TIME KINETIC (RTK) GPS OBSERVATIONS IN REFERENCE TO UTM 18 NORTH COORDINATE SYSTEM.
- ALL SURVEY ELEVATIONS ARE IN REFERENCE TO CGVD28.
- ALL LIDAR ELEVATIONS ARE IN REFERENCE TO CGVD2013.

* * DRAWINGS ARE NOT TO BE SCALED * *

REVISIONS

NO.	DATE	DESCRIPTION	BY

LEGEND

ID # / CN/% ha — CURVE NUMBER OR % IMP

INTERIOR BOUNDARY

MAJOR STORM ROUTE

N W E S

JEWELL ENGINEERING

UPPER MILL POND PARK GATE DEVELOPMENT

NORWOOD, ONTARIO

TOWNSHIP OF ASPHODEL-NORWOOD

CATCHMENT PLAN POST-DEVELOPMENT (CONTOURS - CGVD2013)

DRAWN BY: JH

PROJECT NO: 210-5049

DESIGNED BY:

DATE: January 2025

CHECKED BY: AMR

SCALE: HORIZONTAL -1:4000 VERTICAL -N/A

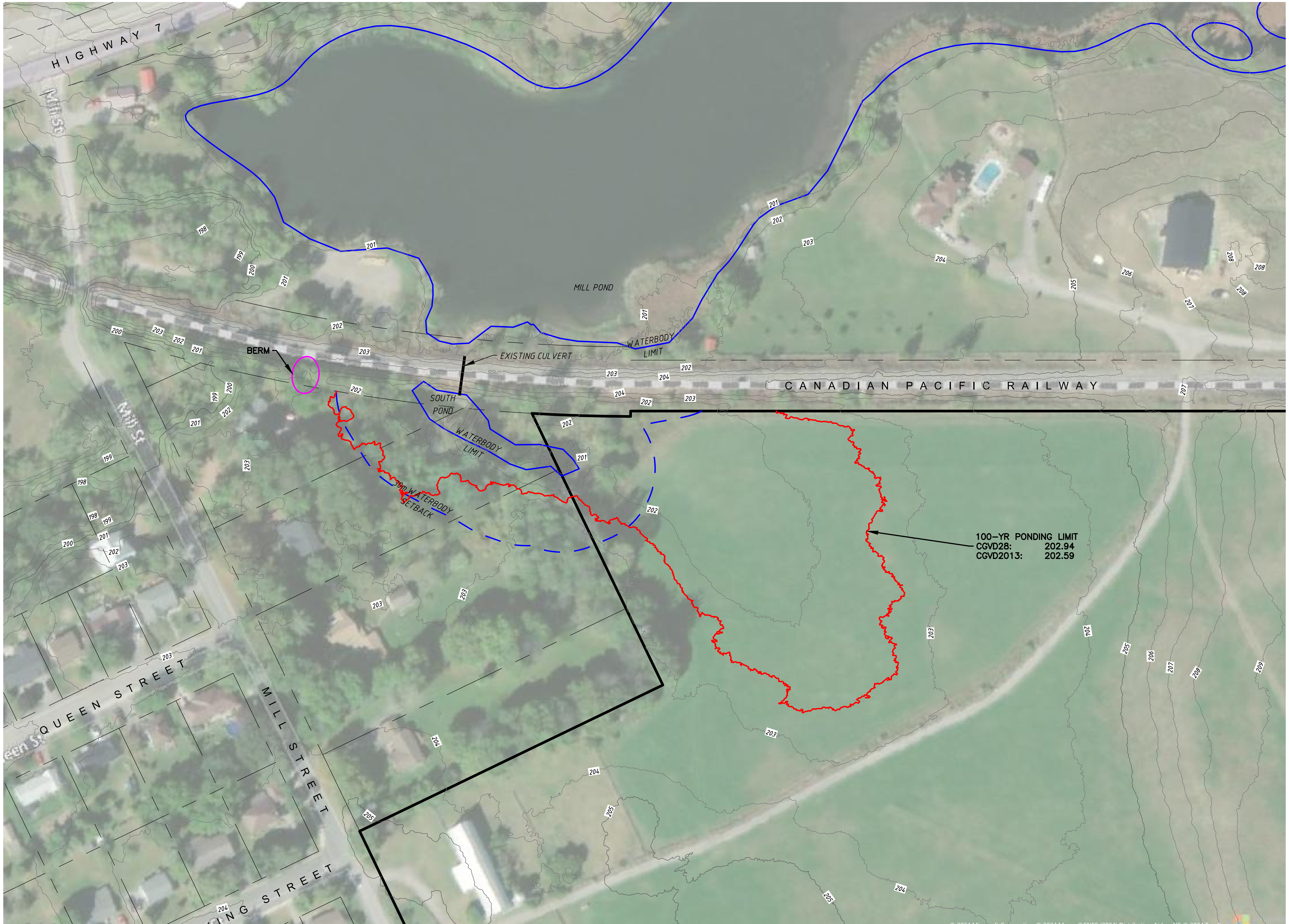
APPROVED BY:

CONTRACT NO:

DRAWING NO: B-2

10/11/2024

F:\FTP\PROJECT FILES\1 CIVIL 3D PROJECT FILES\2105049 - MILL ST NORWOOD\3 SHEETS\2105049 - B-3 - 100-YR PONDING LIMIT - PRE



GENERAL NOTES:

- ALL INFORMATION TO BE VERIFIED ON SITE PRIOR TO COMMENCING ANY WORK. ANY DISCREPANCIES ARE TO BE REPORTED TO THE CONSULTANT IMMEDIATELY.
- 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.
- EXCLUDING THE BENCHMARK AND DESCRIPTION PROVIDED FOR THIS PROJECT, NO OTHER ELEVATIONS ARE TO BE USED AS A REFERENCE ELEVATION FOR ANY PURPOSE.

METRIC NOTE:

- ALL DIMENSIONS SHOWN ARE IN METRES OR MILLIMETRES, UNLESS OTHERWISE NOTED.

GEOMETRIC NOTE:

- ALL SURVEY DATA SHOWN ON THIS DRAWING WAS RECORDED USING REAL-TIME KINETIC (RTK) GPS OBSERVATIONS IN REFERENCE TO UTM 18 NORTH COORDINATE SYSTEM.
- ALL SURVEY ELEVATIONS ARE IN REFERENCE TO CGVD28.
- ALL LIDAR ELEVATIONS ARE IN REFERENCE TO CGVD2013.

* * DRAWINGS ARE NOT TO BE SCALED * *

REVISIONS

NO.	DATE	DESCRIPTION	BY

JEWELL ENGINEERING

UPPER MILL POND PARK GATE DEVELOPMENT

NORWOOD, ONTARIO

TOWNSHIP OF ASPHODEL-NORWOOD

100-YR PONDING LIMIT PRE-DEVELOPMENT (CONTOURS - CGVD2013)

DRAWN BY: JH

PROJECT NO: 210-5049

DESIGNED BY:

DATE: October 2024

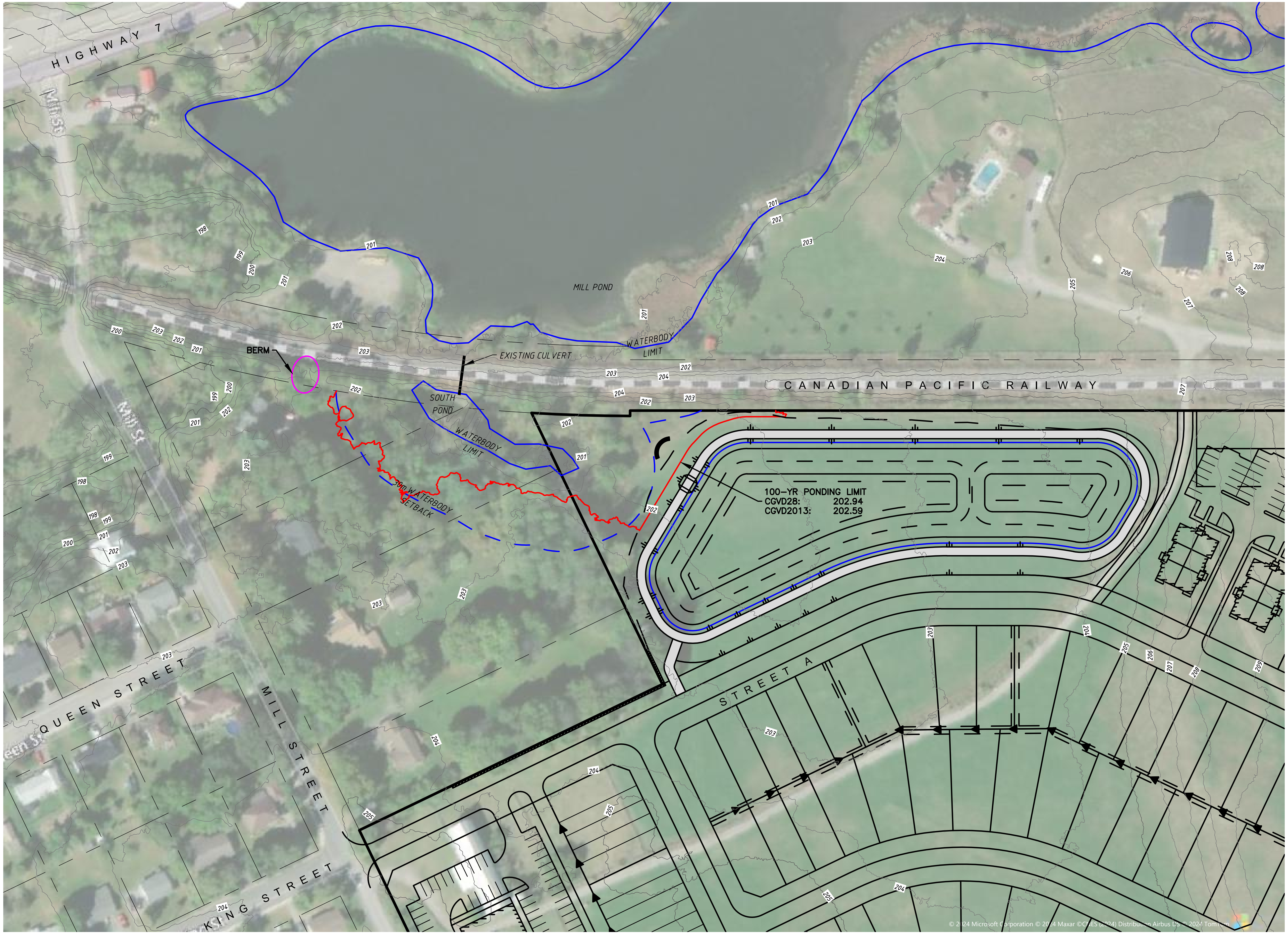
CHECKED BY: AMR

SCALE: HORIZONTAL -1:1500 VERTICAL -N/A

APPROVED BY:

CONTRACT NO:

DRAWING NO: B-3



GENERAL NOTES:

- ALL INFORMATION TO BE VERIFIED ON SITE PRIOR TO COMMENCING ANY WORK. ANY DISCREPANCIES ARE TO BE REPORTED TO THE CONSULTANT IMMEDIATELY.
- 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.
- EXCLUDING THE BENCHMARK AND DESCRIPTION PROVIDED FOR THIS PROJECT, NO OTHER ELEVATIONS ARE TO BE USED AS A REFERENCE ELEVATION FOR ANY PURPOSE.

METRIC NOTE:

- ALL DIMENSIONS SHOWN ARE IN METRES OR MILLIMETRES, UNLESS OTHERWISE NOTED.

GEOMETRIC NOTE:

- ALL SURVEY DATA SHOWN ON THIS DRAWING WAS RECORDED USING REAL-TIME KINETIC (RTK) GPS OBSERVATIONS IN REFERENCE TO UTM 18 NORTH COORDINATE SYSTEM.
- ALL SURVEY ELEVATIONS ARE IN REFERENCE TO CGVD28.
- ALL LIDAR ELEVATIONS ARE IN REFERENCE TO CGVD2013.

** DRAWINGS ARE NOT TO BE SCALED **

REVISIONS

NO.	DATE	DESCRIPTION	BY

JEWELL ENGINEERING

UPPER MILL POND PARK GATE DEVELOPMENT

NORWOOD, ONTARIO

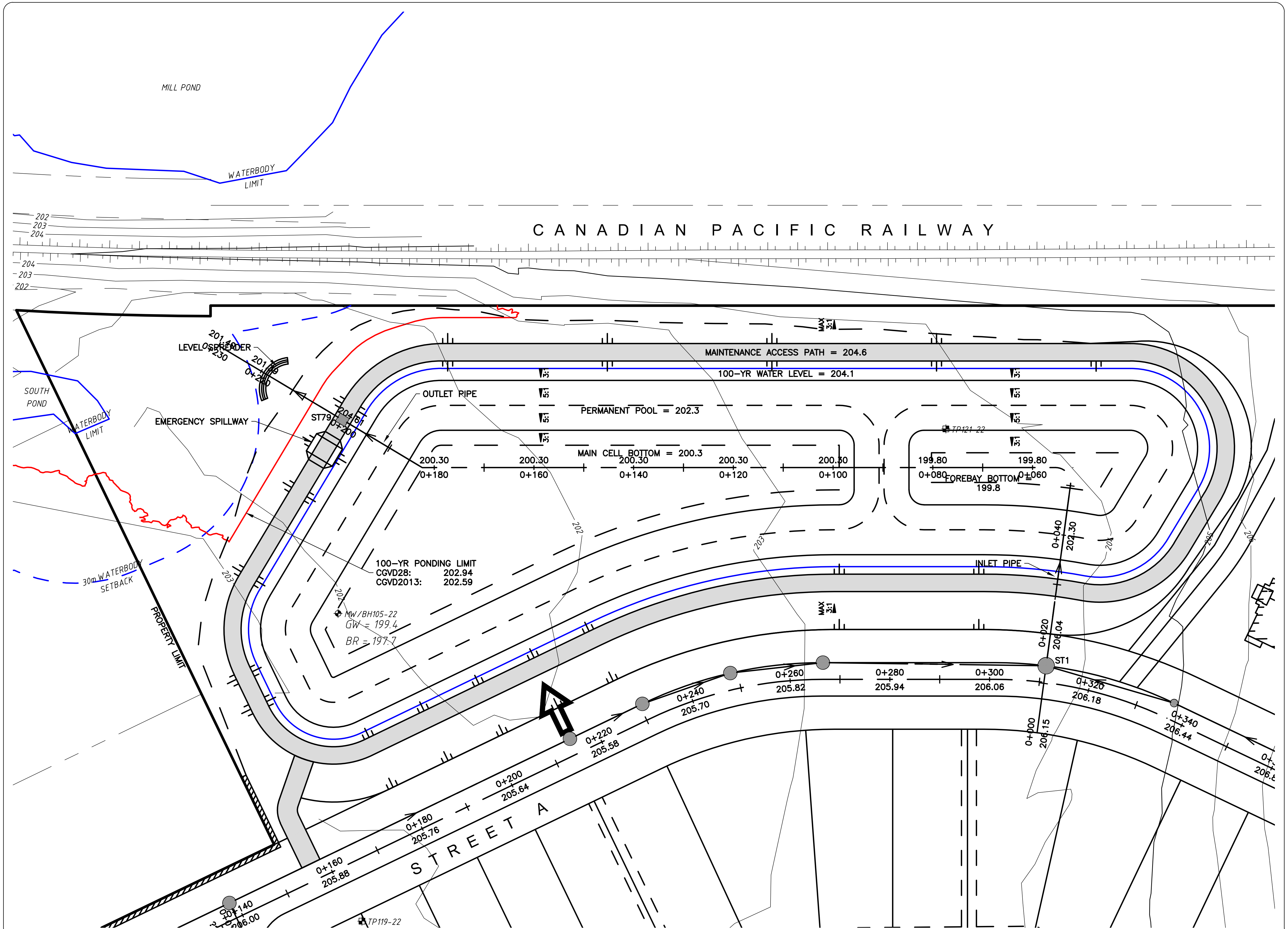
TOWNSHIP OF ASPHODEL-NORWOOD

100-YR PONDING LIMIT POST-DEVELOPMENT (CONTOURS - CGVD2013)

DRAWN BY: JH
PROJECT NO: 210-5049
DESIGNED BY:
DATE: October 2024
CHECKED BY: AMR
SCALE: HORIZONTAL -1:1500 VERTICAL -N/A
APPROVED BY:
CONTRACT NO:
DRAWING NO: B-4

10/11/2024

F:\FTP\PROJECT FILES\1 CIVIL 3D PROJECT FILES\2105049 - MILL ST NORWOOD\3 SHEETS\2105049 - B-5 - STORMWATER MANAGEMENT FACILITY



GENERAL NOTES:

- ALL INFORMATION TO BE VERIFIED ON SITE PRIOR TO COMMENCING ANY WORK. ANY DISCREPANCIES ARE TO BE REPORTED TO THE CONSULTANT IMMEDIATELY.
- 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.
- EXCLUDING THE BENCHMARK AND DESCRIPTION PROVIDED FOR THIS PROJECT, NO OTHER ELEVATIONS ARE TO BE USED AS A REFERENCE ELEVATION FOR ANY PURPOSE.

METRIC NOTE:

- ALL DIMENSIONS SHOWN ARE IN METRES OR MILLIMETRES, UNLESS OTHERWISE NOTED.

GEOMETRIC NOTE:

- ALL SURVEY DATA SHOWN ON THIS DRAWING WAS RECORDED USING REAL-TIME KINETIC (RTK) GPS OBSERVATIONS IN REFERENCE TO UTM 18 NORTH COORDINATE SYSTEM.
- ALL SURVEY ELEVATIONS ARE IN REFERENCE TO CGVD28.
- ALL LIDAR ELEVATIONS ARE IN REFERENCE TO CGVD2013.

* * DRAWINGS ARE NOT TO BE SCALED * *

REVISIONS

NO.	DATE	DESCRIPTION	BY

LEGEND

MAJOR FLOW ROUTE

MINOR FLOW ROUTE

JEWELL ENGINEERING

UPPER MILL POND PARK GATE DEVELOPMENT

NORWOOD, ONTARIO

TOWNSHIP OF ASPHODEL-NORWOOD

STORMWATER MANAGEMENT FACILITY (CONTOURS - CGVD28)

DRAWN BY: JH

PROJECT NO: 210-5049

DESIGNED BY:

DATE: October 2024

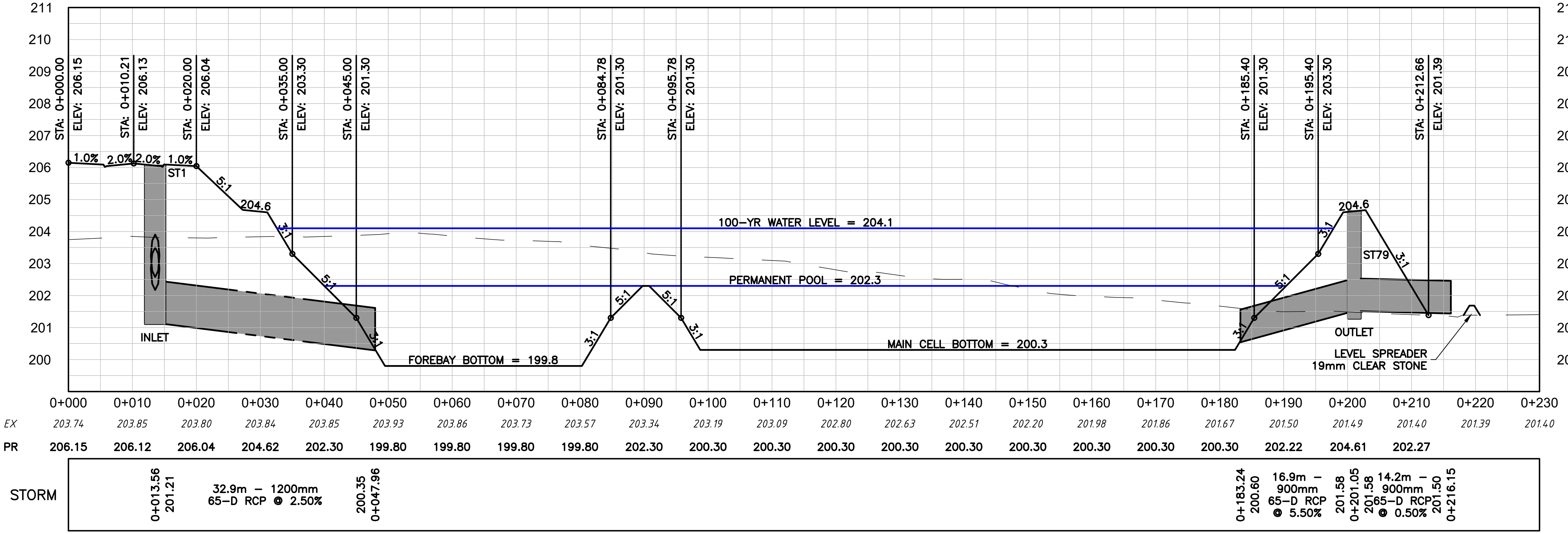
CHECKED BY: AMR

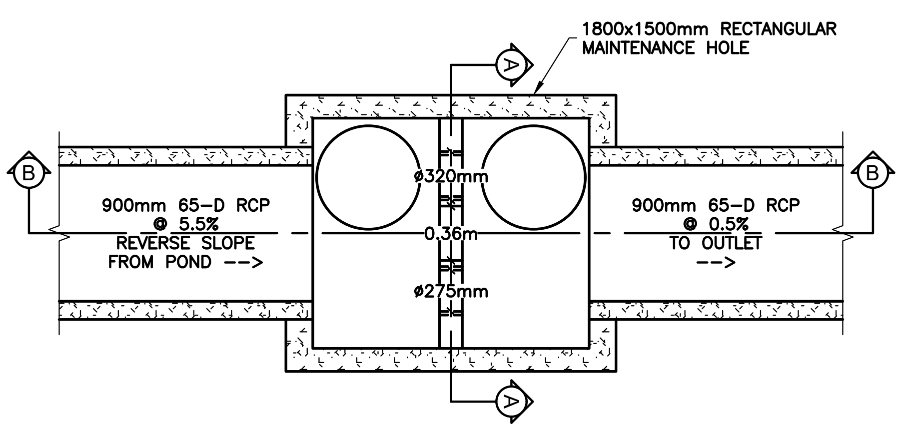
SCALE: HORIZONTAL -1:750 VERTICAL -N/A

APPROVED BY:

CONTRACT NO:

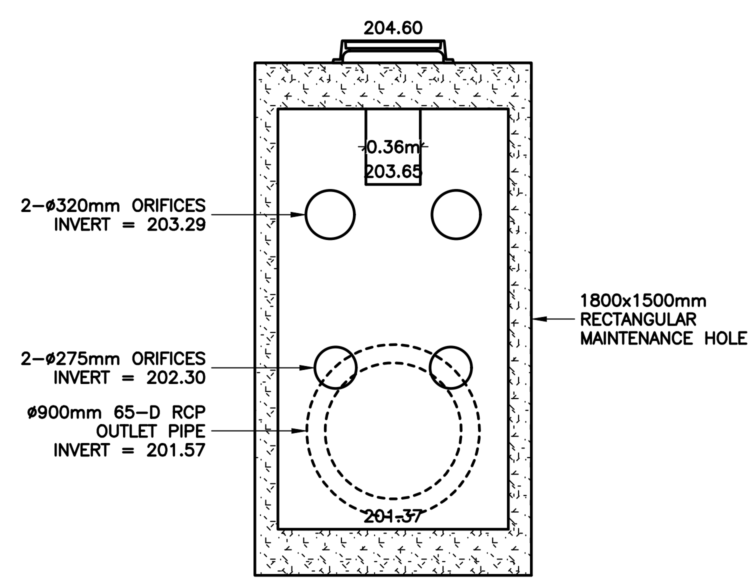
DRAWING NO: B-5





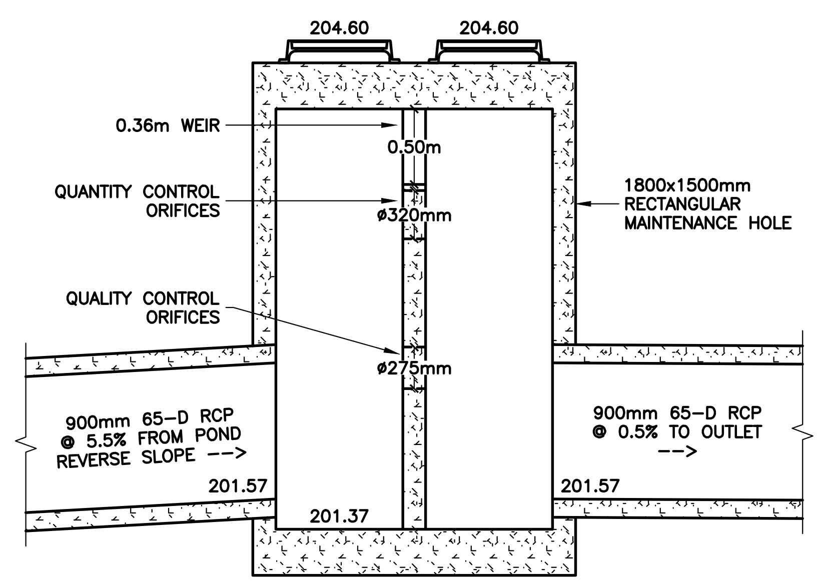
OUTLET STRUCTURE
PLAN VIEW

SCALE - 1:50



OUTLET STRUCTURE
SECTION A-A

SCALE - 1:50



OUTLET STRUCTURE
SECTION B-B

SCALE - 1:50

GENERAL NOTES:

- ALL INFORMATION TO BE VERIFIED ON SITE PRIOR TO COMMENCING ANY WORK. ANY DISCREPANCIES ARE TO BE REPORTED TO THE CONSULTANT IMMEDIATELY.
- 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.
- EXCLUDING THE BENCHMARK AND DESCRIPTION PROVIDED FOR THIS PROJECT, NO OTHER ELEVATIONS ARE TO BE USED AS A REFERENCE ELEVATION FOR ANY PURPOSE.

METRIC NOTE:

- ALL DIMENSIONS SHOWN ARE IN METRES OR MILLIMETRES, UNLESS OTHERWISE NOTED.

GEOMETRIC NOTE:

- ALL SURVEY DATA SHOWN ON THIS DRAWING WAS RECORDED USING REAL-TIME KINETIC (RTK) GPS OBSERVATIONS IN REFERENCE TO UTM 18 NORTH COORDINATE SYSTEM.
- ALL SURVEY ELEVATIONS ARE IN REFERENCE TO CGVD28.
- ALL LIDAR ELEVATIONS ARE IN REFERENCE TO CGVD2013.

* * DRAWINGS ARE NOT TO BE SCALED * *

REVISIONS

NO.	DATE	DESCRIPTION	BY

JEWELL ENGINEERING

UPPER MILL POND
PARK GATE
DEVELOPMENT

NORWOOD, ONTARIO

TOWNSHIP OF ASPHODEL-NORWOOD

STORMWATER MANAGEMENT
FACILITY
PROFILE & OUTLET DETAIL

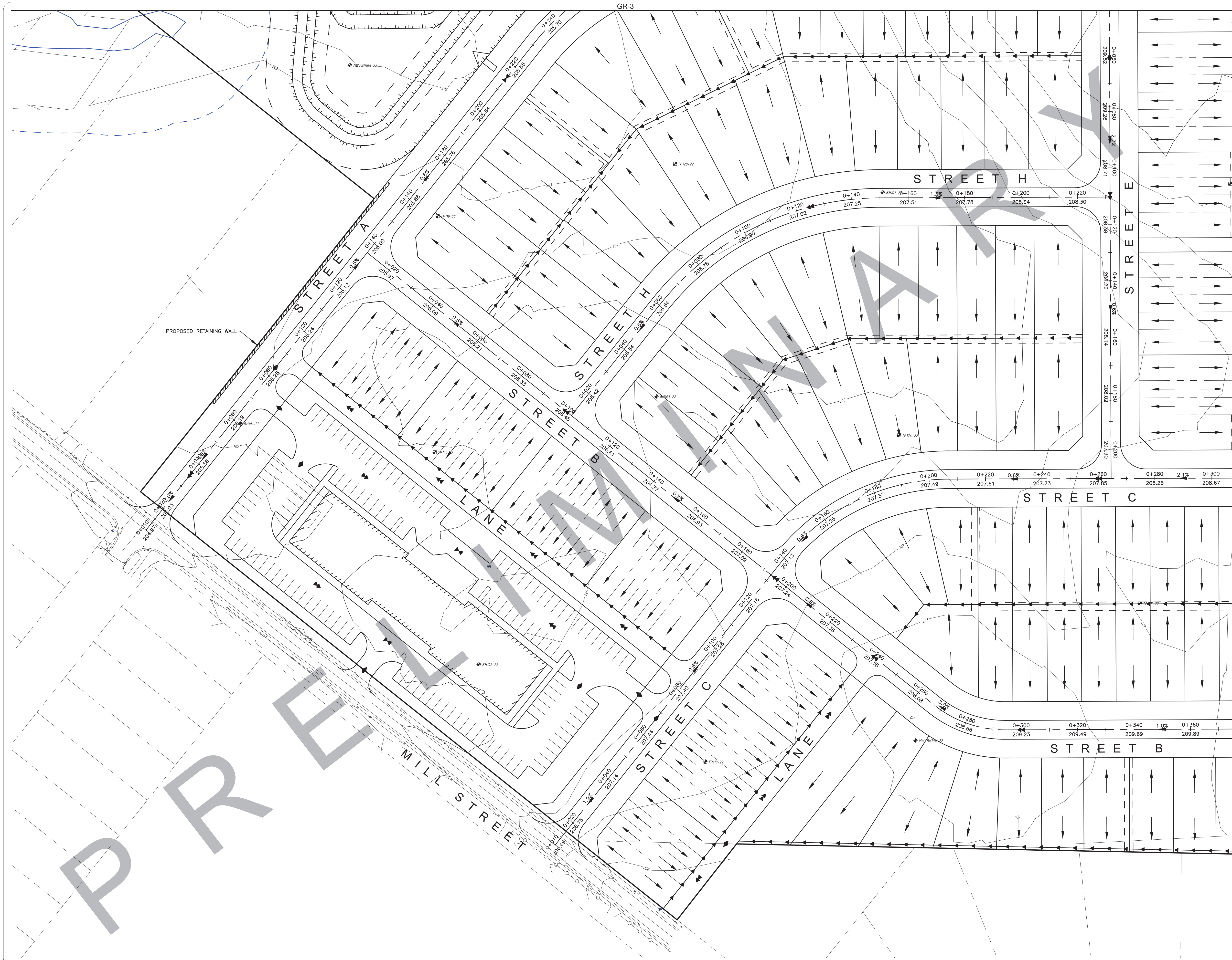
DRAWN BY: JH
PROJECT NO: 210-5049

DESIGNED BY:
DATE: October 2024

CHECKED BY: AMR
SCALE: HORIZONTAL -1:750 VERTICAL -1:150

APPROVED BY:
CONTRACT NO:
DRAWING NO: B-6

11/09/2023



GENERAL NOTES:

- ALL INFORMATION TO BE VERIFIED ON SITE PRIOR TO COMMENCING ANY WORK. ANY DISCREPANCIES ARE TO BE REPORTED TO THE CONSULTANT IMMEDIATELY.
- 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.
- EXCLUDING THE BENCHMARK AND DESCRIPTION PROVIDED FOR THIS PROJECT, NO OTHER ELEVATIONS ARE TO BE USED AS A REFERENCE ELEVATION FOR ANY PURPOSE.

METRIC NOTE:

- ALL DIMENSIONS SHOWN ARE IN METRES OR MILLIMETRES, UNLESS OTHERWISE NOTED.

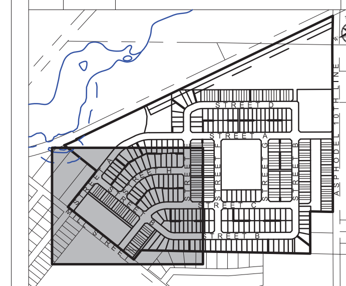
GEOMETRIC NOTE:

- ALL SURVEY DATA SHOWN ON THIS DRAWING WAS RECORDED USING REAL-TIME KINETIC (RTK) GPS OBSERVATIONS IN REFERENCE TO UTM 18 NORTH COORDINATE SYSTEM.
- ALL ELEVATIONS ARE IN REFERENCE TO LOCAL DATUM NAD83 - GEODETIC MODEL HT2_0, UNLESS DESCRIBED OTHERWISE.

* * DRAWINGS ARE NOT TO BE SCALED * *

REVISIONS

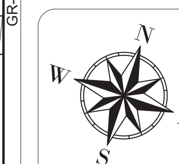
NO.	DATE	DESCRIPTION	BY



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

F:\FTP\PROJECT FILES\1 CIVIL 3D PROJECT FILES\2105049 - MILL ST NORWOOD\3 SHEETS\2105049 - GR

GENERAL NOTES:

- ALL INFORMATION TO BE VERIFIED ON SITE PRIOR TO COMMENCING ANY WORK. ANY DISCREPANCIES ARE TO BE REPORTED TO THE CONSULTANT IMMEDIATELY.
- 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.
- EXCLUDING THE BENCHMARK AND DESCRIPTION PROVIDED FOR THIS PROJECT, NO OTHER ELEVATIONS ARE TO BE USED AS A REFERENCE ELEVATION FOR ANY PURPOSE.

METRIC NOTE:

- ALL DIMENSIONS SHOWN ARE IN METRES OR MILLIMETRES, UNLESS OTHERWISE NOTED.

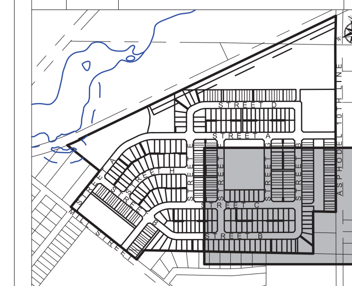
GEOMETRIC NOTE:

- ALL SURVEY DATA SHOWN ON THIS DRAWING WAS RECORDED USING REAL-TIME KINETIC (RTK) GPS OBSERVATIONS IN REFERENCE TO UTM 18 NORTH COORDINATE SYSTEM.
- ALL ELEVATIONS ARE IN REFERENCE TO LOCAL DATUM NAD83 - GEODETIC MODEL HT2_0, UNLESS DESCRIBED OTHERWISE.

* * DRAWINGS ARE NOT TO BE SCALED * *

REVISIONS

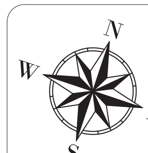
NO.	DATE	DESCRIPTION	BY



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

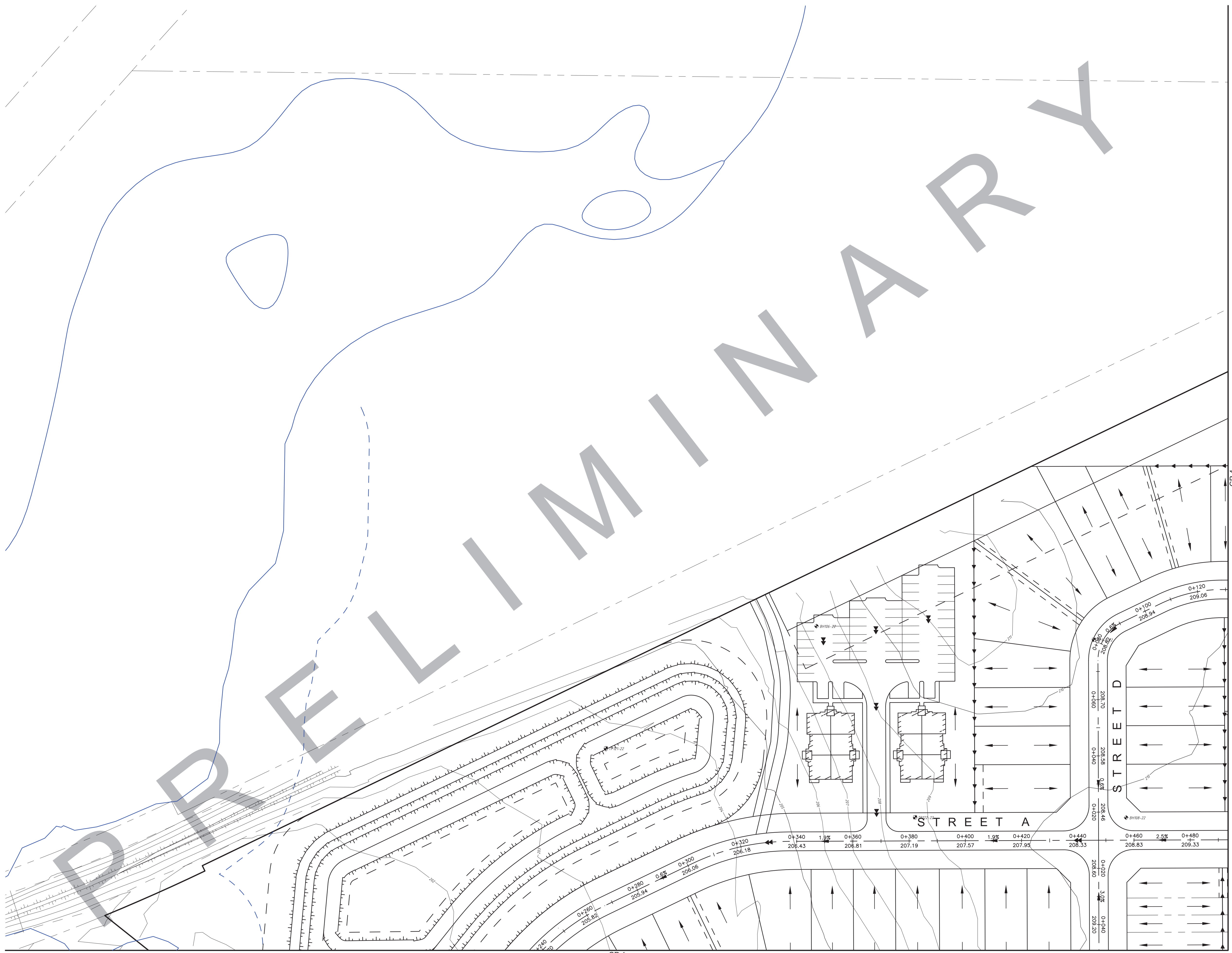
NORWOOD, ONTARIO
TOWNSHIP OF ASPHODEL-NORWOOD

PRELIMINARY
GRADING PLAN
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

F:\FTP\PROJECT FILES\1 CIVIL 3D PROJECT FILES\2105049 - MILL ST NORWOOD\3 SHEETS\2105049 - GR

11/09/2023



GENERAL NOTES:

- ALL INFORMATION TO BE VERIFIED ON SITE PRIOR TO COMMENCING ANY WORK. ANY DISCREPANCIES ARE TO BE REPORTED TO THE CONSULTANT IMMEDIATELY.
- 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.
- EXCLUDING THE BENCHMARK AND DESCRIPTION PROVIDED FOR THIS PROJECT, NO OTHER ELEVATIONS ARE TO BE USED AS A REFERENCE ELEVATION FOR ANY PURPOSE.

METRIC NOTE:

- ALL DIMENSIONS SHOWN ARE IN METRES OR MILLIMETRES, UNLESS OTHERWISE NOTED.

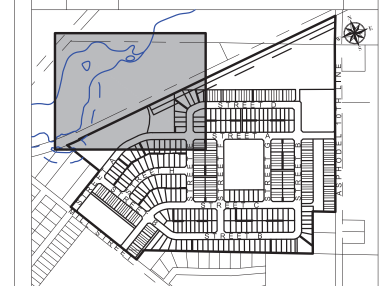
GEOMETRIC NOTE:

- ALL SURVEY DATA SHOWN ON THIS DRAWING WAS RECORDED USING REAL-TIME KINETIC (RTK) GPS OBSERVATIONS IN REFERENCE TO UTM 18 NORTH COORDINATE SYSTEM.
- ALL ELEVATIONS ARE IN REFERENCE TO LOCAL DATUM NAD83 - GEODETIC MODEL HT2_0, UNLESS DESCRIBED OTHERWISE.

* * DRAWINGS ARE NOT TO BE SCALED * *

REVISIONS

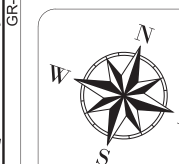
NO.	DATE	DESCRIPTION	BY



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

GENERAL NOTES:

- ALL INFORMATION TO BE VERIFIED ON SITE PRIOR TO COMMENCING ANY WORK. ANY DISCREPANCIES ARE TO BE REPORTED TO THE CONSULTANT IMMEDIATELY.
- 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.
- EXCLUDING THE BENCHMARK AND DESCRIPTION PROVIDED FOR THIS PROJECT, NO OTHER ELEVATIONS ARE TO BE USED AS A REFERENCE ELEVATION FOR ANY PURPOSE.

METRIC NOTE:

- ALL DIMENSIONS SHOWN ARE IN METRES OR MILLIMETRES, UNLESS OTHERWISE NOTED.

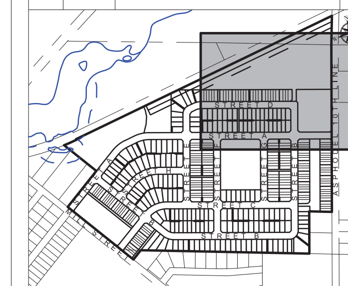
GEOMETRIC NOTE:

- ALL SURVEY DATA SHOWN ON THIS DRAWING WAS RECORDED USING REAL-TIME KINETIC (RTK) GPS OBSERVATIONS IN REFERENCE TO UTM 18 NORTH COORDINATE SYSTEM.
- ALL ELEVATIONS ARE IN REFERENCE TO LOCAL DATUM NAD83 - GEODETIC MODEL HT2_0, UNLESS DESCRIBED OTHERWISE.

* * DRAWINGS ARE NOT TO BE SCALED * *

REVISIONS

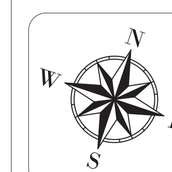
NO.	DATE	DESCRIPTION	BY



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



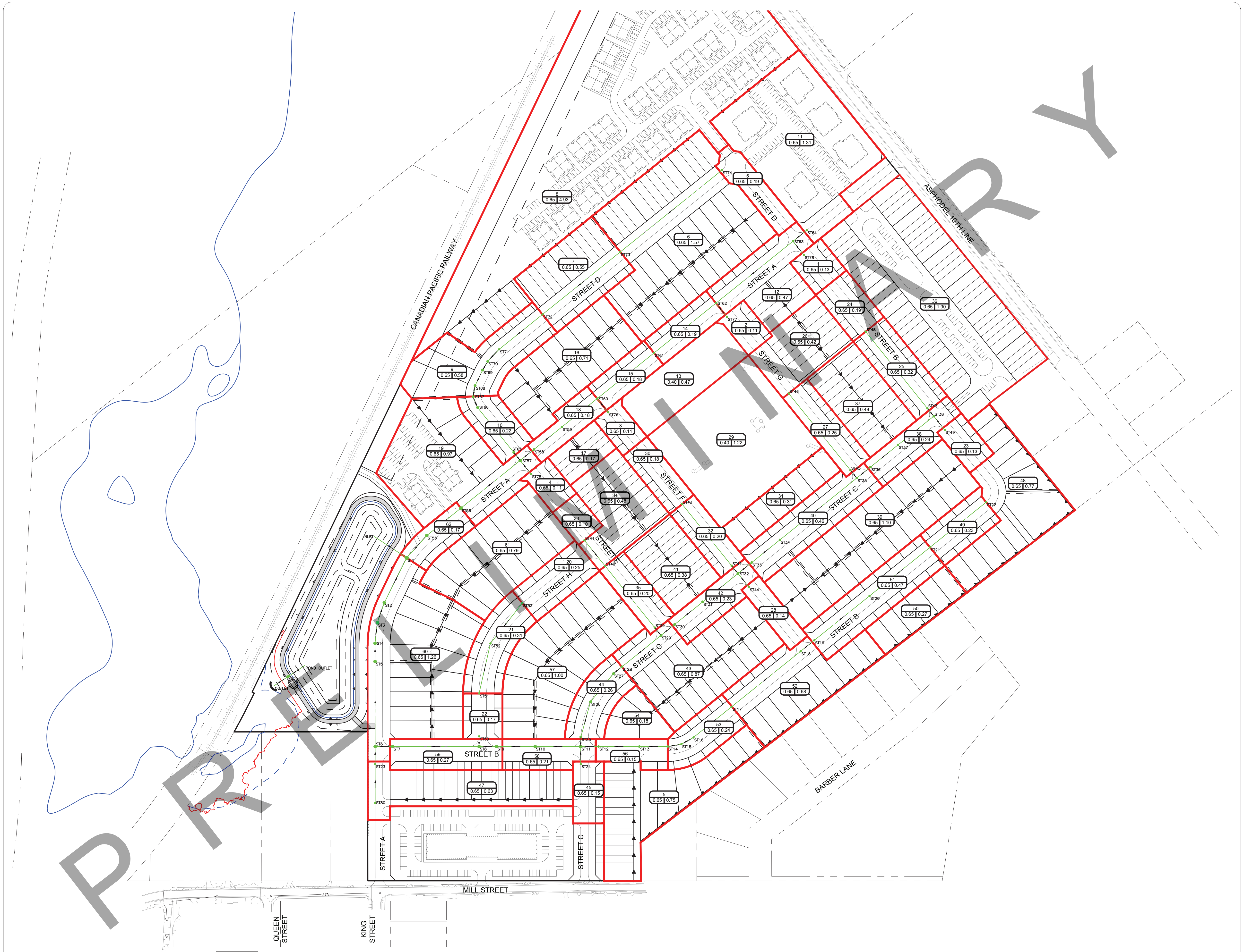
JEWELL ENGINEERING

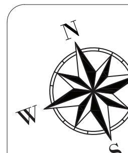
MILL STREET SUBDIVISION
PARK GATE DEVELOPMENT

NORWOOD, ONTARIO
TOWNSHIP OF ASPHODEL-NORWOOD

PRELIMINARY
GRADING PLAN
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





GENERAL NOTES:

- ALL INFORMATION TO BE VERIFIED ON SITE PRIOR TO COMMENCING ANY WORK. ANY DISCREPANCIES ARE TO BE REPORTED TO THE CONSULTANT IMMEDIATELY.
- 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.
- EXCLUDING THE BENCHMARK AND DESCRIPTION PROVIDED FOR THIS PROJECT, NO OTHER ELEVATIONS ARE TO BE USED AS A REFERENCE ELEVATION FOR ANY PURPOSE.

METRIC NOTE:

- ALL DIMENSIONS SHOWN ARE IN METRES OR MILLIMETRES, UNLESS OTHERWISE NOTED.

GEOMETRIC NOTE:

- ALL SURVEY DATA SHOWN ON THIS DRAWING WAS RECORDED USING REAL-TIME KINETIC (RTK) GPS OBSERVATIONS IN REFERENCE TO UTM 18 NORTH COORDINATE SYSTEM.
- 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

JEWELL ENGINEERING

MILL STREET SUBDIVISION
PARK GATE DEVELOPMENT

NORWOOD, ONTARIO
TOWNSHIP OF ASPHODEL-NORWOOD

STORM SEWER NETWORK
CATCHMENT PLAN

DRAWN BY: JH
PROJECT NO: 210-5049
DESIGNED BY:
DATE: February 2025
CHECKED BY: AMR
SCALE: HORIZONTAL - 1:1500 VERTICAL - N/A
APPROVED BY:
CONTRACT NO:
DRAWING NO: ST-1

STORM SEWER DESIGN SHEET

Peak Runoff Estimate by Rational Method

$$Q = \frac{1}{360}\, C\, i\, A$$

Where:

Q = Peak Flow in cms
C = Runoff Coefficient
i = Rainfall Intensity in mm/hr
A = Area in hectares

Intensity for: Trenton
Station: 6158875

$$i = A * T_c^{\,B}$$

Where:

i = Rainfall Intensity in mm/hr
T_c = Time of Concentration in hours

5-Year Parameters
A = 25.2
B = -0.664

100-Year Parameters
A = 43.4
B = -0.674

Manning's Coef
CSP 0.024
RCP/PVC 0.013

Pipe Capacity by Manning's Equation

Where:

$$Q = \frac{1}{n} A R^{2/3} S^{1/2}$$

A = area of pipe in m^2
R = Hydraulic radius = A / P
P = Wetted perimeter
S = Slope (m/m)
n = Manning's friction coef.

Check

$q \leq Q$
$V \leq 6\, m/s$

LOCATION				PEAK FLOW CALCULATION										PROPOSED SEWER								
Street	Catchment ID	Upstream Structure	Downstream Structure	Catchment Areas / Runoff Coefficient 0.25	0.40	0.45	0.55	0.65	RC x A Individual (ha)	RC x A Cummulitive (ha)	Time of Concentration (min)	Intensity (mm/hr)	Peak Flow (m^3/s)	Pipe Size (mm)	Length (m)	Type of Pipe (material)	Grade (m/m) (%)	Capacity, n 0.013 (m^3/s)	Full Flow Velocity (m/s)	Time of Flow (min)	Actual Velocity at Q_d (m/s)	Check Capacity
Street B	1	ST78	**ST63**					0.13	0.08	0.08	15.00	63.3	0.01	300	14.5	PVC	0.30%	0.05	0.75	0.32	0.64	OK
Street G	2	ST77	**ST62**					0.11	0.07	0.07	15.00	63.3	0.01	300	14.5	PVC	0.30%	0.05	0.75	0.32	0.61	OK
Street F	3	ST76	**ST60**					0.11	0.07	0.07	15.00	63.3	0.01	300	14.4	PVC	0.30%	0.05	0.75	0.32	0.61	OK
Street E	4	ST75	**ST57**					0.11	0.07	0.07	15.00	63.3	0.01	300	13.9	PVC	0.30%	0.05	0.75	0.31	0.61	OK
Street D	5	ST74	ST73					0.19	0.12	0.12	15.00	63.3	0.02	300	115.3	PVC	0.30%	0.05	0.75	2.56	0.71	OK
Street D	6	ST73	ST72					1.57	1.02	1.14	17.56	57.0	0.18	600	87.5	RCP	0.30%	0.34	1.19	1.23	1.21	OK
Street D	7	ST72	ST71					0.55	0.36	1.50	18.79	54.5	0.23	600	48.5	RCP	0.30%	0.34	1.19	0.68	1.27	OK
Street D		ST71	ST70						0.00	1.50	19.47	53.2	0.22	600	13.2	RCP	0.30%	0.34	1.19	0.18	1.27	OK
Street D	8	ST70	ST69					4.93	3.20	4.71	19.66	52.9	0.69	900	7.2	RCP	0.30%	0.99	1.56	0.08	1.68	OK
Street D		ST69	ST68						0.00	4.71	19.73	52.7	0.69	900	13.7	RCP	0.30%	0.99	1.56	0.15	1.68	OK
Street D		ST68	ST67						0.00	4.71	19.88	52.5	0.69	900	8.2	RCP	0.30%	0.99	1.56	0.09	1.68	OK
Street D	9	ST67	ST66					0.58	0.38	5.08	19.97	52.3	0.74	975	8.6	RCP	0.30%	1.23	1.64	0.09	1.71	OK
Street D		ST66	ST65						0.00	5.08	20.05	52.2	0.74	975	49.8	RCP	0.30%	1.23	1.64	0.50	1.71	OK
Street D	10	ST65	**ST57**					0.22	0.14	5.23	20.56	51.3	0.75	975	6.9	RCP	0.30%	1.23	1.64	0.07	1.71	OK
Street A	11	ST64	**ST63**					1.31	0.85	0.85	15.00	63.3	0.15	525	14.5	RCP	0.30%	0.24	1.09	0.22	1.15	OK
Street A		**ST63**	**ST62**						0.00	0.94	15.32	62.4	0.16	525	86.8	RCP	0.30%	0.24	1.09	1.33	1.17	OK
Street A	12	**ST62**	ST61					0.47	0.31	1.31	16.65	59.0	0.22	600	69.5	RCP	0.30%	0.34	1.19	0.97	1.26	OK
Street A	13, 14	ST61	**ST60**		0.47			0.19	0.31	1.62	17.63	56.8	0.26	675	63.5	RCP	0.30%	0.46	1.29	0.82	1.32	OK
Street A	15	**ST60**	ST59					0.18	0.12	1.81	18.45	55.1	0.28	675	38.9	RCP	0.30%	0.46	1.29	0.50	1.34	OK
Street A	16, 17	ST59	ST58					0.88	0.57	2.39	18.95	54.2	0.36	750	30.4	RCP	0.30%	0.61	1.38	0.37	1.43	OK
Street A	18	ST58	**ST57**					0.18	0.12	2.50	19.32	53.5	0.37	750	13.8	RCP	0.30%	0.61	1.38	0.17	1.44	OK
Street A	19	**ST57**	ST56					0.97	0.63	8.43	20.63	51.2	1.20	1200	65.4	RCP	0.30%	2.14	1.89	0.58	1.93	OK
Street A		ST56	ST55						0.00	8.43	21.21	50.3	1.18	1200	36.7	RCP	0.30%	2.14	1.89	0.32	1.93	OK
Street A		ST55	**ST1**						0.00	8.43	21.53	49.8	1.17	1200	24.0	RCP	0.30%	2.14	1.89	0.21	1.92	OK
Street H	20	ST53	ST52					0.25	0.16	0.16	15.00	63.3	0.03	300	44.6	PVC	0.30%	0.05	0.75	0.99	0.76	OK
Street H		ST52	ST51						0.00	0.16	15.99	60.6	0.03	300	44.6	PVC	0.30%	0.05	0.75	0.99	0.75	OK
Street H	21	ST51	ST50					0.31	0.20	0.36	16.98	58.3	0.06	375	37.1	PVC	0.30%	0.10	0.87	0.71	0.91	OK
Street H	22	ST50	**ST8**					0.14	0.09	0.46	17.70	56.7	0.07	450	7.2	PVC	0.30%	0.16	0.98	0.12	0.96	OK
Street B	23	ST49	**ST38**					0.13	0.08	0.08	15.00	63.3	0.01	300	14.4	PVC	0.30%	0.05	0.75	0.32	0.64	OK
Street B	24	ST48	ST47					0.19	0.12	0.12	15.00	63.3	0.02	300	86.6	PVC	0.30%	0.05	0.75	1.93	0.71	OK
Street B	25	ST47	**ST38**					0.32	0.21	0.33	16.93	58.4	0.05	375	7.6	PVC	0.30%	0.10	0.87	0.15	0.89	OK
Street G	26	ST46	ST45					0.42	0.27	0.27	15.00	63.3	0.05	375	86.6	PVC	0.30%	0.10	0.87	1.66	0.87	OK
Street G	27	ST45	**ST35**					0.25	0.16	0.44	16.66	59.0	0.07	450	7.6	PVC	0.30%	0.16	0.98	0.13	0.96	OK

STORM SEWER DESIGN SHEET

Peak Runoff Estimate by Rational Method

$$Q = \frac{1}{360}\, C\, i\, A$$

Where:

Q = Peak Flow in cms
C = Runoff Coefficient
i = Rainfall Intensity in mm/hr
A = Area in hectares

Intensity for: Trenton
Station: 6158875

$$i = A * T_c^{\,B}$$

Where:

i = Rainfall Intensity in mm/hr
T_c = Time of Concentration in hours

5-Year Parameters
A = 25.2
B = -0.664

100-Year Parameters
A = 43.4
B = -0.674

Manning's Coef
CSP 0.024
RCP/PVC 0.013

Pipe Capacity by Manning's Equation

Where: $$Q = \frac{1}{n}\, A\, R^{2/3}\, S^{1/2}$$

A = area of pipe in m^2
R = Hydraulic radius = A / P
P = Wetted perimeter
S = Slope (m/m)
n = Manning's friction coef.

Check
$q \le Q$
$V \le 6\, m/s$

LOCATION				PEAK FLOW CALCULATION										PROPOSED SEWER								
Street	Catchment ID	Upstream Structure	Downstream Structure	Catchment Areas / Runoff Coefficient 0.25	0.40	0.45	0.55	0.65	RC x A Individual (ha)	RC x A Cummulitive (ha)	Time of Concentration (min)	Intensity (mm/hr)	Peak Flow (m^3/s)	Pipe Size (mm)	Length (m)	Type of Pipe (material)	Grade (m/m) (%)	Capacity, n 0.013 (m^3/s)	Full Flow Velocity (m/s)	Time of Flow (min)	Actual Velocity at Q_d (m/s)	Check Capacity
Street F	28	ST44	**ST32**					0.14	0.09	0.09	15.00	63.3	0.02	300	14.2	PVC	0.30%	0.05	0.75	0.32	0.66	OK
Street F	29, 30, 31	ST43	ST42		1.22			0.49	0.81	0.81	15.00	63.3	0.14	525	69.2	RCP	0.30%	0.24	1.09	1.06	1.13	OK
Street F	32	ST42	**ST32**					0.20	0.13	0.94	16.06	60.5	0.16	600	7.5	RCP	0.30%	0.34	1.19	0.11	1.17	OK
Street E	33	ST41	ST40					0.10	0.07	0.07	15.00	63.3	0.01	300	28.2	PVC	0.30%	0.05	0.75	0.63	0.60	OK
Street E	34	ST40	ST39					0.48	0.31	0.38	15.63	61.6	0.06	375	69.2	PVC	0.30%	0.10	0.87	1.33	0.93	OK
Street E	35	ST39	**ST29**					0.20	0.13	0.51	16.95	58.3	0.08	450	7.5	RCP	0.30%	0.16	0.98	0.13	0.99	OK
Street C	36	**ST38**	ST37					1.90	1.24	1.65	17.07	58.1	0.27	675	40.1	RCP	0.30%	0.46	1.29	0.52	1.33	OK
Street C	37	ST37	ST36					0.48	0.31	1.96	17.59	56.9	0.31	675	30.0	RCP	0.30%	0.46	1.29	0.39	1.38	OK
Street C	38	ST36	**ST35**					0.24	0.16	2.12	17.98	56.1	0.33	675	14.2	RCP	0.30%	0.46	1.29	0.18	1.40	OK
Street C		**ST35**	ST34						0.00	2.55	18.16	55.7	0.40	750	86.3	RCP	0.30%	0.61	1.38	1.04	1.46	OK
Street C	39	ST34	ST33					1.10	0.72	3.27	19.21	53.7	0.49	825	30.8	RCP	0.30%	0.79	1.47	0.35	1.54	OK
Street C	40	ST33	**ST32**					0.46	0.30	3.57	19.56	53.1	0.53	825	14.1	RCP	0.30%	0.79	1.47	0.16	1.57	OK
Street C		**ST32**	ST31						0.00	4.60	19.71	52.8	0.67	900	38.6	RCP	0.30%	0.99	1.56	0.41	1.67	OK
Street C	41	ST31	ST30					0.38	0.25	4.84	20.13	52.0	0.70	900	30.2	RCP	0.30%	0.99	1.56	0.32	1.69	OK
Street C	42	ST30	**ST29**					0.23	0.15	4.99	20.45	51.5	0.71	900	13.9	RCP	0.30%	0.99	1.56	0.15	1.70	OK
Street C		**ST29**	ST28						0.00	5.50	20.60	51.3	0.78	975	42.9	RCP	0.30%	1.23	1.64	0.43	1.74	OK
Street C	43	ST28	ST27					0.87	0.57	6.07	21.03	50.5	0.85	975	7.7	RCP	0.30%	1.23	1.64	0.08	1.77	OK
Street C		ST27	ST26						0.00	6.07	21.11	50.4	0.85	975	30.7	RCP	0.30%	1.23	1.64	0.31	1.77	OK
Street C		ST26	ST25						0.00	6.07	21.42	49.9	0.84	975	30.7	RCP	0.30%	1.23	1.64	0.31	1.77	OK
Street C	44	ST25	**ST11**					0.26	0.17	6.23	21.73	49.5	0.86	975	6.4	RCP	0.30%	1.23	1.64	0.06	1.77	OK
Street C	45	ST24	**ST11**					0.15	0.10	0.10	15.00	63.3	0.02	300	14.5	PVC	0.30%	0.05	0.75	0.32	0.67	OK
Street A	47	ST80	ST23					0.63	0.41	0.41	15.00	63.3	0.07	525	33.4	RCP	0.30%	0.24	1.09	0.51	0.96	OK
Street A		ST23	**ST6**						0.00	0.41	15.51	61.9	0.07	525	13.9	RCP	0.30%	0.24	1.09	0.21	0.95	OK
Street B	48	ST22	ST21					0.77	0.50	0.50	15.00	63.3	0.09	450	63.0	RCP	0.30%	0.16	0.98	1.07	1.01	OK
Street B	49, 50	ST21	ST20					0.50	0.33	0.83	16.07	60.4	0.14	525	67.9	RCP	0.30%	0.24	1.09	1.04	1.13	OK
Street B		ST20	ST19						0.00	0.83	17.11	58.0	0.13	525	62.0	RCP	0.30%	0.24	1.09	0.95	1.12	OK
Street B	51	ST19	ST18					0.47	0.31	1.13	18.06	55.9	0.18	600	14.5	RCP	0.30%	0.34	1.19	0.20	1.20	OK
Street B		ST18	ST17						0.00	1.13	18.26	55.5	0.17	600	77.6	RCP	0.30%	0.34	1.19	1.09	1.20	OK
Street B	52	ST17	ST16					0.68	0.44	1.57	19.35	53.4	0.23	600	42.5	RCP	0.30%	0.34	1.19	0.60	1.28	OK
Street B		ST16	ST15						0.00	1.57	19.95	52.4	0.23	600	11.2	RCP	0.30%	0.34	1.19	0.16	1.28	OK
Street B		ST15	ST14						0.00	1.57	20.10	52.1	0.23	600	11.0	RCP	0.30%	0.34	1.19	0.15	1.27	OK
Street B	53	ST14	ST13					0.24	0.16	1.73	20.26	51.8	0.25	675	23.7	RCP	0.30%	0.46	1.29	0.31	1.31	OK
Street B	54, 55	ST13	ST12					0.93	0.60	2.33	20.56	51.3	0.33	750	34.8	RCP	0.30%	0.61	1.38	0.42	1.41	OK
Street B	56	ST12	**ST11**					0.15	0.10	2.43	20.98	50.6	0.34	750	13.9	RCP	0.30%	0.61	1.38	0.17	1.41	OK
Street B		**ST11**	ST10						0.00	8.76	21.80	49.4	1.20	1200	38.2	RCP	0.30%	2.14	1.89	0.34	1.94	OK
Street B	57	ST10	ST9					1.00	0.65	9.41	22.14	48.9	1.28	1200	31.9	RCP	0.30%	2.14	1.89	0.28	1.96	OK
Street B	58	ST9	**ST8**					0.21	0.14	9.55	22.42	48.4	1.29	1200	13.3	RCP	0.30%	2.14	1.89	0.12	1.97	OK

STORM SEWER DESIGN SHEET

Peak Runoff Estimate by Rational Method

$$Q = \frac{1}{360}\ C\ i\ A$$

Where:

Q = Peak Flow in cms
C = Runoff Coefficient
i = Rainfall Intensity in mm/hr
A = Area in hectares

Intensity for: Trenton
Station: 6158875

$$i = A * T_c^{\ B}$$

Where:

i = Rainfall Intensity in mm/hr
T_c = Time of Concentration in hours

5-Year Parameters

A = 25.2
B = -0.664

100-Year Parameters

A = 43.4
B = -0.674

Manning's Coef

CSP 0.024
RCP/PVC 0.013

Pipe Capacity by Manning's Equation

Where: $$Q = \frac{1}{n}\ A\ R^{2/3}\ S^{1/2}$$

A = area of pipe in m^2
R = Hydraulic radius = A / P
P = Wetted perimeter
S = Slope (m/m)
n = Manning's friction coef.

Check

$q \leq Q$
$V \leq 6\ m/s$

LOCATION				PEAK FLOW CALCULATION										PROPOSED SEWER								
Street	Catchment ID	Upstream Structure	Downstream Structure	Catchment Areas / Runoff Coefficient 0.25	0.40	0.45	0.55	0.65	RC x A Individual (ha)	RC x A Cummulitive (ha)	Time of Concentration (min)	Intensity (mm/hr)	Peak Flow (m^3/s)	Pipe Size (mm)	Length (m)	Type of Pipe (material)	Grade (m/m) (%)	Capacity, n 0.013 (m^3/s)	Full Flow Velocity (m/s)	Time of Flow (min)	Actual Velocity at Q_d (m/s)	Check Capacity
Street B		**ST8**	ST7						0.00	10.00	22.54	48.3	1.34	1200	74.5	RCP	0.30%	2.14	1.89	0.66	1.99	OK
Street B	59	ST7	**ST6**					0.27	0.18	10.18	23.19	47.4	1.34	1200	13.4	RCP	0.30%	2.14	1.89	0.12	1.98	OK
Street A		**ST6**	ST5						0.00	10.59	23.31	47.2	1.39	1200	73.4	RCP	0.30%	2.14	1.89	0.65	2.00	OK
Street A	60	ST5	ST4					1.26	0.82	11.41	23.96	46.4	1.47	1200	13.7	RCP	0.30%	2.14	1.89	0.12	2.03	OK
Street A		ST4	ST3						0.00	11.41	24.08	46.2	1.47	1200	16.3	RCP	0.30%	2.14	1.89	0.14	2.03	OK
Street A		ST3	ST2						0.00	11.41	24.22	46.0	1.46	1200	16.3	RCP	0.30%	2.14	1.89	0.14	2.03	OK
Street A	61	ST2	**ST1**					0.79	0.51	11.92	24.37	45.8	1.52	1200	42.1	RCP	0.30%	2.14	1.89	0.37	2.05	OK
Street A	62	**ST1**	Pond Inlet					0.17	0.11	20.46	24.74	45.4	2.58	1200	32.9	RCP	2.50%	6.16	5.45	0.10	5.18	OK
SWM Facility	Pond	ST79	Outlet										1.10	900	15.3	RCP	0.50%	1.28	2.01	0.13	2.27	OK

JEWELL ENGINEERING

Jewell Engineering Inc
1-71 Millennium Parkway
Belleville, ON, K8N 4Z5
Ph. 613-969-1111
Fx. 613-969-8988
www.jewelleng.ca

Designed:	Julie Humphrie, C.E.T.	**Project:**
Checked:	Amanda Redden, P.Eng.	Upper Mill Pond Subdivision
Date:	February 11, 2025	Norwood, Ontario

APPENDIX C

Pre-Development Model Inputs

Lots	Area, ha	Imp. Per Lot, m^2	Imp. Cover, ha	Imperviousness	Land Type	Notes
71	2.98	216	1.53	51%	12.2m single-detached lots	180m2 + 36m2 driveway
52	3.32	256	1.33	40%	13.7m single-detached lots	220m2 + 36m2 driveway
73	4.41	296	2.16	49%	15.0m single-detached lots	260m2 + 36m2 driveway
134	4.22	196	2.63	62%	6.1m two-storey townhouses	160m2 + 36m2 driveway
70	2.07	216	1.51	73%	7.4m bungalow townhouses	180m2 + 36m2 driveway
24	0.55			70%	Two 12-unit, 3-storey, stacked townhouses	
60	1.30			55%	Five 12-unit, 3-storey buildings	
40	1.13			85%	3-storey apartment with at-grade commercial	
116	4.03			40%	medium-density condo block	
	1.84			20%	parkland, walkways, service easements	Conservative (mostly pervious)
	1.75			50%	SWMF	Standard 50% for Permanent Pool Area
	0.92			0%	safety berm & accoustic fence	No Imp.
	6.98			50%	20.0 municipal road allowance	8.5m road + 1.5m sidewalk
	35.50			**49%**		

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

<u>**T_p calculations – Airport Method**</u>

Selected pre-development runoff coefficient = 0.22

Catchment 100 – 22.7ha

Longest flow length: 800m

85% elevation: 210.5m

10% elevation: 202.5m

Slope = 0.013 (1.3%)

$$T_c = \frac{3.26 * (1.1 - C) * \sqrt{L}}{S_w^{0.33}} = 74\ min$$

T_p = 2/3 * T_c = 50 min = 0.82hr

Catchment 200 – 2.3ha

Longest flow length: 85m

85% elevation: 212.0m

10% elevation: 209.0m

Slope = 0.047 (4.7%)

$$T_c = \frac{3.26 * (1.1 - C) * \sqrt{L}}{S_w^{0.33}} = 16\ min$$

T_p = 2/3 * T_c = 11 min = 0.18hr

APPENDIX D

Facility Sizing – Wet Pond SWMF, Apartment/Commercial Modified Rational Method

Proposed outlets:

- Two, 275mm diam. orifices, inverts at 202.30m
- Two, 320mm diam orifices, inverts at 203.29m
- 0.36m broad-crested weir, invert at 203.65m
- 4m broad-crested spillway, invert at 204.18m (Q = 1.67LH^(3/2)) = 1.82m^3/s at Top of Berm 204.6

Elevation	Area (sq.m)				Volume (cu.m)	
(m)	Forebay	Main Cell	Full Pond	Total	Increment	Cumulative
199.8	232.6			232.6	0.0	0.0
199.9	259.0			259.0	24.6	24.6
200.0	286.0			286.0	27.2	51.8
200.1	313.7			313.7	30.0	81.8
200.2	342.0			342.0	32.8	114.6
200.3	371.0	1,845.4		2,216.4	127.9	242.5
200.4	400.7	1,919.6		2,320.3	226.8	469.4
200.5	431.0	1,994.3		2,425.3	237.3	706.6
200.6	462.0	2,069.6		2,531.6	247.8	954.5
200.7	493.6	2,145.6		2,639.2	258.5	1,213.0
200.8	525.9	2,222.1		2,748.0	269.4	1,482.4
200.9	558.9	2,299.2		2,858.1	280.3	1,762.7
201.0	592.5	2,376.9		2,969.4	291.4	2,054.1
201.1	626.8	2,455.2		3,082.0	302.6	2,356.6
201.2	661.8	2,534.1		3,195.9	313.9	2,670.5
201.3	697.4	2,613.6		3,311.0	325.3	2,995.9
201.4	757.2	2,747.5		3,504.7	340.8	3,336.7
201.5	818.5	2,882.8		3,701.3	360.3	3,697.0
201.6	881.4	3,019.8		3,901.2	380.1	4,077.1
201.7	945.9	3,158.3		4,104.2	400.3	4,477.3
201.8	1,011.9	3,298.4		4,310.3	420.7	4,898.1
201.9	1,079.5	3,440.1		4,519.6	441.5	5,339.6
202.0	1,148.7	3,583.4		4,732.1	462.6	5,802.2
202.1	1,219.4	3,728.2		4,947.6	484.0	6,286.1
202.2	1,291.7	3,874.6		5,166.3	505.7	6,791.8
202.3			5,468.5	5,468.5	531.7	7,323.6
202.4			5,675.7	5,675.7	557.2	7,880.8
202.5			5,884.4	5,884.4	578.0	8,458.8
202.6			6,094.7	6,094.7	599.0	9,057.7
202.7			6,306.5	6,306.5	620.1	9,677.8
202.8			6,519.9	6,519.9	641.3	10,319.1
202.9			6,734.9	6,734.9	662.7	10,981.9
203.0			6,951.4	6,951.4	684.3	11,666.2
203.1			7,169.5	7,169.5	706.0	12,372.2
203.2			7,389.2	7,389.2	727.9	13,100.2
203.3			7,610.4	7,610.4	750.0	13,850.1
203.4			7,743.9	7,743.9	767.7	14,617.9
203.5			7,878.0	7,878.0	781.1	15,399.0
203.6			8,012.7	8,012.7	794.5	16,193.5
203.7			8,147.9	8,147.9	808.0	17,001.5
203.8			8,283.7	8,283.7	821.6	17,823.1
203.9			8,420.1	8,420.1	835.2	18,658.3
204.0			8,557.0	8,557.0	848.9	19,507.1
204.1			8,694.4	8,694.4	862.6	20,369.7
204.2			8,832.4	8,832.4	876.3	21,246.0
204.3			8,971.0	8,971.0	890.2	22,136.2
204.4			9,110.2	9,110.2	904.1	23,040.3
204.5			9,249.9	9,249.9	918.0	23,958.3
204.6			9,390.6	9,390.6	932.0	24,890.3

Mill St Norwood SWMF Sizing

Andrew Rosenthal, EIT / October 1, 2024

Pond Elevations			**Outlet 1**		**Outlet 2**		**Outlet 3**	
Perm.Pool	202.3		Use Outlet 1?	Yes	Use Outlet 2?	Yes	Use Outlet 3?	Yes
Max. Elev	204.61		Type	Orifice	Type	Orifice	Type	Weir
Increment	0.1		Invert	202.3	Invert	203.29	Invert	203.65
			diam (m)	0.275	diam (m)	0.32	Length	0.36
			No. of Outlets	2	No. of Outlets	2	No. of Outlets	1

Q = 1.67LH^1.5

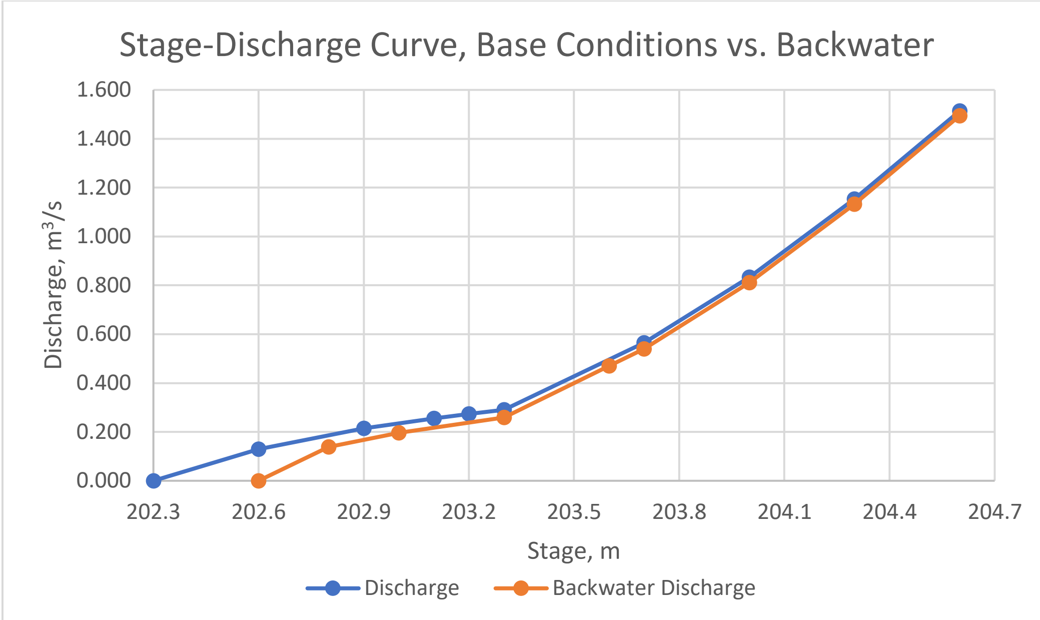
Orifice Equation - Allows orifice flowing partially full

$$= \langle h \le 2r \rangle 0.6 * \left[\left(arccos\left(\frac{r-h}{r}\right)\right) r^2 - r(r-h) * sin\left(arccos\left(\frac{r-h}{r}\right)\right)\right] * \sqrt{2g * \left(\frac{4r * sin^3\left(arccos\left(\frac{r-h}{r}\right)\right)}{3\left(2\left(arccos\left(\frac{r-h}{r}\right)\right) - sin\left(2\left(arccos\left(\frac{r-h}{r}\right)\right)\right)\right)} - (r-h)\right)}$$

$$+ \langle h > 2r \rangle 0.6\pi r^2 * \sqrt{2g(h-r)}$$

Elevation m	Incr.Vol m3	Cum.Vol m3	Head on inv., m	Q, m3/s	Head on inv., m	Q, m3/s	Head on inv., m	Q, m3/s	Q.total m3/s
202.30	0	0	0	0.000	-	0.000	-	0.000	0.000
202.40	557	557	0.1	0.021	-	0.000	-	0.000	0.021
202.50	578	1135	0.2	0.073	-	0.000	-	0.000	0.073
202.60	599	1734	0.3	0.127	-	0.000	-	0.000	0.127
202.70	620	2354	0.4	0.162	-	0.000	-	0.000	0.162
202.80	641	2996	0.5	0.190	-	0.000	-	0.000	0.190
202.90	663	3658	0.6	0.215	-	0.000	-	0.000	0.215
203.00	684	4343	0.7	0.237	-	0.000	-	0.000	0.237
203.10	706	5049	0.8	0.257	-	0.000	-	0.000	0.257
203.20	728	5777	0.9	0.276	-	0.000	-	0.000	0.276
203.30	750	6527	1	0.293	0.01	0.000	-	0.000	0.293
203.40	768	7294	1.1	0.310	0.11	0.028	-	0.000	0.338
203.50	781	8075	1.2	0.325	0.21	0.090	-	0.000	0.416
203.60	795	8870	1.3	0.340	0.31	0.165	-	0.000	0.505
203.70	808	9678	1.4	0.355	0.41	0.214	0.05	0.007	0.575
203.80	822	10500	1.5	0.369	0.51	0.253	0.15	0.035	0.656
203.90	835	11335	1.6	0.382	0.61	0.287	0.25	0.075	0.744
204.00	849	12184	1.7	0.395	0.71	0.317	0.35	0.124	0.836
204.10	863	13046	1.8	0.407	0.81	0.345	0.45	0.181	0.933
204.20	876	13922	1.9	0.419	0.91	0.370	0.55	0.245	1.035
204.30	890	14813	2	0.431	1.01	0.394	0.65	0.315	1.140
204.40	904	15717	2.1	0.442	1.11	0.417	0.75	0.390	1.249
204.50	918	16635	2.2	0.453	1.21	0.438	0.85	0.471	1.363
204.60	932	17567	2.3	0.464	1.31	0.458	0.95	0.557	1.479

4m Spillway Engaged



Adjusted stage-discharge curve calculated using head differential in bottom outlet pair (pond WSEL minus downstream WSEL of 202.60). Other outlets remain unaffected by downstream backwater.

Quality Sizing

Stage, m	Storage, m3	Discharge, L/s	m3/h, avg	h/m3, avg	hr, incr.
202.7	2,354	162	-	-	-
202.6	1,734	127	520	0.002	1.2
202.5	1,135	73	361	0.003	1.7
202.4	557	21	170	0.006	3.4
202.35	279	6	49	0.021	5.7
202.32	105	2	14	0.069	12.1
				Total Drawdown Time	**24**

SWMF Contributing Area	36.51ha
Percent Impervious	50%
Annual Sediment Loading	1.575 m^3/ha = 57.50 m^3/yr
Assumed Treatment Efficiency	80%
Required PP at 75% Treatment	101 m^3/ha = 3,688m^3
Surplus Permanent Pool Capacity	> 3,000m^3
Estimated Cleanout Frequency	3,000 / (57.50*0.80) = > 40Yr

The facility can provide the required quality treatment (design TSS removal - 5%) for 40Yr while maintaining the required permanent pool. The maximum recommended cleanout interval is 40 years.

Southwest Apartment Block – Modified Rational Method Calculations

Ret Per'd	IDF Param.		Pre-Development					Post-, Uncontrolled					Q_all
	A	B	RC	t_c	i	A	Q	RC	t_c	i	A	Q	
2 Yr	20.5	-0.680	0.25	0.58	29.7	2.3	47	0.6	0.33	43.6	0.32	23	24
5 Yr	27.4	-0.675			39.6		63			57.9		31	32
100 Yr	46.1	-0.668			66.3		132			96.7		64	↓

*t_c above in hr, i in mm/h, A in ha, Q in L/s

2 Year Event

Duration	C	i, mm/h	A, ha	Q, m^3/s	Qall, m^3/s	del Q, m^3/s	Storage, m^3
5 min	0.65	111.1	1.08	0.217	0.024	0.192	58
10 min	0.65	69.3	1.08	0.135	0.024	0.111	67
15 min	0.65	52.6	1.08	0.103	0.024	0.078	71
30 min	**0.65**	**32.8**	**1.08**	**0.064**	**0.024**	**0.040**	**72**
60 min	0.65	20.5	1.08	0.040	0.024	0.016	57
2 hr	0.65	12.8	1.08	0.025	0.024	0.001	6
6 hr	0.65	6.1	1.08	0.012	0.024	-0.012	-
12 hr	0.65	3.8	1.08	0.007	0.024	-0.017	-
24 hr	0.65	2.4	1.08	0.005	0.024	-0.020	-

5 Year Event

Duration	C	i, mm/h	A, ha	Q, m^3/s	Qall, m^3/s	del Q, m^3/s	Storage, m^3
5 min	0.65	146.6	1.08	0.286	0.032	0.254	76
10 min	0.65	91.8	1.08	0.179	0.032	0.147	88
15 min	0.65	69.8	1.08	0.136	0.032	0.104	93
30 min	**0.65**	**43.7**	**1.08**	**0.085**	**0.032**	**0.053**	**95**
60 min	0.65	27.4	1.08	0.053	0.032	0.021	76
2 hr	0.65	17.2	1.08	0.033	0.032	0.001	8
6 hr	0.65	8.2	1.08	0.016	0.032	-0.016	-
12 hr	0.65	5.1	1.08	0.010	0.032	-0.022	-
24 hr	0.65	3.2	1.08	0.006	0.032	-0.026	-

100 Year Event

Duration	C	i, mm/h	A, ha	Q, m^3/s	Qall, m^3/s	del Q, m^3/s	Storage, m^3
5 min	0.813	242.4	1.08	0.591	0.032	0.559	168
10 min	0.813	152.6	1.08	0.372	0.032	0.340	204
15 min	0.813	116.4	1.08	0.284	0.032	0.251	226
30 min	0.813	73.2	1.08	0.179	0.032	0.146	263
60 min	**0.813**	**46.1**	**1.08**	**0.112**	**0.032**	**0.080**	**288**
2 hr	0.813	29.0	1.08	0.071	0.032	0.038	276
6 hr	0.813	13.9	1.08	0.034	0.032	0.002	35
12 hr	0.813	8.8	1.08	0.021	0.032	-0.011	-
24 hr	0.813	5.5	1.08	0.013	0.032	-0.019	-

APPENDIX E

Culvert Hydraulics

Downstream 100Yr WSEL – 202.22m

Maximum design flow in culvert (100Yr pre-development) – $1.03m^3/s$

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

$$\mathrm{V} = \frac{\mathrm{Q}}{\mathrm{A}} = \frac{1.03\mathrm{m}^3/\mathrm{s}}{1.22\mathrm{m} * 0.455\mathrm{m}} = 1.86m/s$$

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

$$H = \frac{1.86^2}{2g}\left[1 + 0.5 + \frac{19.6 * 0.013^2 * 16}{0.166^{4/3}}\right] = 0.37m$$

Max design WSEL upstream of culvert = 203.59m

APPENDIX F

OTTHYMO Model Outputs

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

        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              00004

Distributed by the INTERHYMO Centre. Copyright (c), 1989.  Paul Wisner & Assoc.


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




DATE: 03-07-2024                      TIME: 11:09:38


COMMENTS: ____________________________________________________________


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

*
*                   Norwood Subdivision
*
*                   Environment Canada Peterborough Airport YPQ Station
*
*                   2 to 100-Yr Return Period
*                   January 31, 2025
*                   Andrew Rosenthal, P.Eng.
*
*                   4hr 25mm Event
*                   24hr SCS Type II Distribution, 2-100 Yr
*                   Timmins Event
*
*                   LGI, LGP from L=SQRT(A/1.5)
*
*                   Note: 1st routing = no backwater
*                         2nd routing = backwater conditions
*
*                   Revised to subtract SW Apt block flows from SWMF
*
******************************************************************************
```

```
*                   Quality 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)=  34.21
|ID= 1 DT= 5.0 min |   Total Imp(%)=  55.00   Dir. Conn.(%)=  45.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      18.82         15.39
     Dep. Storage     (mm)=       2.00          5.00
     Average Slope     (%)=       2.00          2.00
     Length            (m)=     478.00        478.00
     Mannings n          =        .013          .250

     Max.eff.Inten.(mm/hr)=      49.38          2.31
                over (min)      10.00        145.00
     Storage Coeff.  (min)=       7.04 (ii)  148.29 (ii)
     Unit Hyd. Tpeak (min)=       5.00        150.00
     Unit Hyd. peak  (cms)=        .17           .01
                                                               *TOTALS*
     PEAK FLOW       (cms)=       1.83           .05            1.83 (iii)
     TIME TO PEAK    (hrs)=       1.75          4.67            1.75
     RUNOFF VOLUME    (mm)=      23.00          4.85           12.99
     TOTAL RAINFALL   (mm)=      25.00         25.00           25.00
     RUNOFF COEFFICIENT   =        .92           .19             .52


       (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.

--------------------------------------------------------------------------------
*                   External (Catchment 200)
--------------------
| CALIB              |
| NASHYD    (0001) |   Area    (ha)=   2.30   Curve Number   (CN)= 72.0
|ID= 2 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .18

     Unit Hyd Qpeak  (cms)=    .49

     PEAK FLOW       (cms)=    .02 (i)
     TIME TO PEAK    (hrs)=   1.58
     RUNOFF VOLUME    (mm)=   3.34
     TOTAL RAINFALL   (mm)=  25.00
     RUNOFF COEFFICIENT   =    .13

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

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


--------------------
| ADD HYD   (0001) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0001):    34.21     1.83     1.75    12.99
        + ID2= 2 (0001):     2.30      .02     1.58     3.34
          ==================================================
          ID = 3 (0001):    36.51     1.85     1.75    12.39

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  36.51
| ID= 3   PCYC=186 |   QPEAK     (cms)=   1.85 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   1.75
--------------------   VOLUME     (mm)=  12.39
  Filename: NRWD2.QIN
  Comments:

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

--------------------------------------------------------------------------------
*                   Route through SWMF
--------------------
| RESERVOIR (0001) |
```

```
| IN= 3---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                            .000       .000   |      .190       .300
                            .021       .056   |      .215       .366
                            .073       .113   |      .257       .505
                            .127       .173   |      .000       .000

                                   AREA     QPEAK     TPEAK       R.V.
                                   (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 3 (0001)     36.51      1.85      1.75      12.39
     OUTFLOW: ID= 1 (0001)     36.51       .16      3.00      12.36

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=  8.81
                   TIME SHIFT OF PEAK FLOW         (min)= 75.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=   .25

--------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  36.51
| ID= 1   PCYC=430 |   QPEAK     (cms)=    .16 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   3.00
--------------------   VOLUME     (mm)=  12.36
  Filename: NRWD2.QOU
  Comments:

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

--------------------------------------------------------------------------------
******************************************************************************
*                    2 to 100 Year Storm
******************************************************************************

--------------------
|    READ STORM    |    Filename: YPQ02SCS.STM
| Ptotal= 49.00 mm |    Comments: 24hr SCS Type 2 - 2Yr
--------------------
                 TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                 1.00     .54 |  7.00     .98 | 13.00    5.34 | 19.00     .88
                 2.00     .54 |  8.00     .98 | 14.00    2.35 | 20.00     .88
                 3.00     .64 |  9.00    1.32 | 15.00    1.47 | 21.00     .59
                 4.00     .64 | 10.00    1.67 | 16.00    1.47 | 22.00     .59
                 5.00     .78 | 11.00    2.65 | 17.00     .88 | 23.00     .59
                 6.00     .78 | 12.00   20.97 | 18.00     .88 | 24.00     .59

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

*                    Pre-Development Catchment 100, 22.70 hectares
--------------------
| CALIB            |
```

```
| NASHYD    (0001) |   Area    (ha)=  22.70   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)=    .82

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

     Unit Hyd Qpeak  (cms)=   1.06

     PEAK FLOW       (cms)=    .24 (i)
     TIME TO PEAK    (hrs)=  12.58
     RUNOFF VOLUME    (mm)=  13.53
     TOTAL RAINFALL   (mm)=  49.00
     RUNOFF COEFFICIENT   =    .28

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

--------------------------------------------------------------------------------
*                   Pre-Development Catchment 200,  2.30 hectares
--------------------
| CALIB            |
| NASHYD    (0001) |   Area    (ha)=   2.30   Curve Number   (CN)= 72.0
|ID= 2 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .18

     Unit Hyd Qpeak  (cms)=    .49

     PEAK FLOW       (cms)=    .05 (i)
     TIME TO PEAK    (hrs)=  12.00
     RUNOFF VOLUME    (mm)=  13.47
     TOTAL RAINFALL   (mm)=  49.00
     RUNOFF COEFFICIENT   =    .27

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

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

--------------------
| ADD HYD   (0001) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0001):    22.70      .24    12.58    13.53
        + ID2= 2 (0001):     2.30      .05    12.00    13.47
          ==================================================
          ID = 3 (0001):    25.00      .25    12.58    13.52

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  25.00
| ID= 3   PCYC=318 |   QPEAK     (cms)=    .25 (i)
```

```
| DT= 5.0 min      |   TPEAK     (hrs)=  12.58
--------------------   VOLUME     (mm)=  13.52
  Filename: NRWDPR2.TXT
  Comments:

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

-------------------------------------------------------------------------------
*                   Post-Development
--------------------
| CALIB            |
| STANDHYD  (0001) |   Area    (ha)=  34.21
|ID= 1 DT= 5.0 min |   Total Imp(%)=  55.00   Dir. Conn.(%)=  45.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      18.82        15.39
     Dep. Storage     (mm)=       2.00         5.00
     Average Slope     (%)=       2.00         2.00
     Length            (m)=     478.00       478.00
     Mannings n          =       .013         .250

     Max.eff.Inten.(mm/hr)=      20.97         7.25
                over (min)       10.00        90.00
     Storage Coeff.  (min)=       9.91 (ii)   99.22 (ii)
     Unit Hyd. Tpeak (min)=      10.00       100.00
     Unit Hyd. peak  (cms)=        .11          .01
                                                             *TOTALS*
     PEAK FLOW       (cms)=        .89          .18             .95 (iii)
     TIME TO PEAK    (hrs)=      12.42        13.92           12.42
     RUNOFF VOLUME    (mm)=      46.95        17.63           30.81
     TOTAL RAINFALL   (mm)=      49.00        49.00           49.00
     RUNOFF COEFFICIENT   =        .96          .36             .63


       (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.

-------------------------------------------------------------------------------
*                   External (Catchment 200)
--------------------
| CALIB            |
| NASHYD    (0001) |   Area    (ha)=   2.30   Curve Number   (CN)= 72.0
|ID= 2 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .18

     Unit Hyd Qpeak  (cms)=    .49

     PEAK FLOW       (cms)=    .05 (i)
```

```
     TIME TO PEAK    (hrs)=  12.00
     RUNOFF VOLUME    (mm)=  13.47
     TOTAL RAINFALL   (mm)=  49.00
     RUNOFF COEFFICIENT   =    .27

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

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


--------------------
| ADD HYD   (0001) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0001):    34.21      .95    12.42    30.81
        + ID2= 2 (0001):     2.30      .05    12.00    13.47
          ==================================================
          ID = 3 (0001):    36.51      .97    12.42    29.72

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  36.51
| ID= 3   PCYC=364 |   QPEAK     (cms)=    .97 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=  12.42
--------------------   VOLUME     (mm)=  29.72
  Filename: NRWD2.QIN
  Comments:

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

--------------------------------------------------------------------------------
*                   Route through SWMF
--------------------
| RESERVOIR (0001) |
| IN= 3---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                            .000       .000   |     .575       .968
                            .127       .173   |     .836      1.218
                            .215       .366   |     .933      1.305
                            .257       .505   |    1.010      1.375
                            .276       .578   |    1.140      1.481
                            .293       .653   |    2.840      1.757

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 3 (0001)     36.51       .97     12.42      29.72
     OUTFLOW: ID= 1 (0001)     36.51       .24     14.58      29.71

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 24.63
```

```
                   TIME SHIFT OF PEAK FLOW         (min)=130.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=   .44

-------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  36.51
| ID= 1   PCYC=514 |   QPEAK     (cms)=    .24 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=  14.58
--------------------   VOLUME     (mm)=  29.71
  Filename: NRWD2.QOU
  Comments:

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

-------------------------------------------------------------------------------
*                   Route through SWMF
--------------------
| RESERVOIR (0001) |
| IN= 3---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                            .000       .000   |      .552        .794
                            .141       .126   |      .815       1.045
                            .200       .261   |      .999       1.201
                            .264       .479   |     1.121       1.308
                            .481       .714   |     2.820       1.583

                                   AREA     QPEAK     TPEAK       R.V.
                                   (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 3 (0001)     36.51       .97     12.42      29.72
     OUTFLOW: ID= 1 (0001)     36.51       .24     14.58      29.71

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 25.28
                   TIME SHIFT OF PEAK FLOW         (min)=130.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=   .41

-------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  36.51
| ID= 1   PCYC=441 |   QPEAK     (cms)=    .24 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=  14.58
--------------------   VOLUME     (mm)=  29.71
  Filename: NRWD2.QBW
  Comments:

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

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

--------------------
|    READ STORM    |    Filename: YPQ05SCS.STM
```

```
| Ptotal= 65.03 mm |    Comments: 24hr SCS Type 2 - 5Yr
--------------------
                 TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                 1.00     .72 |  7.00    1.30 | 13.00    7.09 | 19.00    1.17
                 2.00     .72 |  8.00    1.30 | 14.00    3.12 | 20.00    1.17
                 3.00     .85 |  9.00    1.76 | 15.00    1.95 | 21.00     .78
                 4.00     .85 | 10.00    2.21 | 16.00    1.95 | 22.00     .78
                 5.00    1.04 | 11.00    3.51 | 17.00    1.17 | 23.00     .78
                 6.00    1.04 | 12.00   27.82 | 18.00    1.17 | 24.00     .78

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

*                   Pre-Development Catchment 100, 22.70 hectares
--------------------
| CALIB            |
| NASHYD    (0001) |   Area    (ha)=  22.70   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)=    .82

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

     Unit Hyd Qpeak  (cms)=   1.06

     PEAK FLOW       (cms)=    .40 (i)
     TIME TO PEAK    (hrs)=  12.58
     RUNOFF VOLUME    (mm)=  22.64
     TOTAL RAINFALL   (mm)=  65.03
     RUNOFF COEFFICIENT   =    .35

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

-------------------------------------------------------------------------------
*                   Pre-Development Catchment 200,  2.30 hectares
--------------------
| CALIB            |
| NASHYD    (0001) |   Area    (ha)=   2.30   Curve Number   (CN)= 72.0
|ID= 2 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .18

     Unit Hyd Qpeak  (cms)=    .49

     PEAK FLOW       (cms)=    .08 (i)
     TIME TO PEAK    (hrs)=  12.00
     RUNOFF VOLUME    (mm)=  22.57
     TOTAL RAINFALL   (mm)=  65.03
     RUNOFF COEFFICIENT   =    .35

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

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

```
--------------------
| ADD HYD   (0001) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0001):    22.70      .40    12.58    22.64
        + ID2= 2 (0001):     2.30      .08    12.00    22.57
          ==================================================
          ID = 3 (0001):    25.00      .43    12.58    22.64

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  25.00
| ID= 3   PCYC=321 |   QPEAK     (cms)=    .43 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=  12.58
--------------------   VOLUME     (mm)=  22.64
  Filename: NRWDPR5.TXT
  Comments:

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

-------------------------------------------------------------------------------
*                   Post-Development
--------------------
| CALIB            |
| STANDHYD  (0001) |   Area    (ha)=  34.21
|ID= 1 DT= 5.0 min |   Total Imp(%)=  55.00   Dir. Conn.(%)=  45.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      18.82        15.39
     Dep. Storage     (mm)=       2.00         5.00
     Average Slope     (%)=       2.00         2.00
     Length            (m)=     478.00       478.00
     Mannings n          =       .013         .250

     Max.eff.Inten.(mm/hr)=      27.82        13.84
                over (min)      10.00        70.00
     Storage Coeff.  (min)=       8.85 (ii)   77.82 (ii)
     Unit Hyd. Tpeak (min)=      10.00        80.00
     Unit Hyd. peak  (cms)=        .12          .01
                                                                *TOTALS*
     PEAK FLOW       (cms)=       1.19          .34           1.33 (iii)
     TIME TO PEAK    (hrs)=      12.33        13.42          12.33
     RUNOFF VOLUME    (mm)=      62.96        28.47          43.98
     TOTAL RAINFALL   (mm)=      65.03        65.03          65.03
     RUNOFF COEFFICIENT   =        .97          .44            .68


       (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.

--------------------------------------------------------------------------------
*                   External (Catchment 200)
--------------------
| CALIB            |
| NASHYD    (0001) |   Area    (ha)=   2.30   Curve Number   (CN)= 72.0
|ID= 2 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .18

     Unit Hyd Qpeak  (cms)=    .49

     PEAK FLOW       (cms)=    .08 (i)
     TIME TO PEAK    (hrs)=  12.00
     RUNOFF VOLUME    (mm)=  22.57
     TOTAL RAINFALL   (mm)=  65.03
     RUNOFF COEFFICIENT   =    .35

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

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

--------------------
| ADD HYD   (0001) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0001):    34.21     1.33    12.33    43.98
        + ID2= 2 (0001):     2.30      .08    12.00    22.57
          ==================================================
          ID = 3 (0001):    36.51     1.37    12.33    42.63

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  36.51
| ID= 3   PCYC=353 |   QPEAK     (cms)=   1.37 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=  12.33
--------------------   VOLUME     (mm)=  42.63
  Filename: NRWD5.QIN
  Comments:

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

--------------------------------------------------------------------------------
*                   Route through SWMF
--------------------
| RESERVOIR (0001) |
```

```
| IN= 3---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                            .000       .000   |      .575       .968
                            .127       .173   |      .836      1.218
                            .215       .366   |      .933      1.305
                            .257       .505   |     1.010      1.375
                            .276       .578   |     1.140      1.481
                            .293       .653   |     2.840      1.757

                                AREA     QPEAK      TPEAK       R.V.
                                (ha)     (cms)      (hrs)       (mm)
     INFLOW : ID= 3 (0001)     36.51      1.37      12.33      42.63
     OUTFLOW: ID= 1 (0001)     36.51       .33      14.67      42.62

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 24.21
                   TIME SHIFT OF PEAK FLOW         (min)=140.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=   .69

--------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  36.51
| ID= 1   PCYC=538 |   QPEAK     (cms)=    .33 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=  14.67
--------------------   VOLUME     (mm)=  42.62
  Filename: NRWD5.QOU
  Comments:

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

--------------------------------------------------------------------------------
*                   Route through SWMF
--------------------
| RESERVOIR (0001) |
| IN= 3---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                            .000       .000   |      .552       .794
                            .141       .126   |      .815      1.045
                            .200       .261   |      .999      1.201
                            .264       .479   |     1.121      1.308
                            .481       .714   |     2.820      1.583

                                AREA     QPEAK      TPEAK       R.V.
                                (ha)     (cms)      (hrs)       (mm)
     INFLOW : ID= 3 (0001)     36.51      1.37      12.33      42.63
     OUTFLOW: ID= 1 (0001)     36.51       .39      14.33      42.63

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 28.90
                   TIME SHIFT OF PEAK FLOW         (min)=120.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=   .62
```

```
--------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  36.51
| ID= 1   PCYC=457 |   QPEAK     (cms)=    .39 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=  14.33
--------------------   VOLUME     (mm)=  42.63
  Filename: NRWD5.QBW
  Comments:

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

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


--------------------
|    READ STORM    |    Filename: YPQ10SCS.STM
| Ptotal= 75.60 mm |    Comments: 24hr SCS Type 2 - 10Yr
--------------------
                 TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                 1.00     .83 |  7.00    1.51 | 13.00    8.24 | 19.00    1.36
                 2.00     .83 |  8.00    1.51 | 14.00    3.63 | 20.00    1.36
                 3.00     .98 |  9.00    2.04 | 15.00    2.27 | 21.00     .91
                 4.00     .98 | 10.00    2.57 | 16.00    2.27 | 22.00     .91
                 5.00    1.21 | 11.00    4.08 | 17.00    1.36 | 23.00     .91
                 6.00    1.21 | 12.00   32.36 | 18.00    1.36 | 24.00     .91

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

*                   Pre-Development Catchment 100, 22.70 hectares
--------------------
| CALIB            |
| NASHYD    (0001) |   Area    (ha)=  22.70   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)=    .82

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

     Unit Hyd Qpeak  (cms)=   1.06

     PEAK FLOW       (cms)=    .53 (i)
     TIME TO PEAK    (hrs)=  12.58
     RUNOFF VOLUME    (mm)=  29.37
     TOTAL RAINFALL   (mm)=  75.60
     RUNOFF COEFFICIENT   =    .39

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

--------------------------------------------------------------------------------
*                   Pre-Development Catchment 200,  2.30 hectares
--------------------
```

```
| CALIB              |
| NASHYD    (0001) |   Area    (ha)=   2.30   Curve Number   (CN)= 72.0
|ID= 2 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .18

     Unit Hyd Qpeak  (cms)=    .49

     PEAK FLOW       (cms)=    .10 (i)
     TIME TO PEAK    (hrs)=  12.00
     RUNOFF VOLUME    (mm)=  29.27
     TOTAL RAINFALL   (mm)=  75.60
     RUNOFF COEFFICIENT   =    .39

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

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

--------------------
| ADD HYD   (0001) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0001):    22.70      .53    12.58    29.37
        + ID2= 2 (0001):     2.30      .10    12.00    29.27
          ==================================================
          ID = 3 (0001):    25.00      .56    12.58    29.36

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  25.00
| ID= 3   PCYC=322 |   QPEAK     (cms)=    .56 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=  12.58
--------------------   VOLUME     (mm)=  29.36
  Filename: NRWDPR10.TXT
  Comments:

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

--------------------------------------------------------------------------------
*                   Post-Development
--------------------
| CALIB              |
| STANDHYD  (0001) |   Area    (ha)=  34.21
|ID= 1 DT= 5.0 min |   Total Imp(%)=  55.00   Dir. Conn.(%)=  45.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      18.82        15.39
     Dep. Storage     (mm)=       2.00         5.00
     Average Slope     (%)=       2.00         2.00
     Length            (m)=     478.00       478.00
```

```
     Mannings n           =       .013         .250

     Max.eff.Inten.(mm/hr)=      32.36        19.70
                over (min)       10.00        60.00
     Storage Coeff.  (min)=       8.33 (ii)   68.21 (ii)
     Unit Hyd. Tpeak (min)=      10.00        70.00
     Unit Hyd. peak  (cms)=        .13          .02
                                                              *TOTALS*
     PEAK FLOW       (cms)=       1.38          .46              1.62 (iii)
     TIME TO PEAK    (hrs)=      12.33        13.25             12.33
     RUNOFF VOLUME    (mm)=      73.52        36.26             53.02
     TOTAL RAINFALL   (mm)=      75.60        75.60             75.60
     RUNOFF COEFFICIENT   =        .97          .48               .70


       (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.

------------------------------------------------------------------------------
*                   External (Catchment 200)
--------------------
| CALIB              |
| NASHYD    (0001) |   Area    (ha)=   2.30   Curve Number   (CN)= 72.0
|ID= 2 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .18

     Unit Hyd Qpeak  (cms)=    .49

     PEAK FLOW       (cms)=    .10 (i)
     TIME TO PEAK    (hrs)=  12.00
     RUNOFF VOLUME    (mm)=  29.27
     TOTAL RAINFALL   (mm)=  75.60
     RUNOFF COEFFICIENT   =    .39

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

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


--------------------
| ADD HYD   (0001) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0001):    34.21     1.62    12.33    53.02
        + ID2= 2 (0001):     2.30      .10    12.00    29.27
          ==================================================
          ID = 3 (0001):    36.51     1.66    12.33    51.53

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

```
-------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  36.51
| ID= 3   PCYC=348 |   QPEAK     (cms)=   1.66 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=  12.33
--------------------   VOLUME     (mm)=  51.53
  Filename: NRWD10.QIN
  Comments:

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

-------------------------------------------------------------------------------
*                   Route through SWMF
--------------------
| RESERVOIR (0001) |
| IN= 3---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                            .000       .000   |      .575        .968
                            .127       .173   |      .836       1.218
                            .215       .366   |      .933       1.305
                            .257       .505   |     1.010       1.375
                            .276       .578   |     1.140       1.481
                            .293       .653   |     2.840       1.757

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 3 (0001)     36.51      1.66     12.33      51.53
     OUTFLOW: ID= 1 (0001)     36.51       .46     14.42      51.51

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 27.49
                   TIME SHIFT OF PEAK FLOW         (min)=125.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=   .84

-------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  36.51
| ID= 1   PCYC=549 |   QPEAK     (cms)=    .46 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=  14.42
--------------------   VOLUME     (mm)=  51.51
  Filename: NRWD10.QOU
  Comments:

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

-------------------------------------------------------------------------------
*                   Route through SWMF
--------------------
| RESERVOIR (0001) |
| IN= 3---> OUT= 1 |
```

```
| DT=  5.0 min     |     OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)    |   (cms)     (ha.m.)
                            .000       .000    |      .552       .794
                            .141       .126    |      .815      1.045
                            .200       .261    |      .999      1.201
                            .264       .479    |     1.121      1.308
                            .481       .714    |     2.820      1.583

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 3 (0001)     36.51      1.66     12.33      51.53
     OUTFLOW: ID= 1 (0001)     36.51       .51     14.17      51.52

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 30.89
                   TIME SHIFT OF PEAK FLOW         (min)=110.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=   .75

--------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  36.51
| ID= 1   PCYC=466 |   QPEAK     (cms)=    .51 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=  14.17
--------------------   VOLUME     (mm)=  51.52
  Filename: NRWD10.QBW
  Comments:

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

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


--------------------
|    READ STORM    |    Filename: YPQ25SCS.STM
| Ptotal= 88.93 mm |    Comments: 24hr SCS Type 2 - 25Yr
--------------------
                 TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                 1.00     .98 |  7.00    1.78 | 13.00    9.69 | 19.00    1.60
                 2.00     .98 |  8.00    1.78 | 14.00    4.27 | 20.00    1.60
                 3.00    1.16 |  9.00    2.40 | 15.00    2.67 | 21.00    1.07
                 4.00    1.16 | 10.00    3.02 | 16.00    2.67 | 22.00    1.07
                 5.00    1.42 | 11.00    4.80 | 17.00    1.60 | 23.00    1.07
                 6.00    1.42 | 12.00   38.05 | 18.00    1.60 | 24.00    1.07

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

*                    Pre-Development Catchment 100, 22.70 hectares
--------------------
| CALIB            |
| NASHYD    (0001) |   Area    (ha)=  22.70   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)=    .82
```

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

    Unit Hyd Qpeak  (cms)=   1.06

    PEAK FLOW       (cms)=    .70 (i)
    TIME TO PEAK    (hrs)=  12.58
    RUNOFF VOLUME    (mm)=  38.48
    TOTAL RAINFALL   (mm)=  88.93
    RUNOFF COEFFICIENT   =    .43

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

--------------------------------------------------------------------------------
*                   Pre-Development Catchment 200,  2.30 hectares
--------------------
| CALIB             |
| NASHYD    (0001) |   Area    (ha)=   2.30   Curve Number   (CN)= 72.0
|ID= 2 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .18

    Unit Hyd Qpeak  (cms)=    .49

    PEAK FLOW       (cms)=    .13 (i)
    TIME TO PEAK    (hrs)=  12.00
    RUNOFF VOLUME    (mm)=  38.37
    TOTAL RAINFALL   (mm)=  88.93
    RUNOFF COEFFICIENT   =    .43

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

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


--------------------
| ADD HYD   (0001) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0001):    22.70      .70    12.58    38.48
        + ID2= 2 (0001):     2.30      .13    12.00    38.37
          ==================================================
          ID = 3 (0001):    25.00      .74    12.50    38.47

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  25.00
| ID= 3   PCYC=324 |   QPEAK     (cms)=    .74 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=  12.50
--------------------   VOLUME     (mm)=  38.47
  Filename: NRWDPR25.TXT
```

```
  Comments:

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

-------------------------------------------------------------------------------
*                   Post-Development
--------------------
| CALIB             |
| STANDHYD  (0001) |   Area    (ha)=  34.21
|ID= 1 DT= 5.0 min |   Total Imp(%)=  55.00   Dir. Conn.(%)=  45.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      18.82        15.39
     Dep. Storage     (mm)=       2.00         5.00
     Average Slope     (%)=       2.00         2.00
     Length            (m)=     478.00       478.00
     Mannings n          =       .013         .250

     Max.eff.Inten.(mm/hr)=      38.05        26.36
                over (min)      10.00        55.00
     Storage Coeff.  (min)=       7.81 (ii)   61.10 (ii)
     Unit Hyd. Tpeak (min)=      10.00        65.00
     Unit Hyd. peak  (cms)=        .13          .02
                                                          *TOTALS*
     PEAK FLOW       (cms)=       1.63          .64           1.99 (iii)
     TIME TO PEAK    (hrs)=      12.25        13.08          12.25
     RUNOFF VOLUME    (mm)=      86.84        46.63          64.72
     TOTAL RAINFALL   (mm)=      88.93        88.93          88.93
     RUNOFF COEFFICIENT   =        .98          .52            .73


       (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.

-------------------------------------------------------------------------------
*                   External (Catchment 200)
--------------------
| CALIB             |
| NASHYD    (0001) |   Area    (ha)=   2.30   Curve Number   (CN)= 72.0
|ID= 2 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .18

     Unit Hyd Qpeak  (cms)=    .49

     PEAK FLOW       (cms)=    .13 (i)
     TIME TO PEAK    (hrs)=  12.00
     RUNOFF VOLUME    (mm)=  38.37
     TOTAL RAINFALL   (mm)=  88.93
```

```
     RUNOFF COEFFICIENT   =    .43

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

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


--------------------
| ADD HYD   (0001) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0001):    34.21     1.99    12.25    64.72
        + ID2= 2 (0001):     2.30      .13    12.00    38.37
          ==================================================
          ID = 3 (0001):    36.51     2.06    12.25    63.06

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  36.51
| ID= 3   PCYC=344 |   QPEAK     (cms)=   2.06 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=  12.25
--------------------   VOLUME     (mm)=  63.06
  Filename: NRWD25.QIN
  Comments:

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

------------------------------------------------------------------------------
*                   Route through SWMF
--------------------
| RESERVOIR (0001) |
| IN= 3---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                            .000        .000  |      .575        .968
                            .127        .173  |      .836       1.218
                            .215        .366  |      .933       1.305
                            .257        .505  |     1.010       1.375
                            .276        .578  |     1.140       1.481
                            .293        .653  |     2.840       1.757

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 3 (0001)     36.51      2.06     12.25      63.06
     OUTFLOW: ID= 1 (0001)     36.51       .61     14.17      63.05

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 29.85
                   TIME SHIFT OF PEAK FLOW        (min)=115.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  1.01
```

```
--------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  36.51
| ID= 1   PCYC=558 |   QPEAK     (cms)=    .61 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=  14.17
--------------------   VOLUME     (mm)=  63.05
  Filename: NRWD25.QOU
  Comments:

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

--------------------------------------------------------------------------------
*                   Route through SWMF
--------------------
| RESERVOIR (0001) |
| IN= 3---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                            .000       .000   |      .552       .794
                            .141       .126   |      .815      1.045
                            .200       .261   |      .999      1.201
                            .264       .479   |     1.121      1.308
                            .481       .714   |     2.820      1.583

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 3 (0001)     36.51      2.06     12.25      63.06
     OUTFLOW: ID= 1 (0001)     36.51       .68     13.92      63.05

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 32.89
                   TIME SHIFT OF PEAK FLOW        (min)=100.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=   .91

--------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  36.51
| ID= 1   PCYC=474 |   QPEAK     (cms)=    .68 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=  13.92
--------------------   VOLUME     (mm)=  63.05
  Filename: NRWD25.QBW
  Comments:

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

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

--------------------
|    READ STORM    |    Filename: YPQ50SCS.STM
| Ptotal= 98.93 mm |    Comments: 24hr SCS Type 2 - 50Yr
--------------------
                 TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
```

```
                  hrs    mm/hr |    hrs    mm/hr |    hrs    mm/hr |    hrs    mm/hr
                 1.00     1.09 |   7.00     1.98 |  13.00    10.78 |  19.00     1.78
                 2.00     1.09 |   8.00     1.98 |  14.00     4.75 |  20.00     1.78
                 3.00     1.29 |   9.00     2.67 |  15.00     2.97 |  21.00     1.19
                 4.00     1.29 |  10.00     3.36 |  16.00     2.97 |  22.00     1.19
                 5.00     1.58 |  11.00     5.34 |  17.00     1.78 |  23.00     1.19
                 6.00     1.58 |  12.00    42.33 |  18.00     1.78 |  24.00     1.19

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

*                   Pre-Development Catchment 100, 22.70 hectares
--------------------
| CALIB            |
| NASHYD    (0001) |   Area    (ha)=  22.70   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)=    .82

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

     Unit Hyd Qpeak  (cms)=   1.06

     PEAK FLOW       (cms)=    .84 (i)
     TIME TO PEAK    (hrs)=  12.58
     RUNOFF VOLUME    (mm)=  45.70
     TOTAL RAINFALL   (mm)=  98.93
     RUNOFF COEFFICIENT   =    .46

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

-------------------------------------------------------------------------------
*                   Pre-Development Catchment 200,  2.30 hectares
--------------------
| CALIB            |
| NASHYD    (0001) |   Area    (ha)=   2.30   Curve Number   (CN)= 72.0
|ID= 2 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .18

     Unit Hyd Qpeak  (cms)=    .49

     PEAK FLOW       (cms)=    .15 (i)
     TIME TO PEAK    (hrs)=  12.00
     RUNOFF VOLUME    (mm)=  45.56
     TOTAL RAINFALL   (mm)=  98.93
     RUNOFF COEFFICIENT   =    .46

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

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

--------------------
| ADD HYD   (0001) |
```

```
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0001):    22.70      .84    12.58    45.70
        + ID2= 2 (0001):     2.30      .15    12.00    45.56
          ==================================================
          ID = 3 (0001):    25.00      .89    12.50    45.69

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  25.00
| ID= 3   PCYC=325 |   QPEAK     (cms)=    .89 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=  12.50
--------------------   VOLUME     (mm)=  45.69
  Filename: NRWDPR50.TXT
  Comments:

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

--------------------------------------------------------------------------------
*                   Post-Development
--------------------
| CALIB            |
| STANDHYD  (0001) |   Area    (ha)=  34.21
|ID= 1 DT= 5.0 min |   Total Imp(%)=  55.00   Dir. Conn.(%)=  45.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      18.82        15.39
     Dep. Storage     (mm)=       2.00         5.00
     Average Slope     (%)=       2.00         2.00
     Length            (m)=     478.00       478.00
     Mannings n          =        .013         .250

     Max.eff.Inten.(mm/hr)=      42.33        31.85
                over (min)       10.00        50.00
     Storage Coeff.  (min)=       7.48 (ii)   56.89 (ii)
     Unit Hyd. Tpeak (min)=       5.00        60.00
     Unit Hyd. peak  (cms)=        .17          .02
                                                               *TOTALS*
     PEAK FLOW       (cms)=       1.81          .78              2.30 (iii)
     TIME TO PEAK    (hrs)=      12.42        13.08             12.42
     RUNOFF VOLUME    (mm)=      96.83        54.72             73.66
     TOTAL RAINFALL   (mm)=      98.93        98.93             98.93
     RUNOFF COEFFICIENT   =        .98          .55               .74


       (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.

--------------------------------------------------------------------------------
*                   External (Catchment 200)
--------------------
| CALIB              |
| NASHYD    (0001) |   Area    (ha)=   2.30   Curve Number   (CN)= 72.0
|ID= 2 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .18

     Unit Hyd Qpeak  (cms)=    .49

     PEAK FLOW       (cms)=    .15 (i)
     TIME TO PEAK    (hrs)=  12.00
     RUNOFF VOLUME    (mm)=  45.56
     TOTAL RAINFALL   (mm)=  98.93
     RUNOFF COEFFICIENT   =    .46

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

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


--------------------
| ADD HYD   (0001) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0001):    34.21     2.30    12.42    73.66
        + ID2= 2 (0001):     2.30      .15    12.00    45.56
          ==================================================
          ID = 3 (0001):    36.51     2.36    12.42    71.90

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  36.51
| ID= 3   PCYC=344 |   QPEAK     (cms)=   2.36 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=  12.42
--------------------   VOLUME     (mm)=  71.90
  Filename: NRWD50.QIN
  Comments:

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

--------------------------------------------------------------------------------
*                   Route through SWMF
--------------------
| RESERVOIR (0001) |
| IN= 3---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)    |   (cms)     (ha.m.)
```

```
                        .000        .000    |      .575       .968
                        .127        .173    |      .836      1.218
                        .215        .366    |      .933      1.305
                        .257        .505    |     1.010      1.375
                        .276        .578    |     1.140      1.481
                        .293        .653    |     2.840      1.757

                            AREA     QPEAK     TPEAK       R.V.
                            (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 3 (0001)     36.51      2.36     12.42      71.90
     OUTFLOW: ID= 1 (0001)     36.51       .75     14.08      71.88

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 31.60
                  TIME SHIFT OF PEAK FLOW        (min)=100.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  1.13

--------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  36.51
| ID= 1   PCYC=566 |   QPEAK     (cms)=    .75 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=  14.08
--------------------   VOLUME     (mm)=  71.88
  Filename: NRWD50.QOU
  Comments:

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

--------------------------------------------------------------------------------
*                    Route through SWMF
--------------------
| RESERVOIR (0001) |
| IN= 3---> OUT= 1 |
| DT=  5.0 min     |      OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------       (cms)     (ha.m.)   |   (cms)     (ha.m.)
                        .000        .000    |      .552       .794
                        .141        .126    |      .815      1.045
                        .200        .261    |      .999      1.201
                        .264        .479    |     1.121      1.308
                        .481        .714    |     2.820      1.583

                            AREA     QPEAK     TPEAK       R.V.
                            (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 3 (0001)     36.51      2.36     12.42      71.90
     OUTFLOW: ID= 1 (0001)     36.51       .81     13.92      71.89

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 34.16
                  TIME SHIFT OF PEAK FLOW        (min)= 90.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  1.04

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

```
| SAVE HYD  (0001) |   AREA       (ha)=  36.51
| ID= 1   PCYC=481 |   QPEAK     (cms)=    .81 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=  13.92
--------------------   VOLUME     (mm)=  71.89
  Filename: NRWD50.QBW
  Comments:

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

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

--------------------
|    READ STORM    |    Filename: YPQ00SCS.STM
| Ptotal=108.69 mm |    Comments: 24hr SCS Type 2 - 100Yr
--------------------
                 TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                 1.00    1.20 |  7.00    2.17 | 13.00   11.85 | 19.00    1.96
                 2.00    1.20 |  8.00    2.17 | 14.00    5.22 | 20.00    1.96
                 3.00    1.41 |  9.00    2.93 | 15.00    3.26 | 21.00    1.30
                 4.00    1.41 | 10.00    3.70 | 16.00    3.26 | 22.00    1.30
                 5.00    1.74 | 11.00    5.87 | 17.00    1.96 | 23.00    1.30
                 6.00    1.74 | 12.00   46.52 | 18.00    1.96 | 24.00    1.30

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

*                   Pre-Development Catchment 100, 22.70 hectares
--------------------
| CALIB            |
| NASHYD    (0001) |   Area    (ha)=  22.70   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)=    .82

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

     Unit Hyd Qpeak  (cms)=   1.06

     PEAK FLOW       (cms)=    .98 (i)
     TIME TO PEAK    (hrs)=  12.58
     RUNOFF VOLUME    (mm)=  53.01
     TOTAL RAINFALL   (mm)= 108.69
     RUNOFF COEFFICIENT   =    .49

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

--------------------------------------------------------------------------------
*                   Pre-Development Catchment 200,  2.30 hectares
--------------------
| CALIB            |
| NASHYD    (0001) |   Area    (ha)=   2.30   Curve Number   (CN)= 72.0
|ID= 2 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
```

```
--------------------   U.H. Tp(hrs)=    .18

     Unit Hyd Qpeak  (cms)=    .49

     PEAK FLOW       (cms)=    .18 (i)
     TIME TO PEAK    (hrs)=  12.00
     RUNOFF VOLUME    (mm)=  52.85
     TOTAL RAINFALL   (mm)= 108.69
     RUNOFF COEFFICIENT   =    .49

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

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

--------------------
| ADD HYD   (0001) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0001):    22.70      .98    12.58    53.01
        + ID2= 2 (0001):     2.30      .18    12.00    52.85
          ==================================================
          ID = 3 (0001):    25.00     1.03    12.50    53.00

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  25.00
| ID= 3   PCYC=325 |   QPEAK     (cms)=   1.03 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=  12.50
--------------------   VOLUME     (mm)=  53.00
  Filename: NRWDPR00.TXT
  Comments:

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

--------------------------------------------------------------------------------
*                   Post-Development
--------------------
| CALIB            |
| STANDHYD  (0001) |   Area    (ha)=  34.21
|ID= 1 DT= 5.0 min |   Total Imp(%)=  55.00   Dir. Conn.(%)=  45.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      18.82        15.39
     Dep. Storage     (mm)=       2.00         5.00
     Average Slope     (%)=       2.00         2.00
     Length            (m)=     478.00       478.00
     Mannings n           =       .013         .250

     Max.eff.Inten.(mm/hr)=      46.52        36.67
```

```
           over (min)       10.00        50.00
Storage Coeff.  (min)=       7.20 (ii)   53.91 (ii)
Unit Hyd. Tpeak (min)=       5.00        55.00
Unit Hyd. peak  (cms)=        .17          .02
                                                          *TOTALS*
PEAK FLOW       (cms)=       1.99          .94              2.63 (iii)
TIME TO PEAK    (hrs)=      12.42        13.00             12.42
RUNOFF VOLUME    (mm)=     106.58        62.83             82.51
TOTAL RAINFALL   (mm)=     108.69       108.69            108.69
RUNOFF COEFFICIENT   =        .98          .58               .76


  (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.

------------------------------------------------------------------------------
*                   External (Catchment 200)
--------------------
| CALIB             |
| NASHYD    (0001) |   Area    (ha)=   2.30   Curve Number   (CN)= 72.0
|ID= 2 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .18

     Unit Hyd Qpeak  (cms)=    .49

     PEAK FLOW       (cms)=    .18 (i)
     TIME TO PEAK    (hrs)=  12.00
     RUNOFF VOLUME    (mm)=  52.85
     TOTAL RAINFALL   (mm)= 108.69
     RUNOFF COEFFICIENT   =    .49

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

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


--------------------
| ADD HYD   (0001) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0001):    34.21     2.63    12.42    82.51
        + ID2= 2 (0001):     2.30      .18    12.00    52.85
          ==================================================
          ID = 3 (0001):    36.51     2.70    12.42    80.65

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

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

```
| SAVE HYD  (0001) |   AREA       (ha)=  36.51
| ID= 3   PCYC=342 |   QPEAK     (cms)=   2.70 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=  12.42
--------------------   VOLUME     (mm)=  80.65
  Filename: NRWD100.QIN
  Comments:

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

--------------------------------------------------------------------------------
*                   Route through SWMF
--------------------
| RESERVOIR (0001) |
| IN= 3---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                            .000       .000   |     .575        .968
                            .127       .173   |     .836       1.218
                            .215       .366   |     .933       1.305
                            .257       .505   |    1.010       1.375
                            .276       .578   |    1.140       1.481
                            .293       .653   |    2.840       1.757

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 3 (0001)     36.51      2.70     12.42      80.65
     OUTFLOW: ID= 1 (0001)     36.51       .88     13.92      80.63

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 32.70
                   TIME SHIFT OF PEAK FLOW         (min)= 90.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  1.26

--------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  36.51
| ID= 1   PCYC=571 |   QPEAK     (cms)=    .88 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=  13.92
--------------------   VOLUME     (mm)=  80.63
  Filename: NRWD00.QOU
  Comments:

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

--------------------------------------------------------------------------------
*                   Route through SWMF
--------------------
| RESERVOIR (0001) |
| IN= 3---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                            .000       .000   |     .552        .794
```

```
                         .141       .126   |     .815      1.045
                         .200       .261   |     .999      1.201
                         .264       .479   |    1.121      1.308
                         .481       .714   |    2.820      1.583

                             AREA     QPEAK     TPEAK       R.V.
                             (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 3 (0001)     36.51      2.70     12.42      80.65
     OUTFLOW: ID= 1 (0001)     36.51       .95     13.75      80.64

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 35.25
                   TIME SHIFT OF PEAK FLOW        (min)= 80.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  1.16

-------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  36.51
| ID= 1   PCYC=486 |   QPEAK     (cms)=    .95 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=  13.75
--------------------   VOLUME     (mm)=  80.64
  Filename: NRWD00.QBW
  Comments:

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

-------------------------------------------------------------------------------
*****************************************************************************
*                   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

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

*                   Post-Development
--------------------
| CALIB            |
| STANDHYD  (0001) |   Area    (ha)=  34.21
|ID= 1 DT= 5.0 min |   Total Imp(%)=  55.00   Dir. Conn.(%)=  45.00
--------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      18.82        15.39
     Dep. Storage     (mm)=       2.00         5.00
```

```
     Average Slope     (%)=       2.00         2.00
     Length            (m)=     478.00       478.00
     Mannings n           =       .013         .250

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

                              IMPERVIOUS    PERVIOUS (i)
     Max.eff.Inten.(mm/hr)=      43.00        43.21
                over (min)       10.00        45.00
     Storage Coeff.  (min)=       7.44 (ii)   51.17 (ii)
     Unit Hyd. Tpeak (min)=       5.00        55.00
     Unit Hyd. peak  (cms)=        .17          .02
                                                              *TOTALS*
     PEAK FLOW       (cms)=       1.84         1.32             2.94 (iii)
     TIME TO PEAK    (hrs)=       7.42         8.00             7.42
     RUNOFF VOLUME    (mm)=     190.33       137.60           161.32
     TOTAL RAINFALL   (mm)=     193.00       193.00           193.00
     RUNOFF COEFFICIENT   =        .99          .71              .84


       (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.

-------------------------------------------------------------------------------
*                   External (Catchment 200)
--------------------
| CALIB            |
| NASHYD    (0001) |   Area    (ha)=   2.30   Curve Number   (CN)= 72.0
|ID= 2 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .18

     Unit Hyd Qpeak  (cms)=    .49

     PEAK FLOW       (cms)=    .21 (i)
     TIME TO PEAK    (hrs)=   7.00
     RUNOFF VOLUME    (mm)= 122.29
     TOTAL RAINFALL   (mm)= 193.00
     RUNOFF COEFFICIENT   =    .63

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

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

--------------------
| ADD HYD   (0001) |
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
         ID1= 1 (0001):    34.21     2.94     7.42   161.32
```

```
       + ID2= 2 (0001):     2.30      .21     7.00   122.29
         ==================================================
         ID = 3 (0001):    36.51     3.05     7.42   158.87

      NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ------------------------------------------------------------------------------
 --------------------
 | SAVE HYD  (0001) |   AREA      (ha)=  36.51
 | ID= 3   PCYC=218 |   QPEAK     (cms)=   3.05 (i)
 | DT= 5.0 min      |   TPEAK     (hrs)=   7.42
 --------------------   VOLUME     (mm)= 158.87
   Filename: NRWD100.QIN
   Comments:

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

 ------------------------------------------------------------------------------
 *                   Route through SWMF
 --------------------
 | RESERVOIR (0001) |
 | IN= 3---> OUT= 1 |
 | DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
 --------------------       (cms)     (ha.m.)   |   (cms)     (ha.m.)
                              .000       .000   |      .575        .968
                              .127       .173   |      .836       1.218
                              .215       .366   |      .933       1.305
                              .257       .505   |     1.010       1.375
                              .276       .578   |     1.140       1.481
                              .293       .653   |     2.840       1.757

                                  AREA     QPEAK     TPEAK       R.V.
                                  (ha)     (cms)     (hrs)       (mm)
      INFLOW : ID= 3 (0001)      36.51      3.05      7.42     158.87
      OUTFLOW: ID= 1 (0001)      36.51      2.22      8.33     158.86

                    PEAK   FLOW   REDUCTION [Qout/Qin](%)= 72.66
                    TIME SHIFT OF PEAK FLOW         (min)= 55.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=  1.66

 ------------------------------------------------------------------------------
 --------------------
 | SAVE HYD  (0001) |   AREA      (ha)=  36.51
 | ID= 1   PCYC=500 |   QPEAK     (cms)=   2.22 (i)
 | DT= 5.0 min      |   TPEAK     (hrs)=   8.33
 --------------------   VOLUME     (mm)= 158.86
   Filename: NRWDTIM.QOU
   Comments:

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

```
------------------------------------------------------------------------------
*                   Route through SWMF
--------------------
| RESERVOIR (0001) |
| IN= 3---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                            .000       .000   |      .552       .794
                            .141       .126   |      .815      1.045
                            .200       .261   |      .999      1.201
                            .264       .479   |     1.121      1.308
                            .481       .714   |     2.820      1.583

                                AREA     QPEAK      TPEAK        R.V.
                                (ha)     (cms)      (hrs)        (mm)
     INFLOW : ID= 3 (0001)     36.51      3.05       7.42      158.87
     OUTFLOW: ID= 1 (0001)     36.51      2.25       8.25      158.86

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 73.70
                   TIME SHIFT OF PEAK FLOW         (min)= 50.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  1.49

------------------------------------------------------------------------------
--------------------
| SAVE HYD  (0001) |   AREA       (ha)=  36.51
| ID= 1   PCYC=412 |   QPEAK     (cms)=   2.25 (i)
| DT= 5.0 min      |   TPEAK     (hrs)=   8.25
--------------------   VOLUME     (mm)= 158.86
  Filename: NRWDTIM.QBW
  Comments:

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

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

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