350 Wellington Road 7

Functional Servicing and Stormwater Management Report

Project Location:
350 Wellington Road 7, Elora, ON

Prepared for:
Elora 7 OP Inc.

Prepared by:
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Revised: April 27, 2022
Revised: August 9, 2023

MTE File No.: 51060-100

Engineers, Scientists, Surveyors.

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1.0 Introduction

MTE Consultants Inc. was retained by the property owner to complete a Functional Servicing and Stormwater Management (FS-SWM) Report for a new residential development to be constructed at 350 Wellington Road 7 (herein referred to as 'the Site') in the Town of Elora, located in the Township of Centre Wellington.

The purpose of this study is to support the Official Plan Amendment (OPA) and Zoning By-Law Amendment (ZBA) Applications. This will be accomplished by reviewing the opportunities and constraints for the subject property with respect to servicing, grading, and stormwater management; reviewing the requirements of the reviewing agencies; describing the development concept; and demonstrating the functional serviceability of the property.

1.1 Site Description and Official Plan/Zoning Designations

The Site comprises of approximately 4.46ha of agricultural land and is located on Wellington Road 7 between Wellington Road 18/Woolwich Street West and Middlebrook Road / David Street West, approximately 490m north of the Grand River. The Site is bounded to the east by Wellington Road 7 and bounded to the north, south and west by existing agricultural land. Existing residential properties and the Elora municipal cemetery are located on the other side of Wellington Road 7, fronting the Site. In addition, there are four Grand River Conservation Authority (GRCA) regulated wetlands adjacent to the Site; three to the northwest and one to the southwest. The southwest wetland regulation limit extends into the southwest portion of the Site. For the exact location of the Site refer to Figure 1.0.

The current Official Plan designation of the Site is Highway Commercial. The current zoning of the Site is Highway Commercial Zone, C2. The Official Plan and Zoning By-Law Amendment Applications are proposed to re-designate and re-zone the Site to allow for the development as outlined in the accompanying planning justification report.

1.2 Proposed Development

The proposed development for the Site is the construction of 35 townhome blocks complete with common drive aisles, surface parking, landscape and amenity areas. The proposed development is intended to create a 271 unit townhome community consisting of conventional, back to backs and double front live/work style townhomes. To create an inviting urban street-scape, which reflects the character of the Town and enhances the function of the community, it is proposed to urbanize the southbound lane of Wellington Road 7 from the northern portion of the Site to the intersection of Wellington Road 7 and Middlebrook Road / David Street West. Given the size of the proposed development, it is expected to be constructed in two phases from south to north. In order to service the development, the existing municipal sanitary sewer and watermain will be extended from the Wellington Road 7 and David Street West intersection to the Site. A municipal storm sewer will also be installed to allow for the urbanization of the southbound lane of Wellington Road 7.

1.3 Reviewing Agencies

Functional grading, servicing and stormwater management designs as well as this FS-SWM Report will be required for submission to the Township of Centre Wellington in support of the Official Plan Amendment and the Zoning By-Law Amendment Applications. The Township will also be responsible for the review and approval of site plans, lighting and landscape designs and ultimately issuing building permits.

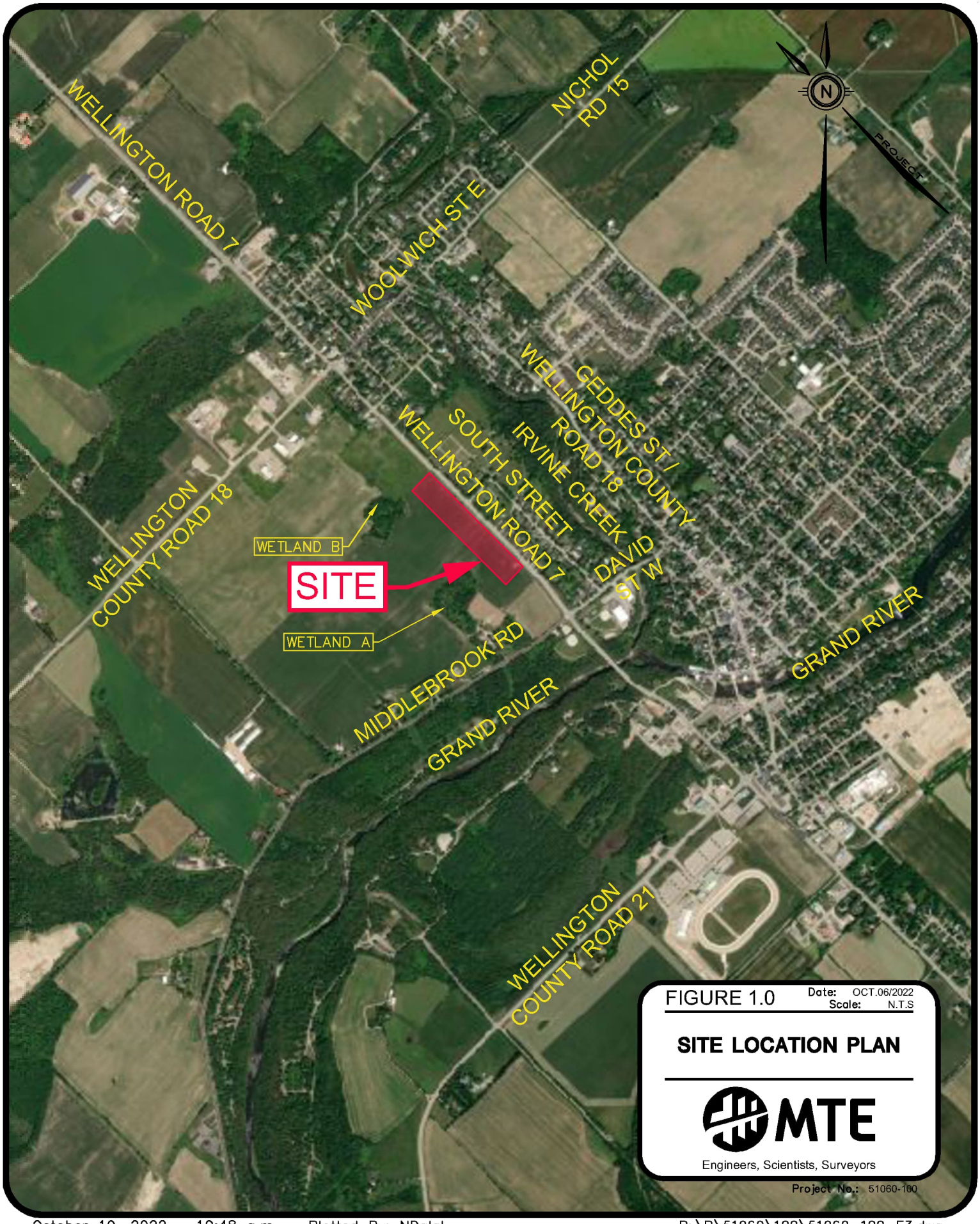

FIGURE 1.0 Date: OCT.06/2022 Scale: N.T.S

SITE LOCATION PLAN

MTE

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Project No.: 51060-100

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As the southwest portion of the Site falls within the GRCA Regulation limit, and the proposed storm sewer will ultimately outlet to the Grand River, the site engineering design will also be submitted to the GRCA for their review and approval. A 'Fill Permit' will be required.

Wellington Road 7 is a County Road. As such, the Wellington County will be circulated on the Official Plan Amendment and the Zoning By-Law Amendment Applications and will need to approve the functional site grading, servicing and stormwater management design as well as this FS-SWM Report.

2.0 Grading

2.1 Existing Topography

The Site is currently agricultural land with two driveway entrances off Wellington Road 7. In the existing condition, the Site drains via broad sheet flow to four main drainage paths based on the existing contours; to the southwest towards Wetland A, to the southeast towards the neighbouring agricultural lands, to the northeast towards Wellington Road 7 and to the northwest towards Wetland B. Fronting the Site, Wellington Road 7 has a rural cross-section with roadside ditches and no pedestrian walkways. There is an elevation difference of approximately 7.7m between the highpoint in Wellington Road 7 along the frontage of the Site and the low point at the southwest corner of the Site. The elevation difference occurs over the length of the Site at a gradual slope. The Site is fully pervious in the existing condition.

2.2 Existing Soils Information

A geotechnical investigation and hydrogeological assessment were undertaken by Grounded Engineering Inc. Their findings are documented in the Geotechnical Engineering Report, dated October 17, 2022 and in the Hydrogeological Assessment dated October 17, 2022, which are included with this submission.

The subsurface stratigraphy is generally comprised of topsoil underlain by disturbed soil consisting of sands and silts with trace to some clay and trace gravel. Beneath the disturbed soils, a sandy silt till with trace to some clay and trace gravel was encountered, followed by sands, underlain by a silt to clayey silt till with trace gravel. The sand deposit is of moderate permeability and will provide moderate recharge capability and groundwater movement, while the tills and disturbed soil deposits are of moderate to low permeability based on the in-situ testing and grain size analyses.

Based on the measured groundwater levels in the monitoring wells on May 17, 2022, the design groundwater table for engineering purposes is at Elev. 403.2 m at the north end of the Site decreasing to Elev. 397.7m at the south end of the Site. The groundwater depth below existing grade varies from 3.7mbgs at the north end of the Site to 0.8mbgs at the middle of the Site to 2.6mbgs at the south end of the Site. There is also perched water in the disturbed soils, which is flowing down towards the groundwater table. It is noted that the observed groundwater table will fluctuate with time depending on the amount of precipitation and surface runoff and may be influenced by known or unknown dewatering activities at nearby sites.

Refer to the Geotechnical Engineering Report and the Hydrogeological Assessment by Grounded for more information.

2.3 Proposed Grading

The preliminary grading strategy for the proposed development was developed based on the topographic survey and the Conceptual Site Plan prepared by MHBC. Refer to the separately appended MTE Drawings, C2.1, C2.2 and C2.3, for the functional grading design for the Site.

The proposed development has 35 townhome blocks complete common drive aisles, surface parking, landscape and amenity areas. The common drive aisles will be connected to Wellington Road 7 through two proposed driveway entrances; one at the north/middle and south end of the Site. The proposed townhome blocks finished floor elevations (FFE) vary from 408.55 at the north end of the Site to 403.30 at the south end of the Site. The finished floor elevations were set to follow the profile of Wellington Road 7, while ensuring at least 1.0m of separation was maintained between the underside of the footings to the groundwater elevations noted in Section 2.2. The proposed development is intended to create a 271 unit townhome community consisting of conventional, back to backs and double front live/work style townhomes. To create an inviting urban street-scape, which reflects the character of the Town and enhances the function of the community, it is proposed to urbanize the southbound lane of Wellington Road 7 from the northern portion of the Site to the intersection of Wellington Road 7 and Middlebrook Road / David Street West. This will include filling in the existing roadside ditch, installing storm sewers, curb and gutter and a multi-use pathway. It is understood that external infrastructure and road works will be designed and administered by the Township/County. On-site, the proposed grading strategy will respect the existing grades along the north, south and west property lines. Regrading will involve raising the east property line to accommodate the proposed urban road cross-section along with raising the majority of the Site to ensure groundwater separation is maintained and to direct the major overland flow route for the Site to the Wellington Road 7 right-of-way.

3.0 Servicing

The preliminary servicing strategy for the proposed development was developed based on the topographic survey, plan and profile information, Municipal Servicing Assessment by Triton Engineering Services Limited and the Conceptual Site Plan prepared by MHBC. Refer to the separately appended MTE Drawings, C2.4, C2.5 and C2.6, for the functional servicing design for the Site and the preliminary watermain and sanitary sewer plan in Appendix A by Triton for the functional municipal service extension design from the Wellington Road 7 and David Street West intersection to the Site. It is understood that external infrastructure and road works will be designed and administered by the Township/County. The proposed servicing strategy has been developed to accommodate the potential for a phase build out of the Site from south to north.

3.1 Water

There is an existing 100mm diameter municipal watermain along Wellington Road 7, from 321 Wellington Road 7 (the south end of the Site) connecting to an existing 300mm diameter municipal watermain along David Street West, located east of Wellington Road 7. There is also an existing 300mm diameter watermain along Wellington Road 7 south of David Street West, which connects to the 300mm watermain on David Street West at the intersection of Wellington Road 7, David Street West, and Middlebrook Road. The closest municipal fire hydrant is located on the east side of Wellington Road 7 in front of 311 Wellington Road 7. The hydrant connects to the 100mm diameter watermain along Wellington Road 7. The Site is not currently serviced by municipal water.

A municipal servicing assessment was undertaken by Triton Engineering Services Limited. Their findings are documented in the 350 Wellington Road 7 Municipal Servicing Assessment, dated July 11, 2022, included in Appendix A. Their assessment indicates that the existing 100mm diameter municipal watermain along Wellington Road 7 does not meet Municipal Standards and is not adequate to convey fire flows to the Site. Additionally, Wellington Road 7 is intended as part of the future trunk watermain loop to service Salem area. As such, Triton recommends that the existing 100mm diameter municipal watermain be replaced with a 200mm watermain

extended north to, at a minimum, South Street so the existing 150mm watermain on South Street could be extended to connect to this proposed 200mm watermain. This will increase fire flows, ensure redundancy of supply and provide looping of the system. Assuming these recommendations are implemented as part of the external infrastructure and road works which will be designed and administered by the Township/County, an expected fire flow of 143.5L/s (8,610L/min) will be available at the Site with an expected static pressure of approximately 54psi at an elevation of 407m. Based on their assessment, the Centre Wellington Water system is expected to have sufficient capacity and pressure to supply the development for domestic and fire flows once the services discussed above are extended to the Site.

A new connection to the extended municipal watermain along Wellington Road 7 will be required in order to service the proposed development. The required private water service size(s) will be determined during detailed design but will be at least 150mm diameter. Each townhome will be serviced with a minimum 25mm diameter domestic connection off the private water service. Given the length of the Site, it is anticipated that seven new private hydrants will be required to service the proposed townhome blocks.

Preliminary water demands were calculated for the proposed development and are included in Appendix B. The maximum day domestic demand for the Site was determined to be 9.33L/s. In addition to the domestic demands, the pressures and flows in the extended system must be sufficient for firefighting conditions as established by the Ontario Building Code (2012). The minimum residual pressure under firefighting conditions is 140kPa (20.3psi) per OBC 2012 A-3.2.5.7 3(b). Preliminary fire flow demand calculations indicate that the required minimum water supply rate based on OBC and FUS is 150L/s (9,000L/min) and 400L/s (24,000L/min), respectively, for the worst-case block (Block 31). Since these fire flow demands are greater than the expected available fire flow of 143.5L/s (8,610L/min) at the Site, building components such as firewalls will need to be added during detailed design to reduce the required fire flow demand to the available fire flow level. It should be noted that even with building components the FUS fire flow demand may still not be met given the limitations of the existing water distribution system, but OBC fire flow demands will be met. Fire flow demands for all blocks, and associated firefighting capacity at each private hydrant, will need to be confirmed at detailed design.

3.2 Sanitary

There is no existing municipal sanitary sewer along Wellington Road 7; therefore, the Site is not currently serviced. There is an existing 200mm diameter municipal sanitary sewer on David Street West draining east. There is an existing 200mm diameter municipal sanitary sewer stub at the intersection of David Street West and Wellington Road 7.

Based on available topographical information from the GRCA mapping tool, there appears to be a 14.5m elevation difference between the south end of the Site and the location of the existing sanitary stub at the intersection of David Street West and Wellington Road 7. Therefore, there is adequate elevation change to extend the sanitary sewer along Wellington Road 7 in order to service the proposed development, and future developments along Wellington Road 7, with a gravity sewer. The existing 200mm diameter municipal sanitary sewer will be extended from the intersection to at least the south end of the Site, where a private sanitary service connection will be made and extended into the Site. It is proposed that the Site will be serviced by a new 200mm diameter sanitary sewer complete with a new manhole at the extended municipal sewer on Wellington Road 7. The private sanitary sewer will be installed at a slope that provides depth for the servicing of each townhome while maintaining adequate capacity. The service sizes and inverts will be confirmed at detailed design.

Based on Triton's municipal servicing assessment, the existing David Street Sanitary Pumping Station (SPS) has sufficient capacity to service the proposed development. In addition, the Elora Waste Water Treatment Facility (WWTF) is also expected to have sufficient capacity to treat the estimated flows produced by the proposed development. Municipal sanitary sewers will need to be extended to the Site as discussed above, but the existing downstream municipal sanitary sewers are also expected to have adequate capacity based on the current SPS configuration / pump rates.

A sanitary flow analysis has been prepared to determine the flows anticipated to be generated by the proposed development. Based on the Township's Development Manual, the anticipated average sanitary flow generation rate is 350L/d/capita and the average density is 3.09 persons/unit based on the 2021 Reserve Capacity Calculations for Centre Wellington. With the proposed townhome blocks having a total of 271 units and a Site area of 4.46ha, the resulting peak flow including infiltration is expected to be 13.72L/s from the Site. Refer to Appendix C for sanitary flow rate calculations. It should be noted that the Township Reserve Capacity Calculations includes allocation of 280 units for this development as confirmed by Triton, therefore, there is sufficient allocation for the proposed 271 unit townhome development.

3.3 Storm

Wellington Road 7 has a rural road cross-section along the front of the Site; therefore, there are no existing municipal storm sewers. However, there are roadside ditches along both sides of Wellington Road 7. The roadside ditches north of the highpoint in Wellington Road 7 drain toward Woolwich Street West, while the roadside ditches south of the highpoint in Wellington Road 7 drain toward David Street West / Middlebrook Road. Runoff from the roadside ditch along the northbound lane of Wellington Road 7 ultimately drains across the road to the west side of Wellington Road 7 via an existing 600mm CSP culvert at the intersection of Wellington Road 7 and David Street West / Middlebrook Road. From there, runoff collected from both roadside ditches (southbound and northbound) drain west through the roadside ditch along the north side of Middlebrook Road where it eventually crosses Middlebrook Road via an existing culvert, discharging through lands owned by the GRCA, and ultimately to the Grand River. Surface runoff from a majority of the Site is currently convey

ed overland to the southwest of the Site where it eventually enters Wetland A, which eventually discharges to a Grand River tributary and ultimately to the Grand River.

To create an inviting urban street-scape, which reflects the character of the Town and enhances the function of the community, it is proposed to urbanize the southbound lane of Wellington Road 7 from the northern portion of the Site to the intersection of Wellington Road 7 and Middlebrook Road / David Street West. The external infrastructure and road works will be designed and administered by the Township/County, but it is assumed a new municipal storm sewer will be installed along the frontage of the Site with catchbasin manholes spaced less than every 90 metres. The diameter of the municipal storm sewer will increase where the private storm sewer system connects to accommodate the flows from the Site. The proposed municipal storm sewer system will extend to the intersection of Wellington Road 7 and Middlebrook Road / David Street West. Beyond this point, two outlet options have been provided to the GRCA for review and comment. Option one proposes extending the proposed storm sewer across Middlebrook Road and further down Wellington Road 7 boulevard, toward the existing bridge, where it would daylight just upstream of the Grand River. This option would require minor regrading of the west boulevard along Wellington Road 7, to maintain cover over the storm sewer, and implementation of erosion control measures at the storm sewer outlet and/or between the outlet and the Grand River. Option two proposes terminating the proposed storm sewer along Wellington Road 7 at Middlebrook Road where runoff would continue to be

conveyed along the north side of Middlebrook Road where it eventually crosses Middlebrook Road via a culvert, discharging through lands owned by the GRCA, and ultimately to the Grand River as it does in the existing condition. This option would require possible upgrades to north roadside ditch along Middlebrook Road and the upsizing of the existing culvert crossing to accommodate the proposed flows. Refer to Appendix D for correspondence with the GRCA and illustration of both options. After review of the proposed storm outlet options, the GRCA has advised they prefer storm outlet option one given adequate erosion control measures at the outlet are implemented and velocities at the outlet point to the Grand River are kept as low as possible. The sewer sizes and inverts will be confirmed at detailed design, along with the requirements to implement the preferred storm outlet option. This work would be completed during the right-of-way works required to extend the municipal watermain and sanitary sewer.

A private storm sewer system will be installed on-site to collect runoff generated from the interior rooftops, landscape, drive aisles and parking areas. The runoff collected in the storm sewers will be directed to an OGS unit located in the south entrance to the Site prior to discharging to the proposed municipal storm sewer system in the Wellington Road 7 right-of-way. Runoff from the frontage of the property will sheet flow towards the Wellington Road 7 right-of-way. Runoff from the outer perimeter townhome blocks and landscape areas will be directed to the west property line, toward Wetland A and B, to maintain a surface runoff water balance to each Wetland. All townhomes with basements will require sump pumps.

4.0 Preliminary Stormwater Management Design

4.1 SWM Criteria

The stormwater management design criteria for the subject Site, as proposed to Triton in the SWM Criteria Brief by MTE dated September 12, 2022, to initiate discussion with Wellington County and the Township of Centre Wellington staff, are as follows:

i) Establish a legal outlet(s) for the Site;
ii) Maintain an annual surface runoff water balance to Wetland A and Wetland B;
iii) Attenuation of the post-development peak flows for the 2-year through 100-year storm events to the allowable flow rate using a C value of 0.75;
iv) Implementation of water quality controls; and,
v) Provide erosion and sediment controls.

Refer to the SWM Criteria Brief in Appendix E for rationale as to why the Township's general stormwater management design criteria is not feasible for the subject Site and how the proposed criteria were established.

Since the receipt of the first OPA/ZBA application submission comments, which referenced back to the Township's typical water quantity control requirements, MTE has had correspondence with Triton who has confirmed the alternate SWM strategy outlined in August 2022 is being considered. Triton is not concerned about the capacity of the Wellington Road 7 system, as the system will be designed to accommodate the proposed flows from the Site, but has requested additional review of the outlet options and constraints from the proposed storm sewer to the Grand River.

The proposed storm outlet options are discussed in Section 3.3 of this report. The GRCA has advised that storm outlet option one is preferred. This option involves a proposed municipal storm sewer along Wellington Road 7, under Middlebrook Road, to the Grand River. As part of

the GRCA's review of the storm outlet options, they further reviewed the stormwater management design criteria for the subject Site and added the following criteria:

i) Maintain existing drainage patterns;

ii) Maintain an annual infiltration water balance across the Site; and,

iii) Provide adequate erosion control measures at the storm outlet sized to withstand and convey the Regional storm event within the proposed municipal storm sewer and ditch.

Refer to Appendix D for correspondence with the GRCA regarding the preferred storm outlet and additional SWM criteria.

4.2 Legal Outlet

In the existing condition, the majority of the runoff from the Site is directed west across the neighbouring property via broad sheet flow to Wetland A and B. Generally, there is no right of drainage for surface water. Therefore, the only legal outlet for the Site in the existing condition is to the municipal right-of-way (Wellington Road 7).

In the post-development condition, it is proposed that the Site's private storm sewer system will outlet to the proposed municipal storm sewer along Wellington Road 7 which will ultimately outlet the Grand River, via one of the outlet options discussed in Section 3.3 of this report. The preferred storm outlet option design will be completed during detailed design in accordance with the criteria established by the GRCA. Through the Site grading design, the major overland flow route will also be directed to the Wellington Road 7 right-of-way. However, given the need to maintain a surface runoff water balance to Wetland A and B, an easement is currently being pursued with the neighbouring property owner to the west to legally allow surface drainage across the adjacent property to these wetlands. This will ensure existing drainage patterns are maintained.

It should be noted that even if an easement is obtained, the primary legal outlet for the Site should still be to Wellington Road 7.

4.3 Surface Runoff Water Balance

An annual surface runoff water balance to Wetland A and Wetland B will be achieved in the post-development condition by directing runoff from rooftop and landscape areas adjacent the west property line to the neighbouring property. From there, runoff will continue to sheet flow across the neighbouring property and into each wetland as it does in the existing condition. A preliminary annual surface runoff water balance analysis was completed for Wetland A and Wetland B resulting in a 34m^3/yr and 67m^3/yr net gain of runoff, respectively. Refer to Appendix F for the preliminary annual surface runoff water balance analysis calculations. The required catchment area to be directed to Wetland A and B is illustrated on the post-development catchment areas Figure 3.0 (Catchment 204 & 205, respectively).

It should be noted that being able to achieve a surface runoff water balance to Wetland A and B is conditional on obtaining an easement to allow surface drainage across the neighbouring property to the west.

4.4 Water Quantity Control

In order to successfully complete the preliminary stormwater management design for the Site, the following specific tasks were undertaken:

i) Calculate the pre-development runoff rates using MIDUSS NET and the allowable runoff rates using the Rational Method;

ii) Determine the percent impervious of the Site and catchment parameters for inclusion in MIDUSSS modeling; and,

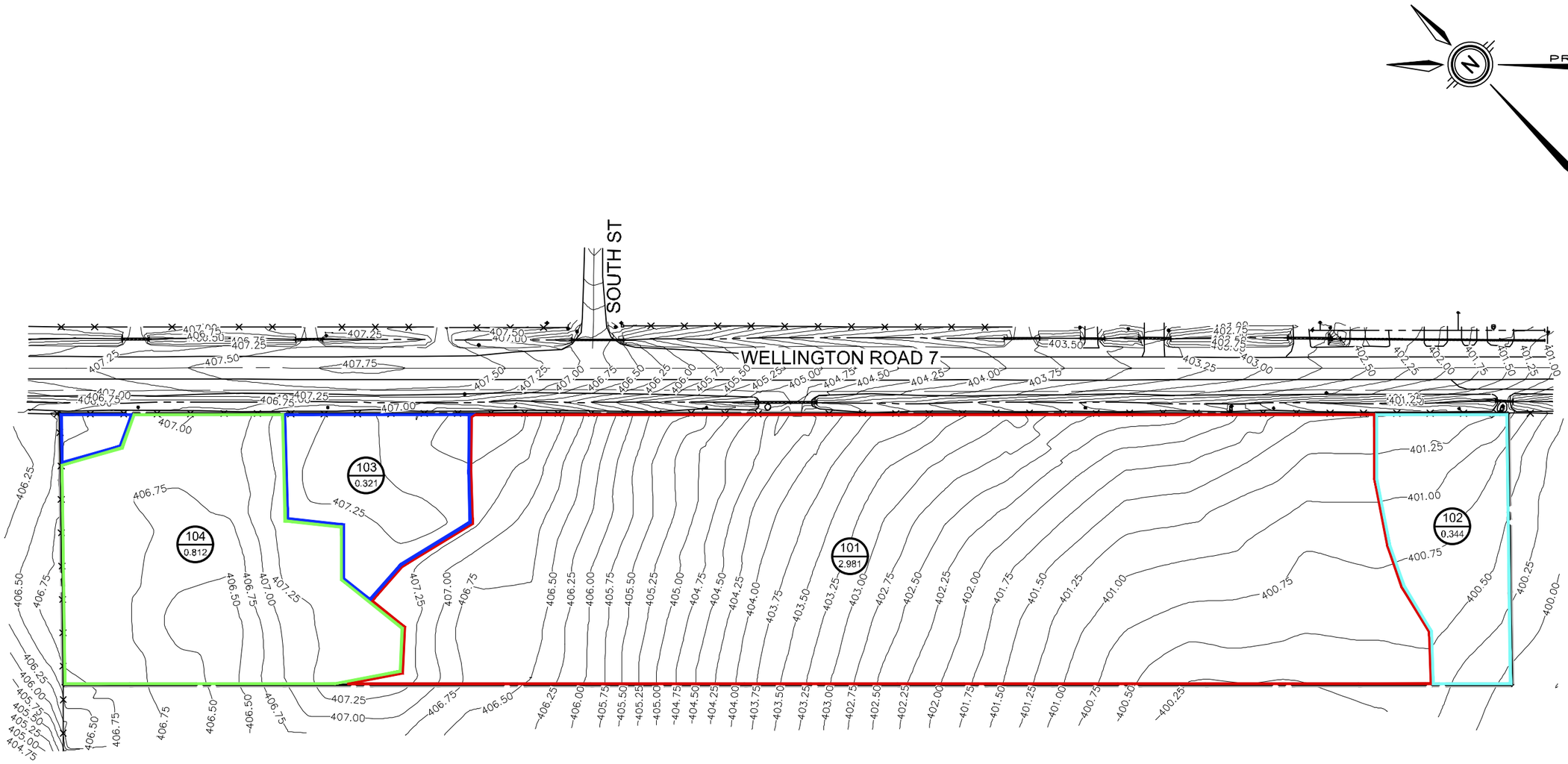
iii) Calculate post-development runoff hydrographs using MIDUSS NET.

The following table summarizes the catchments used in modeling of the Site. The pre-development condition was separated into four catchment areas based on the existing drainage paths for the Site. The post-development condition was separated into five catchment areas; the controlled area and the uncontrolled areas. Figure 2.0 illustrates the limits of the pre-development catchment areas. Figure 3.0 illustrates the limits of the post-development catchment areas.

Table 4.1 – Catchment Parameters

#	Catchment	Area (ha)	% Impervious	Pervious CN	Impervious CN	Slope (%)	Flow Length (m)
Pre-Development Catchment Areas							
101	To Wetland A (Southwest)	2.981	0.0	75	98	3.5	200.0
102	To adjacent property (South)	0.344	0.0	75	98	2.0	100.0
103	To Wellington Road 7 (Northeast)	0.321	0.0	75	98	1.5	50.0
104	To Wetland B (Northwest)	0.812	0.0	75	98	2.5	80.0
Post-Development Catchment Areas							
201	Controlled Area to Wellington Road 7 (Southeast)	3.071	81.5	75	98	2.0	30.0
202	Uncontrolled Area to Wellington Road 7 (Southeast)	0.240	68.0	75	98	2.0	5.0
203	Uncontrolled Area to Wellington Road 7 (Northeast)	0.124	53.1	75	98	2.0	5.0
204	Uncontrolled Area to Wetland A (Southwest)	0.763	48.8	75	98	3.0	20.0
205	Uncontrolled Area to Wetland B (Northwest)	0.260	38.5	75	98	3.0	20.0

Based on the findings from the geotechnical investigation by Grounded, as detailed in Section 2.2, a pervious CN of 75 for grass areas is appropriate.



LEGEND

- CATCHMENT 101
- CATCHMENT 102
- CATCHMENT 103
- CATCHMENT 104

101 — SUB-CATCHMENT NUMBER

2.981 — AREA (ha.)

406.50 — EXISTING CONTOURS

FIGURE 2.0

Date: SEPT. 06/22

Scale: 1:1500

PRE-DEVELOPMENT CATCHMENT AREAS

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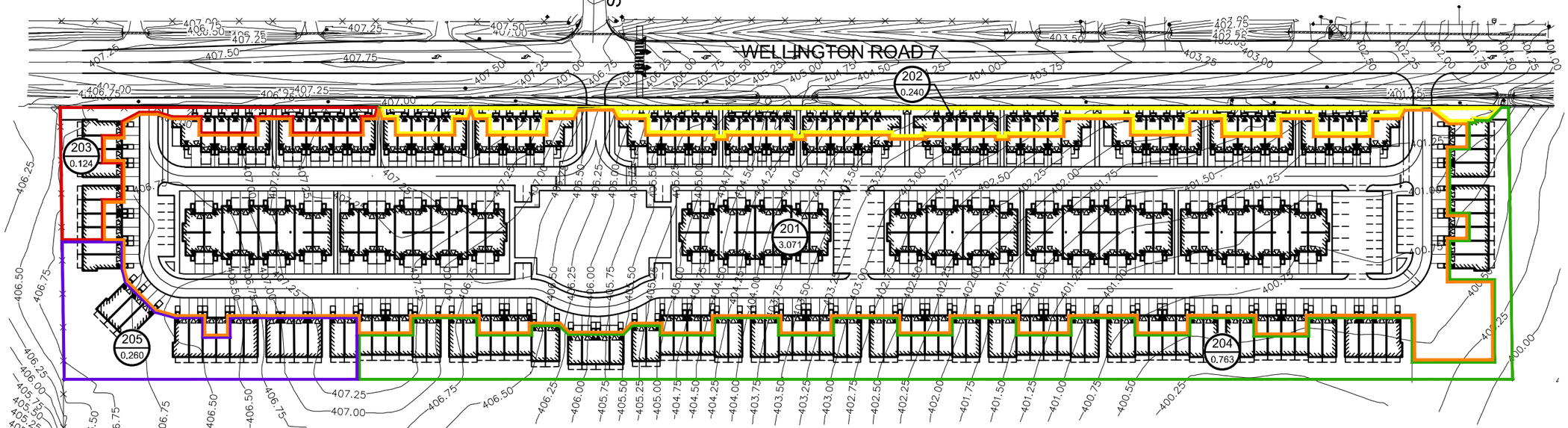
PROJECT

SOUTH ST

WELLINGTON ROAD 7



LEGEND

- CATCHMENT 201
- CATCHMENT 202
- CATCHMENT 203
- CATCHMENT 204
- CATCHMENT 205

201 — SUB-CATCHMENT NUMBER

3.071 — AREA (ha.)

401.50 — EXISTING CONTOURS

PROPOSED BUILDING

FIGURE 3.0 Date: SEPT. 06/22 Scale: 1:1500

POST-DEVELOPMENT CATCHMENT AREAS

MTE Engineers, Scientists, Surveyors

Project No.: 51060-100

October 19, 2022 10:42 a.m. Plotted By: NDalal

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In order to achieve the stormwater management requirements for the Site, runoff generated from the interior rooftops, landscape, drive aisles and parking areas will be controlled with a properly sized outlet pipe to Wellington Road 7. Storage volume for the control outlet pipe will be provided in two underground storm tanks located at the south end of the Site. Refer to Appendix G for preliminary storm tank sizing sheets. The following table illustrates the stage-storage-discharge relationship of the storm system.

Table 4.2 – Stage-Storage-Discharge Information

Elevation (m)	Head (m)	Outlet Pipe Flow (m^3/s)	Volume (m^3)	Remarks
399.000	0.00	0.00000	0.00	Estimated Invert of Storm Outlet Pipe
399.300	0.30	0.04841	0.00	Estimated Invert of Storm Tanks
401.000	2.00	0.45120	1088.49	Estimated Obvert of Storm Tanks
402.190	3.19	0.59990	1088.49	Top of Grate of CBMH41 & CBMH42

With the addition of the 450mm diameter outlet control pipe with a 1.0% slope, the post-development runoff from the controlled portion of the Site for the 5-year and 100-year storm events is controlled to $0.221m^3/s$ and $0.435m^3/s$, respectively. The following table summarizes the expected flows that will be generated by the whole Site. Refer to Appendix G for the MIDUSS NET output, but please note that these flows are subject to change at the detailed design stage.

Table 4.3 – Summary of Flows

Modelling Condition	2-Year Storm Event (m^3/s)	5-Year Storm Event (m^3/s)	10-Year Storm Event (m^3/s)	25-Year Storm Event (m^3/s)	50-Year Storm Event (m^3/s)	100-Year Storm Event (m^3/s)
Pre-Development – Total Site	0.036	0.102	0.171	0.277	0.377	0.491
Allowable (C=0.75) – Total Site	0.511	0.724	0.887	1.055	1.202	1.349
Post-Development – Total Site	0.255	0.350	0.439	0.545	0.640	0.749
Pre-Development – to Wetland A	0.022	0.064	0.107	0.174	0.237	0.308
Post-Development – to Wetland A	0.086	0.121	0.153	0.182	0.212	0.237
Pre-Development – to Wetland B	0.009	0.024	0.040	0.064	0.089	0.112
Post-Development – to Wetland B	0.023	0.033	0.042	0.051	0.060	0.073
Pre-Development – to Wellington Road 7	0.004	0.010	0.017	0.028	0.037	0.048
Post-Development – to wellington Road 7	0.172	0.246	0.301	0.376	0.423	0.481

Note: Time of Concentration (Tc) of 20 mins was used in the rational method calculations to determine the allowable flow rates.

With the addition of the outlet control pipe, the post-development runoff from the Site is controlled well below the allowable peak flow rates based on a runoff coefficient of 0.75 requested in the SWM Criteria Brief. This results in reduced storm pipe sizes on-site and off-site, reduces the additional peak flow rate to Wellington Road 7 while still avoiding over controlling the Site given the proximity to the Grand River. This helps allow the peak flow from the Site to occur in advance of the peak flow from the Grand River's upstream drainage area.

Peak flow rates leaving the Site towards Wetland A and Wetland B are increased in the smaller storm events but are reduced in the larger storm events. This is a result of the increase in impervious area directed to the wetlands but the reduction in catchment area. These peak flow rates will be attenuated further as they sheet flow across the agricultural lands and by the natural features of the Wetlands. It should be noted that the proposed wetland catchment areas are dictated based on the water balance requirements discussed in Section 4.3.

Downstream of Wetland A, a GRCA regulated watercourses conveys runoff from the wetland to the Grand River. During an open house for this proposed development, a property owner adjacent to this watercourse brought up concerns with an existing culvert restricting flow and keeping the upstream water levels quite high close to their barns finished floor elevation. It is unknown if this culvert in question is a municipal or private culvert, but it should be investigated during detailed design to design to ensure downstream impacts are avoided and by the Township/Owner as it appears to be an issue in the existing condition. Cleaning out this culvert or upsizing it may be required.

4.5 Water Quality Control

A Stormceptor EFO10 will be installed on the private storm sewer system to provide water quality control for the Site (Catchment 201). The chosen unit is expected to provide Enhanced Level water quality control. Refer to Appendix H for the sizing output from the Stormceptor Expert program. The Stormceptor will require regular annual maintenance to ensure it is operating properly. The owner may be required to enter into a maintenance agreement with a suitable contractor to complete this work. In addition, all the storm structures will have a 600mm sump.

Runoff from the frontage of the property and towards the wetlands will be from rooftop and landscape areas which are considered "clean"; therefore no quality controls are required for those catchment areas (Catchment 202, 203, 204 and 205).

4.6 Erosion & Sediment Control

Precautions will need to be taken during construction to limit erosion and sedimentation. Typically, the following measures are recommended during construction for erosion and sedimentation control:

i) Erosion and sedimentation facilities are to be installed prior to any area grading operations;

ii) All erosion control measures are to be inspected and monitored by the contractor and repairs are to be completed as required;

iii) All materials and equipment used for the purpose of site preparation and project completion should be operated and stored in a manner that prevents any deleterious substance from leaving the Site;

iv) Construction of temporary swales to direct runoff to a sedimentation basin, with rock check dams as required to control velocities;

v) Stripping and strategic placement of topsoil stockpiles. Placement of sediment control fencing around all stockpile areas;

vi) Re-vegetation of completed areas as soon as possible after construction, including those areas not slated for construction, within 60-days of rough grading; and,

vii) To minimize the amount of mud being tracked onto the roadway, a mud mat should be installed at the primary construction entrance.

4.7 Infiltration Water Balance / Low Impact Development (LID)

Based on the findings of the geotechnical investigation and hydrogeological assessment by Grounded, as detailed in Section 2.2, there is only 3.7 m at the north end of the Site to 0.8m at the middle of the Site to 2.6m at the south end of the Site between the existing grade and the groundwater table across the Site. This shallow groundwater table is not ideal for the installation of a traditional on-site infiltration gallery given the required 1m vertical separation between the bottom of the gallery and the seasonal high groundwater table. In addition, the soils above the observed groundwater table were noted to be moist to wet, further indicating the Site may not be suitable for an infiltration gallery. However, this will be reviewed further during detailed design given the majority of the Site is being raised and best efforts will be made to maintain an annual infiltration water balance across the Site. Other LID methods such as amended topsoil will also be explored during detailed design to help promote at-surface infiltration.

It should be noted that adding on-site infiltration will help reduce the runoff volume and peak flow rate directed to the proposed storm sewer along Wellington Road 7.

5.0 Conclusions

Based on the foregoing analysis, it is concluded that:

- The proposed grading design will match into existing grades along the north, south and west property boundaries, and will raise the grade along the east property boundary and the majority of the Site to achieve an overland flow route to the municipal right-of-way.
- The proposed development will include urbanizing the southbound land of Wellington Road 7 from the northern portion of the Site to the intersection of Wellington Road 7 and Middlebrook Road / David Street West to create an inviting urban street-scape, which reflects the character of the Town and enhances the function of the community.
- Existing municipal infrastructure for water and sanitary servicing is available at the intersection of Wellington Road 7 and David Street West and will be extended along Wellington Road 7 to service the Site.
- Installation of a municipal storm sewer will be required, and outlet directly to the Grand River or existing roadside ditches along Middlebrook Road, to urbanize the southbound land of Wellington Road 7 and provide storm servicing to the Site.
- The existing municipal infrastructure, Elora WWTF and Centre Wellington Water system are expected to have sufficient capacity to support the proposed development. The expected max day domestic water demand for the Site is 9.33L/s. The expected available fire flow demand is 143.5L/s (8,610L/min) at the Site, building components such as firewalls will need to be added during detailed design to reduce the required fire flow demand to the available fire flow level. The expected peak sanitary flow rate is 13.72L/s and the These flow rates are provided to the Township for inclusion in their model.

- The SWM criteria, established in the SWM Criteria Brief, can be satisfied and with the implementation of on-site controls for water quantity and water quality. A surface water runoff balance can be maintained to Wetland A and Wetland B through grading and will result in a small net gain in annual runoff over pre-development site conditions, given an easement with the neighboring property owner to the west can be obtained. A Site Infiltration Water Balance/LID methods will be explored during detailed design.

Additional grading, servicing and stormwater management details will be provided during detailed design.

All of which is respectfully submitted,

MTE Consultants Inc.

51060-100

Tyler Arndt, E.I.T.
Designer
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TMA:dlb

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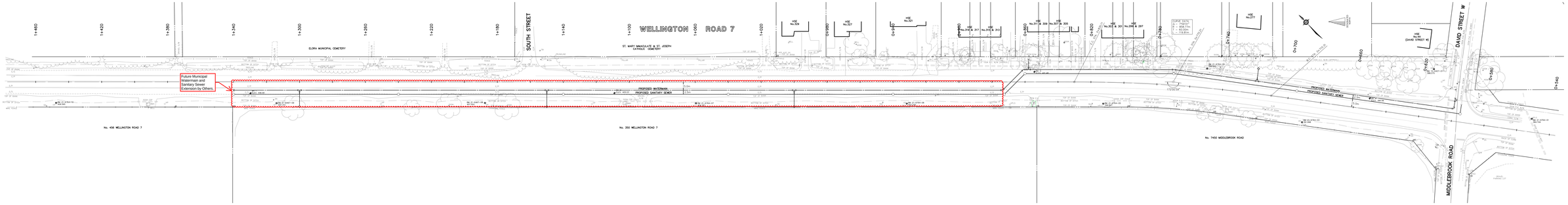
Appendix A

350 Wellington Road 7 Municipal Servicing Assessment & Preliminary Watermain and Sanitary Sewer Plan



PRELIMINARY

TRUCK ENGINEERING SERVICES LIMITED Consulting Engineers	TOWNSHIP OF CENTRE WELLINGTON WELLINGTON ROAD 7 STUDY PLAN
	PROJECT No. A6764
DRAWN BY: A.S.B.	SCALE: 1:500
DATE: DECEMBER 2021	DWG. No. SK-01

TRITON ENGINEERING SERVICES LIMITED
Consulting Engineers

Memorandum

DATE:	July 11, 2022
TO:	Chantalle Pellizzari
FROM:	Dustin Lyttle & Ray Kirtz
RE:	350 Wellington Road 7 Municipal Servicing Assessment
FILE:	A6764A

Introduction:

The following memo is intended to provide insight on the expected downstream sanitary sewer capacity, water system operating conditions and available municipal water for fire fighting purposes within the proposed 350 Wellington Road 7 (W.R.7) condominium development. A concept plan was provided by the developer that outlined the proposed 280 townhouse units on the 4.45 ha development area.

Sanitary Servicing:

David Street Sewage Pumping Station:

Existing Run-Times:

The Township provided historical data indicating the hours that the pumps operated each day over the past 3-years. On average, Pump One runs for 18 minutes each day, and Pump Two runs for 13 minutes each day. The maximum time that Pump One has operated was on April 29th, 2021 for 3.9 hours. For Pump Two, this occurred on April 30th, 2021, operating for 1.4 hours. Based on historical data, the high flows do not correlate with a rain event, and therefore are expected to be the result of operation occurring at the neighbouring small community centre and curling club.

Existing Pump Rates:

There is no flow metering at the David Street SPS, therefore, Triton/Twsp staff performed a series of drawdown tests in order to estimate the pumping rate. The pumps do not have variable frequency drives, and therefore operate at full speed when running. The tests revealed that Pump One pumps at a rate of 2.55 L/s, and Pump Two at a rate of 15.7 L/s. When the pumps are run at the same time, they pump at a combined rate of 15.3 L/s. These calculations are outlined in Table 1 below.

Table 1 – Pump Drawdown Test Results

Parameter	Pump One		Pump Two	Pumps One & Two
	1st Run	2nd Run	1st Run	1st Run
Run Time (s)	90	120	120	120
Initial Depth (m)	2.45	1.64	2.40	2.00
Final Depth (m)	2.39	1.59	2.00	1.61
Change in Depth (m)	0.06	0.05	0.400	0.39
Volume of Sewage (L)	282.7	235.6	1,884.8	1,837.7
Pump Rate (L/s)	3.14	1.96	15.7	15.3

Note: the diameter on the wet well was measured as 2.45m on site.

During the pump test, it was observed that Pump One was not operating properly and causing significant turbulence, indicating that the impeller volute may be cracked or broken, which may provide explanation of the low pump rate. It was also observed that the flow was coming through the overflow check valve from the adjoining

tank into the wet well during the pump test at low liquid levels. For this reason, it is expected that both pumps may be able to operate at higher rates than noted, and that the 15.7 L/s is a conservative value. This assumes that Pump One is repaired.

Existing Flow Rates:

Using the existing run times and pump rates, the existing flow rates received by the pumping station can be calculated. The pumping station currently services 48 units, or **149 people**, as well as a small community centre and curling club. The average existing daily flow rate is **0.18 L/s** (15.2 m^3/day). The maximum existing day flow rate was calculated based off of the day where the greatest volume of sewage was pumped. This occurred on April 29th, 2021, resulting in a maximum day flow of **0.94 L/s** (81.0 m^3/day).

From this, an average existing per person flow rate of **102.0 L/capita/day** (315.1 L/unit/day) was determined. The maximum day existing per person flow rate is **543.4 L/capita/day** (1679.0 L/unit/day) Further to this, it is worth noting that the existing per person flow rates include any additional flows contributed by ICI users.

Proposed Development Loading:

The 2021 Reserve Capacity Calculations (RCC) for Centre Wellington reported that the current system has an average density of 3.09 persons/unit, a maximum day water demand of 0.92 m^3/day/unit (297 L/d/capita), and an average daily sewage flow of 0.664 m^3/day/unit (215 L/d/capita).

Based on the expected populations of the proposed development, and considering both sanitary the flow rates from the RCC (226 L/d/capita), as well as values outlined by the MOE (450 L/d/capita), the total expected peak sanitary sewage flows produced may range from **8.58 L/s** (740.9 m^3/day) to **17.07 L/s** (1475.1 m^3/day) (using a calculated Harmon peaking factor of 3.84).

Expected Flow Rates from the Combined Existing and Proposed Development:

The flows generated from this development will be directed to the David Street Sewage Pumping Station (SPS), which pumps across the David Street bridge to a manhole at the north end of Smith Street. From this manhole it flows down Victoria Street through the downtown area, ultimately discharging to the Clyde St. SPS where it is then again pumped to the Elora WWTP.

As seen in the following table, the average day flows to be directed to this SPS, including the existing users and subject development, are estimated between **2.51 L/s** and **4.62 L/s**. This will result in the pumps running between 44 and 80 times per day for approximately 5 minutes, based on the volume available between the design set points within the wet well, for a total run-time of 4 to 7 hours a day.

Table 2 – Effect of Average Flows on Pump Run Time

ADF (L/capita/day)	Expected Flow Rate (L/s)	Cycle Duration (minutes)	Frequency (times/day)	Total Hours Operating per day
226	2.23	5.35	41	3.7
450	4.62	5.35	80	7.0

The flows directed to the SPS are estimated between **8.76 L/s** and **17.255 L/s** when peaked using the Harmon formula and combined with the historic maximum day flows calculated at the SPS. Although the highest peak flow exceeds the measured capacity of the pumps, these flows are not expected to occur for a long duration, or frequently and therefore can be attenuated by the existing stations storage capacity. Further to this, due to the emergency storage contribution during the pump test, the expectation is that the pumps have greater capacity that has not been quantified.

Emergency Storage:

The SPS overflow chamber provides emergency storage (14.36 m^3) in the event that both pumps fail. Based on the RCC ADF, the time the Township has before the overflow begins discharging to the environment is over 95 hours under average day flows, and over 24 hours under peak day flows. When considering the MOE ADF, the emergency storage provides over 51 and 13 hours under average day flows and peak day flows.

Existing Sewer & Forcemain Capacity Assessment:

An existing 200mm diameter sanitary sewer is located on David Street which discharges into the David SPS. To service the subject development, a 200mm sanitary sewer needs to be extended north along W.R.7 from David Street. The existing sewer on David St. has sufficient capacity to convey flows from the subject development to the SPS.

The hydraulic capacity of the sanitary sewers downstream of the discharge point were explored using the existing and future condition SewerCAD model. The system was modelled under both the existing and developed condition scenarios with the developed condition scenario including complete build out of all current known developments and within the current urban boundary.

Conveying the specified pump rate of **15.7 L/s** during the peak day flow condition identified a number of sections of sewer that are surpassing, or close to, their theoretical capacity based on modelling. These sections are indicated in the following table.

Table 3 – Sewer Capacity

Sewer Section	Percent Full	
	Existing Condition	Future Developed Condition
MH-133 to MH-134 on Victoria Cr.	70.0%	102%
MH-140 to MH-141 on Price St.	82.4%	118%
MH-141 to MH-144 on Church St. W	68.4%	97%

The velocity of the sewage discharged from the SPS through the 100mm forcemain is 2.00 m/s, which is within MOE guidelines.

Reserve Capacity:

As indicated within the 2021 RCC for the Elora Wastewater Treatment Facility (WWTF), there are 2,774 uncommitted units remaining in treatment capacity which includes the proposed development of 280 units.

Water Servicing:

The existing water distribution system does not provide servicing to the subject site. Currently, a 100mm diameter Asbestos Cement watermain is located along the east side of W.R.7 to approximately 250m north of David Street which serves the residences fronting this section of W.R.7. This main does not meet Municipal Standards and is not adequate to convey fire flows to the subject site. Additionally, W.R.7 is intended as part of the future trunk watermain loop to service the Salem area.

As such, it is recommended that the existing 100mm watermain on W.R.7 be replaced with a 200mm watermain extended north to, at a minimum, South Street. Further, the existing 150mm watermain on South Street should be extended northerly/westerly to connect to the future W.R.7 watermain. This will increase fire flows, ensure redundancy of supply, and provide looping of the system.

Following these recommendations, an expected fire flow of 143.5 L/s will be available at the site with an expected static pressure of approximately 54PSI at an elevation of 407m

The 2021 RCC for the Centre Wellington Water System indicate that there are 1,113 uncommitted units available in water supply capacity which includes the proposed development of 280 units.

Stormwater:

The subject site slopes westerly (i.e., away from W.R.7) where runoff sheet flows onto another agricultural property. It may be necessary to investigate and secure an adequate outlet to the west. It is possible that part of the site could be graded to drain to W.R.7 where the existing ditch drains southerly to Middlebrook Road, then westerly along Middlebrook Road to an eventual outlet to the Grand River. Wellington County will need to be consulted and approve any stormwater design intended to discharge to their ROW.

Regardless of the outlet, it is recommended at this preliminary stage that Enhance Quality Treatment and Post-to-Pre-Peak Flow attenuation be provided. The southwest portion of the site is within a GRCA regulation limit, therefore GRCA approval of stormwater design must be obtained.

Conclusion:

David St. SPS & Reserve Capacity

As noted above the existing per person flow rates are lower than those reported in the RCC. However, as a factor of safety, we believe it is reasonable to assess the SPS using the RCC per person flow rates. This results in the existing SPS having sufficient capacity to service the development, although repairs and improvements are warranted given the current condition.

To further assess the impact of this development, we completed the assessment utilizing the MOE recommended value of 450L/capita/day which are 99% larger than the current RCC flow rates. Although considering these flows result in the current station being under sized, we do not believe these flows are realistic. Further to this, given the large overflow/emergency storage available and the opportunity to adjust float elevations, it is our opinion that the current station is adequately sized to attenuate the flows in the rare event larger flows are realized.

Additionally, the Elora WWTF is expected to have sufficient capacity to treat the estimated flows produced by the development.

Existing Sewers:

Based on the current SPS configuration/pump rates, it is expected that the downstream sewers will have adequate capacity. As a point of clarification, following development build-out the pumps will run more frequently, albeit at the same rate, resulting in no increase in flow rate directed to the existing downstream sewer system. However, it is worth noting that as Elora continues to develop there may be some areas of concern, as noted previously. These should be closely monitored moving forward to reduce the risk of surcharge events.

Sanitary sewers will need to be extended to the proposed development frontage, however the existing sewers on David Street are expected to have sufficient depth and capacity to service this development.

Water Servicing:

Based on the above analysis/recommendations, the expected system pressures and fire flow available in the site is expected to be acceptable for typical housing needs. However, the adequacy of the fire flows will need to be confirmed by the developer and their agents based on building specifics.

Further to this, the Centre Wellington Water system is expected to have sufficient capacity to supply the Development once services are extended to the site.

Stormwater Management:

As discussed above, an enhanced level of treatment and GRCA permitting is expected. Additionally, Wellington County approval of drainage to their ROW is required. Further, GRCA is to be consulted regarding SWM requirements to development of the site.

If you have any questions or concerns, please do not hesitate to contact us.

Appendix B

Water Demand Analysis

350 Wellington Road 7
WATER FLOW DEMANDS
Elora, Ontario
Project #: 51060-100
Date: August 4, 2023
Design By: TMA
Checked By : LEI

Development Information[1,5]									Fire Flow[2,5]																	Domestic Flow[3,4]					
									Ontario Building Code							Fire Underwriters Survey														
Node ID / Area ID / Building #	F.F.E. (m.a.s.l.)	Description	# of Units	Site Area	Population	Bldg Area (1st Floor)	Total Bldg Area	Building Volume	K	V	S_{tot}	Q	F	F		C	A	F	(2) Occupancy Reduction	(3) Sprinkler Protection	(4) Building Exposure	F	F		Fire Flow (Max OBC /FUS)	2021 RCC Guidelines	Average Day	Max Day	Peak Hour	Minimum Hour	Max Day + Fire Flow
				ha	# of people	m^2	m^2	m^3		m^3		L	L/min	L/s			m^2	L/min					L/min	L/s		L/s	L/s	L/s	L/s	L/s	L/s
	Varies	Townhouse Block	271	4.46	837	948	2,875	7,763	23	7,763	2.00	357,120	9,000	150		1.50	2,460	16,000	-15%	0%	75%	24,000	400		400	3.392	3.392	9.329	14.112	1.357	409
		TOTALS FOR SITE	**271**	**4.46**	**837**	**948**	**2875**	**7763**	**Governing OBC Fire Flow =**					**150**		**Max Fire Flow =**							**400**		**400**	**3.39**	**3.39**	**9.33**	**14.11**	**1.36**	**409**
																								Sum of Maximum Day Flows + OBC Fire Flow (L/s) =						**159**
																								Sum of Maximum Day Flows + FUS Fire Flow (L/s) =						**409**

Assumptions:

1 The building area, volume and units are based on the Conceptual Site Plan by MHBC and are based on the worst case block (Block 31). Assumed 3.09 ppu based on 2021 Reserve Capacity Calculations (RCC) for Centre Wellington.

2 The building is classified as occupancy group C (Residential Occupancy) with limited combustible contents. All units The building construction type was assumes to be combustible.

3 Average Day Demand based on the Township of Centre Wellington Development Manual:

Residential = 350 L/cap/day

4 Peaking Factors based on "Design Guidelines for Drinking-Water Systems" (MOE, 2008):

Average Day =	1
Maximum Day =	2.75
Peak Hour =	4.16
Minimum Hour =	0.4

5 The raised deck/patio was included in the calculations. The basement was not included in the FUS calculations given at least 50% of it is below grade.

Appendix C

Sanitary Flow Analysis

350 Wellington Road 7

Sanitary Flow Rate Analysis

Elora, Ontario

Project #: 51060-100
Date: August 4, 2023
By: TMA
Checked By: LEI

Sanitary Flow Calculations											
Land Use	**Site Area** *(ha)*	**# of units[1]**	**Equivalent Population Density[2]** *(ppu/ppha)*	**Population** *(capita)*	**Average Per Capita DWF[3]** *(L/cap/d)*	**Average Flow** *(L/s)*	**Peaking Factor[4]**	**Peak Flow** *(L/s)*	**Infiltration[5]** *(L/s)*	**Total Average Flow + Infiltration** *(L/s)*	**Total Peak Flow + Infiltration** *(L/s)*
Residential	4.46	271	3.09	837.39	350.00	3.39	3.85	13.05	0.67	4.06	13.72

Assumptions:

1 Unit count of 271 was obtained from the Conceptual Site Plan prepared by MHBC
2 Based on 2021 Reserve Capacity Calculations (RCC) for Centre Wellington, a rate of 3.09 ppu was used.
3 Average residential sanitary design flow of 350 L/cap/d was used per the Township of Centre Wellington Development Manual.
4 Residential Harmon Peaking Factor Formula per the Township of Centre Wellington Development Manual;
F=1+(14/(4+P^0.5)) Where P = population (in thousands) F = min 2.0, max 4.0
5 Infiltration Rate of 0.15 L/s/ha was used per the Township of Centre Wellington Development Manual.

Appendix D

Storm Outlet Options

Tyler Arndt

From: Ray Kirtz <rkirtz@tritoneng.on.ca>
Sent: Tuesday, March 28, 2023 4:14 PM
To: Tyler Arndt
Cc: Lynn Ingram; Dustin Lyttle
Subject: RE: 350 Wellington Rd 7, Elora - Storm Water Management

Follow Up Flag: Follow up
Flag Status: Flagged

Hi Tyler;

Approach to confirm SWM strategy/criteria is acceptable.

Regarding comments that can be deferred to detailed design, highlighted items are OK ***except***;

- Items related to SWM Storage sizing needs to be addressed as part of OPA and ZBA Applications to confirm site layout/configuration. This would include comments 1.19, 1.20, 1.23, 1.24 and 1.26.

/Ray

From: Tyler Arndt <TArndt@mte85.com>
Sent: March 27, 2023 12:29 PM
To: Ray Kirtz <rkirtz@tritoneng.on.ca>
Cc: Lynn Ingram <LIngram@mte85.com>; Dustin Lyttle <dlyttle@tritoneng.on.ca>
Subject: RE: 350 Wellington Rd 7, Elora - Storm Water Management

Hi Ray,

Thank you for providing your notes from our August 2022 meeting regarding an alternate SWM Strategy, they generally align with ours and what we expected to see in Triton's Engineering Review Comments… we will continue our functional design on this bases.

As suggested, we will be reaching out to the GRCA to discuss the proposed outlet beyond the WR7 and Middlebrook intersection to review the adequacy of the outlet and if they have any specific requirements which need to be met… I will follow up after to inform you of the outcome of these discussions, at which point a meeting may be required to discuss what Triton will require for review of this outlet at this functional design stage to support the OPA and ZBA Applications given design flexibility and review during detailed design.

On the topic of functional design vs detailed design, we have reviewed Triton's Engineering Review Comments and believe the majority of them are requesting information above and beyond that typically required at a functional design stage and request they be differed to detail design. I have attached our comment response matrix and have highlighted Triton's Engineering Review Comments related to MTE's design that we believe should be differed. Please review and confirm if you're in agreement, we would be happy to attend a meeting to discuss the comments in question further if required.

Thanks,
Tyler

Tyler Arndt, E.I.T. | **Designer**
MTE Consultants Inc.
T: 519-743-6500 x1386 | TArndt@mte85.com

From: Ray Kirtz <rkirtz@tritoneng.on.ca>
Sent: Monday, March 13, 2023 11:50 AM
To: Tyler Arndt <TArndt@mte85.com>
Cc: Lynn Ingram <LIngram@mte85.com>; Dustin Lyttle <dlyttle@tritoneng.on.ca>
Subject: RE: 350 Wellington Rd 7, Elora - Storm Water Management

Hi Tyler,

I have reviewed my notes from our August 2022 meeting and you are correct that an alternate SWM strategy was considered as follows;

- Currently no runoff is directed to WR7 from this site, however, an appropriate outlet is needed and this is only one available. Obviously, they can't achieve post-pre on the runoff to WR7. Not sure the value of trying to achieve post-pre for the site as it will require significant storage since the proposed site is very high imperviousness. Suggested that the hydraulic considerations (ditch, culverts, watercourse) of the outlet along WR7, Middlebrook and watercourse to the river be reviewed to determine if there are any limitations/concerns with this outlet.
- A quantity control strategy which provides attenuation to a level that is feasible to implement within the proposed site configuration should be looked at.

Based on this, the outlet constraints would need to be reviewed, which I don't believe was done on the previous submission. We're not too worried about WR7 system since we're going to be designing this system to accommodate whatever flows come from the site. That said, controlling the flows on-site will reduce the size/cost of this future system on WR7.

However, the storm system downstream on Middlebrook and across GRCA property to the Grand River will need to be considered if flows to this system are going to be increased. Also, we'd suggest that you touch base with GRCA regarding the adequacy of the outlet across their property and any specific requirements they have.

If you want to discuss this please contact me.

/Ray

From: Tyler Arndt <TArndt@mte85.com>
Sent: March 10, 2023 2:12 PM
To: Ray Kirtz <rkirtz@tritoneng.on.ca>
Cc: Lynn Ingram <LIngram@mte85.com>; Dustin Lyttle <dlyttle@tritoneng.on.ca>
Subject: RE: 350 Wellington Rd 7, Elora - Storm Water Management

Hi Ray,

I hope all is well with you.

Based on our meeting back in August 2022, it was understood that the typical quantity control SWM Criteria (Post to Pre) should not apply to this Site given the existing conditions and that a new storm sewer is proposed to be installed along Wellington Road 7… We recently received Triton's Engineering Review Comments which note that the proposed SWM criteria is not acceptable given the size of the proposed development and that post-development flows are to be

within the pre-development rates, requesting the typical quantity control SWM Criteria which we discussed was not feasible given the Site's circumstances. Given this, we would like to request another meeting with Triton to review the quantity control SWM Criteria for the Site and come up with a resolution that works for all parties.

Please provide your availability over the next week or two so we can find a suitable time to meet... In addition, we believe it would be best to have any required parties from the Township or County in attendance so please pass this email on accordingly.

Thanks,
Tyler

Tyler Arndt, E.I.T. | **Designer**
MTE Consultants Inc.
T: 519-743-6500 x1386 | TArndt@mte85.com

From: Zenthus Anyalemechi <ZAnyalemechi@mte85.com>
Sent: Monday, September 12, 2022 2:37 PM
To: 'Ray Kirtz' <rkirtz@tritoneng.on.ca>; Dustin Lyttle <dlyttle@tritoneng.on.ca>
Cc: Lynn Ingram <LIngram@mte85.com>; Tyler Arndt <TArndt@mte85.com>
Subject: RE: 350 Wellington Rd 7, Elora - Storm Water Management

Good day Ray, we have completed a preliminary SWM brief based on our discussions during our meeting on the August 24th.
Let us know if you have any comments/concerns.

Please click on the following link to download the attachments: https://files.mte85.ca/message/jgbsX8bVkHI9rRikeEg1A0
The attachments are available until: **Monday, 26 September.**

FILES INCLUDED IN THIS LINK:
SWM Criteria Brief.pdf 2.68 MB

Thanks

Client First | **Right Solution** | **Work Together** Zenthus Anyalemechi, M.Eng., P.Eng.
Project Manager
Kitchener x1321

From: Ray Kirtz <rkirtz@tritoneng.on.ca>
Sent: Tuesday, August 23, 2022 4:36 PM
To: Zenthus Anyalemechi <ZAnyalemechi@mte85.com>
Cc: Dustin Lyttle <dlyttle@tritoneng.on.ca>
Subject: RE: 350 Wellington Rd 7, Elora - Storm Water Management

Hi Zenthus,

Typically the Twsp/Cty would require Post to Pre quantity control for a development unless there are extenuating circumstances that make this not feasible.

I am available most of tomorrow (except 3- 3:30) to discuss if you would like.

/Ray

From: Zenthus Anyalemechi <ZAnyalemechi@mte85.com>
Sent: August 17, 2022 11:58 AM
To: Ray Kirtz <rkirtz@tritoneng.on.ca>
Subject: FW: 350 Wellington Rd 7, Elora - Storm Water Management

Good day Ray, we are having some conversations around the SWM for this site and would like to add you to this conversation.

While we are looking at maintaining flows to the wetland per existing conditions and to meet GRCA requirements our primary legal outlet remains WR7.

We would like to discussed with the township and County to come up with an appropriate release rate for our Site, since our client will be urbanizing a portion of the WR7 to eliminate the ditch.

Currently working with post to pre will require huge storage within our site given that the site is 100% pervious under pre development condition.

Please let me know your thoughts and if we can set up a meeting to discuss.

Zenthus Anyalemechi, M.Eng., P.Eng. | **Project Manager**
MTE Consultants Inc.
T: 519-743-6500 x1321 | ZAnyalemechi@mte85.com
520 Bingemans Centre Drive, Kitchener, Ontario N2B 3X9
www.mte85.com | Twitter | LinkedIn | Instagram | Facebook

Tyler Arndt

From: Laura Warner <lwarner@grandriver.ca>
Sent: Wednesday, July 19, 2023 11:38 AM
To: Tyler Arndt
Cc: Jessica Conroy; Lynn Ingram
Subject: RE: 51060-100_350 Wellington Road 7, Township of Elora - Storm Outlet Review
Attachments: GRCA Comments-OP01-22 & RZ17-22 - 350 Wellington Road 7.pdf

HI Tyler,

GRCA staff have already provided clearance to the OPA and ZBA applications through our attached comments provided to the Township in January. Our review of the materials provided to date have been at a higher level given the nature of the applications, understanding that detailed design review will be completed through subsequent planning applications/GRCA permit.

Your understanding of our SWM criteria is correct and we understand these requirements will be addressed through detailed design. If any requirement cannot be met in full (i.e. achieving an annual infiltration water balance across the site) best efforts to achieve the requirement should be demonstrated with appropriate rational.

Without reviewing a detailed design submission, I would suggest it is premature for GRCA to comment on whether our requirements have been met at this time.

If you have any questions, please let me know.

Kind regards,
Laura

Laura Warner
Resource Planner
Grand River Conservation Authority

400 Clyde Road, PO Box 729
Cambridge, ON N1R 5W6
Office: 519-621-2763 ext. 2231
Toll-free: 1-866-900-4722
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From: Tyler Arndt <TArndt@mte85.com>
Sent: Tuesday, July 18, 2023 10:26 AM
To: Laura Warner <lwarner@grandriver.ca>
Cc: Jessica Conroy <jconroy@grandriver.ca>; Lynn Ingram <LIngram@mte85.com>
Subject: FW: 51060-100_350 Wellington Road 7, Township of Elora - Storm Outlet Review

Hi Laura,

I hope all is well with you.

I got an automatic reply from Jessica's email noting she will be returning on July 24, 2023 which is why I am reaching out… We are hoping the GRCA can review the consolidated SWM criteria summarized below and confirm the

requirements are covered as we are looking to complete our OPA and ZBA Application resubmission within the next week and need this confirmed prior to doing so. Anything to expedite this confirmation while Jessica is off is much appreciated.

Thanks,
Tyler

Tyler Arndt, E.I.T. | **Designer**
MTE Consultants Inc.
T: 519-743-6500 x1386 | TArndt@mte85.com

From: Tyler Arndt
Sent: Tuesday, July 18, 2023 10:15 AM
To: 'Jessica Conroy' <jconroy@grandriver.ca>
Cc: Lynn Ingram <LIngram@mte85.com>
Subject: RE: 51060-100_350 Wellington Road 7, Township of Elora - Storm Outlet Review

Hi Jessica,

Thank you for providing GRCA's stance on the outlet options provided and requirements for the Site, it is much appreciated.

Based on our review of the information provided, we understand the GRCA's SWM Criteria for the Site are as follows:

1. *Maintain existing drainage patterns*
   This is already being achieved based on the current grading, servicing and SWM design proposed in the FS-SWM Report.
2. *Achieve an annual surface runoff water balance to Wetland A and Wetland B (feature-based), runoff volumes in the pre-development and post-development condition must be shown in the water balance analysis*
   An annual surface runoff water balance to each wetland feature has been achieved based on the current grading, servicing and SWM design proposed in the FS-SWM Report: the water balance analysis already illustrates runoff volumes in the pre-development and post-development condition.
3. *Achieve an annual infiltration water balance across the Site*
   Based on the findings of the geotechnical investigation and hydrogeological assessment by Grounded, there is only 3.7 m at the north end of the Site to 0.8m at the middle of the Site to 2.6m at the south end of the Site between the existing grade and the groundwater table across the Site. This shallow groundwater table is not ideal for the installation of a traditional on site infiltration gallery given the required 1m vertical separation between the bottom of the gallery and the seasonal high groundwater table. In addition, the soils above the observed groundwater table were noted to be moist to wet, further indicating the Site may not be suitable for an infiltration gallery. However, this will be reviewed further during detailed design given the majority of the Site is being raised. Other LID methods such as amended topsoil will also be explored during detailed design to help promote infiltration. This has already been noted in the FS-SWM Report.
4. *Storm Outlet Option #1 is preferred by the GRCA, adequate erosion control measures at the outlet sized to withstand the regional storm event are required, all uncontrolled flows up to the regional storm event must be contained within the proposed municipal storm sewer and municipal ditch*
   Runoff from the Site is proposed to be controlled by an outlet control pipe with storage provided in underground storage tanks provided within the Site. Despite on-site control, flows are not proposed to be over controlled to pre-development rates for several reasons, including the minimal allowable flow rate to Wellington Road 7 in the pre-development condition though this is the legal outlet for the Site, proximity to the Grand River (though not directly adjacent) and the fact that the proposed storm outlet along Wellington Road 7 is being funded by the developer. Because of these reasons, this development

is a unique situation and does not set a precedent for future developers with respect to quantity control criteria.

Please review and confirm that the condensed SWM Criteria noted above is accurate and satisfies the requirements of the GRCA.

Thanks,
Tyler

From: Jessica Conroy <jconroy@grandriver.ca>
Sent: Tuesday, July 4, 2023 1:16 PM
To: Tyler Arndt <TArndt@mte85.com>
Cc: Lynn Ingram <LIngram@mte85.com>
Subject: RE: 51060-100_350 Wellington Road 7, Township of Elora - Storm Outlet Review

Hi Tyler,

Thank you for following up and sorry for the delay. Hope you had a nice long weekend too!

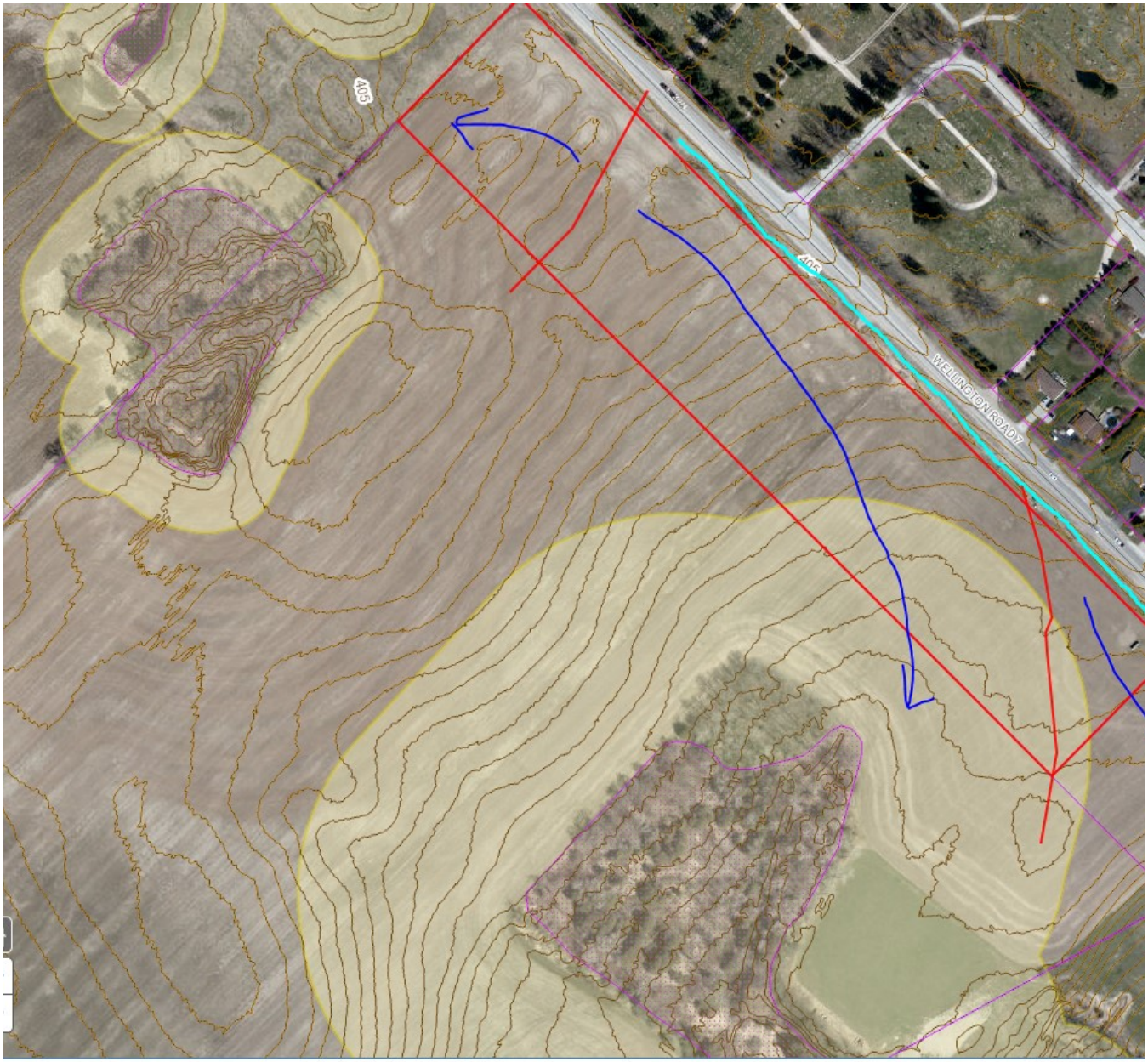
We have reviewed this internally and can provide the below comments. Feel free to forward these comments to Triton.

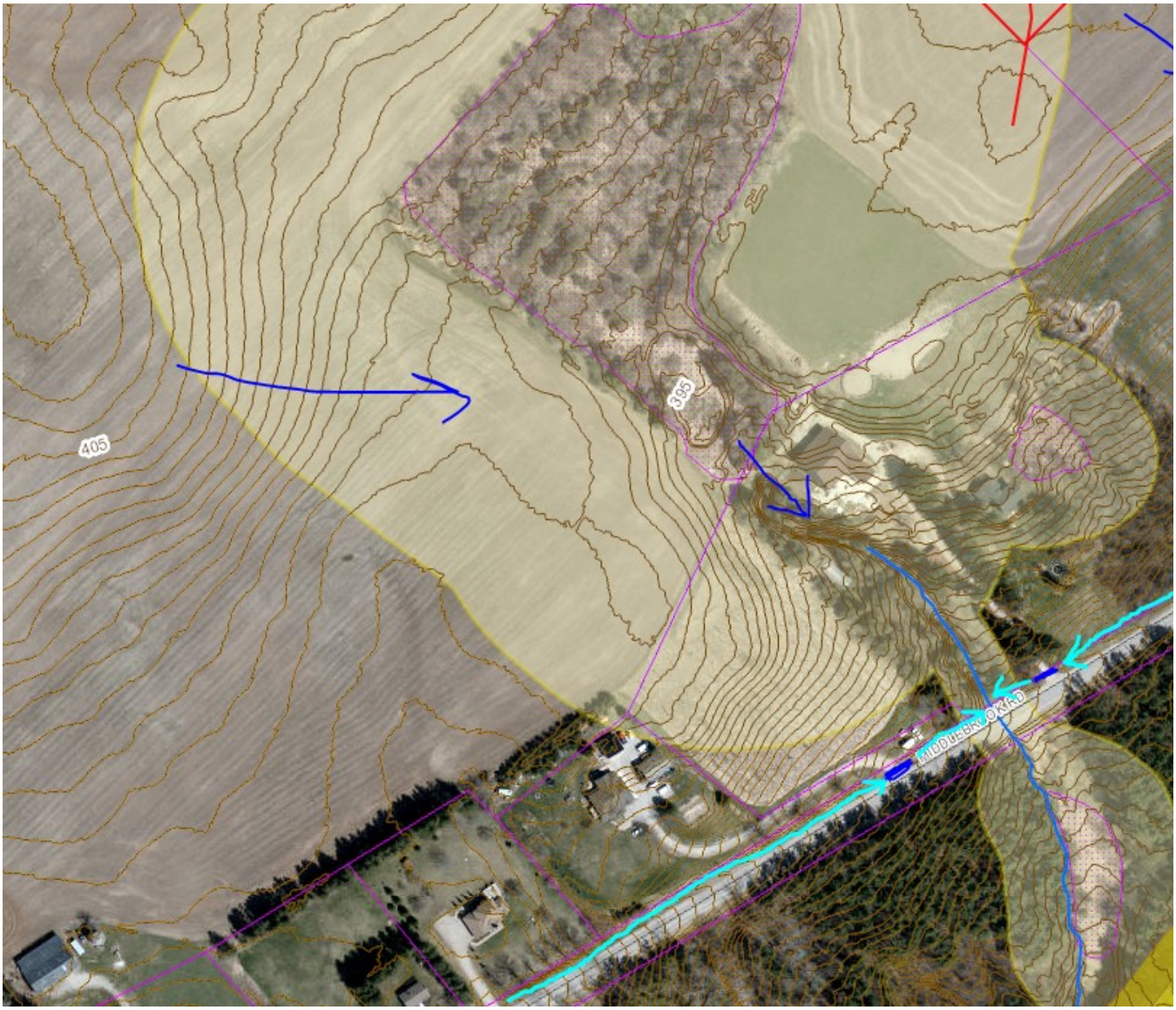
Engineering Comments

See below for a summary of engineering's stance on each option and our requirements for each:

Overview:

- Under existing conditions, it appears that:
    - The majority of the property sheet flows to the existing wetlands adjacent to the property; either to the wetlands north or southwest of the property.
    - A smaller portion of the property sheet flows south towards Middlebrook Road, where it is intercepted by a roadside ditch that conveys flows west to an existing watercourse through GRCA lands.
    - The watercourse through GRCA lands appears to be fed by the wetlands, flows from the residential properties to the west of the watercourse, as well as flows from Wellington Road 7 & a portion of the subject property that are captured in the roadside ditch.


406
WELLINGTON ROAD 7



- **REQUIREMENTS:**
    - The existing drainage patterns of the site must be maintained.
    - Wetlands require quantity control and a feature-based water balance.
    - Site water balance will be required.
    - All water balances must show pre-development, post-development (uncontrolled), and post-development (controlled) conditions.
    - Consultants can refer to Section 6 of TRCA's Stormwater Management Criteria for water balance guidance.
- There are situations where GRCA may allow a property that is directly adjacent to a large river to discharge uncontrolled runoff into the large river in an effort to 'Beat the Peak'.
    - This property is not directly adjacent to the Grand River and, therefore, areas and infrastructure downstream of the property would be impacted by the release of uncontrolled runoff from the developed property.

<u>Outlet Option 1:</u> Proposed Municipal Storm Sewer to Proposed Culvert under Middlebrook Road to Proposed Ditch to Grand River

- This option ties-into municipal infrastructure before discharging to the Grand River.

- GRCA would require adequate erosion control measures at the outlet, sized to withstand the regional storm event. Velocities at the outlet point to the Grand River must be kept low. Consider the use of energy dissipation measures.
- If uncontrolled runoff is being directed through Option 1, as proposed by the consultant, <u>all uncontrolled flows up to the regional storm event must be contained within the proposed municipal storm sewer and municipal ditch</u>.
    - *<u>Advisory to the Municipality:</u>*
        - As this is the Municipality's infrastructure, it is up to the Municipality if they would like to assume this risk.
        - GRCA advises against the discharge of uncontrolled runoff to the proposed municipal storm sewer system.
            - This would increase the risk of flooding along the road and downstream properties. The municipality would have to size a large storm sewer and ditch to accommodate this development for all storm events up to the regional storm.
            - This sets a precedent for future developments. Developers of nearby properties may also want to tie into the Municipality's storm sewer system and release uncontrolled flows from their site as well. Will this storm sewer system then be sized to accommodate all properties that want to do this? How would this impact future roadway upgrades and developments within the Municipality? Where would this line be drawn?
            - The potential cumulative impact of this and the precedent it sets for future developers and Municipal infrastructure upgrades is of concern.
        - GRCA recommends that quantity control is met for all storms (2-year to 100-year) and safe conveyance of the Regional storm through the site and into the Municipality's infrastructure.

<u>Outlet Option 2:</u> Proposed Municipal Storm Sewer to North Ditch along Middlebrook Road to Existing Watercourse to Grand River (through GRCA property)

- This option ties-into municipal infrastructure, but discharges to a regulated watercourse that flows through GRCA owned lands.
- This option matches existing drainage patterns.
- Uncontrolled post-development runoff to this location is not acceptable.
- Quantity controls will be required for the proposed development to ensure existing drainage conditions are maintained. It must also be ensured that the proposed road upgrades do not increase flows to the existing watercourse. Matching existing conditions would make this option acceptable.
- The proposed development would introduce a larger volume of water to this watercourse over time, therefore, runoff volume control is required as well. If runoff volume control cannot be met, then a stream erosion study by a fluvial geomorphologist will be required.

GRCA Property Comments:

- Option 2 would involve GRCA owned land (Elora Gorge Conservation Area). GRCA Property staff have concerns about Option 2 and further details and discussion/justification would be needed to entertain this option.

I hope this helps.

Thank you,
Jessica

Jessica Conroy, MES Pl.
Resource Planner
Grand River Conservation Authority

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From: Tyler Arndt <TArndt@mte85.com>
Sent: Tuesday, July 4, 2023 12:08 PM
To: Jessica Conroy <jconroy@grandriver.ca>
Cc: Laura Warner <lwarner@grandriver.ca>; Maria Vogiatzis <mvogiatzis@grandriver.ca>; Lynn Ingram <LIngram@mte85.com>
Subject: RE: 51060-100_350 Wellington Road 7, Township of Elora - Storm Outlet Review

Hi Jessica,

I hope all is well with you and that you enjoyed the Canada Day long weekend!

I am reaching out to follow up on the status of the GRCA's review of the Stormwater Management Criteria and Storm Outlet strategy for the proposed development at 350 Wellington Road 7, as it has been quite some time since our meeting on April 5th 2023. The second ZBA/OPA submission for this development was completed on April 27th 2023 and our revised Functional Servicing and Stormwater Management Report incorporated the information provided during and after our meeting for all agencies to review. We just received agency comments back, however, the GRCA comments received appear to be from the first ZBA/OPA submission indicating that the GRCA has no objection to the application (see attached).

Please confirm that this stance holds true for the presented Stormwater Management Criteria and Storm Outlet strategy for the proposed development, both of which have already been found acceptable by Triton Engineering Services Limited pending GRCA's approval/confirmation. As noted previously, it is understood that the design of the external Site works which includes the new storm outlet will be completed by the Township/County's Engineer, Triton. Therefore, the GRCA's preferred storm outlet solution can continue to be worked through with them during detailed design.

Thanks,
Tyler

Tyler Arndt, E.I.T. | **Designer**
MTE Consultants Inc.
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From: Jessica Conroy <jconroy@grandriver.ca>
Sent: Wednesday, April 12, 2023 11:46 AM
To: Tyler Arndt <TArndt@mte85.com>
Subject: RE: 51060-100_350 Wellington Road 7, Township of Elora - Storm Outlet Review

Hi Tyler,

Received, thank you. We will review and get back to you as soon as possible.

Thank you,
Jessica

Jessica Conroy, MES PI.
Resource Planner
Grand River Conservation Authority

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From: Tyler Arndt <TArndt@mte85.com>
Sent: Tuesday, April 11, 2023 8:27 AM
To: Jessica Conroy <jconroy@grandriver.ca>; Maria Vogiatzis <mvogiatzis@grandriver.ca>; Laura Warner <lwarner@grandriver.ca>
Cc: Lynn Ingram <LIngram@mte85.com>
Subject: RE: 51060-100_350 Wellington Road 7, Township of Elora - Storm Outlet Review

Hello All,

I hope you enjoyed the long weekend and thanks again for meeting last week to discuss the proposed storm sewer outlet from 350 Wellington Road 7 (WR7) to the Grand River. Below I have provided an overview of the proposed development, stormwater management design, and the proposed storm outlet options to the Grand River which I've attached schematic markups for. Note, I have worked in the points that were discussed during our meeting regarding the storm outlets into this overview.

Proposed Development

The proposed development for the Site is the construction of 34 townhome blocks complete with common drive aisles, surface parking, landscape and amenity areas. To create an inviting urban street-scape, which reflects the character of the Town and enhances the function of the community, it is proposed to urbanize the southbound lane of Wellington Road 7 along the frontage of the Site down to Middlebrook Road/ David Street West Intersection. This work would include filling in the existing roadside ditch and installing a municipal storm sewer in its place, providing catchbasins and concrete curb and gutters to create a proper boulevard which will facilitate a multi-use path and street trees. The installation of the new municipal storm sewer will provide a legal storm outlet for the Site and will be sized to accommodate the proposed flows. It is our understanding that the design of the external Site works will be completed by the Township/County's Engineer, Triton.

Stormwater Management Design

Typically the Stormwater Management (SWM) Design Criteria in the Township of Centre Wellington is post- to pre-development quantity control for the 2-year through 100-year storm events, implementation of enhanced level water quality controls, and to provide erosion and sediment controls based on the Township's draft Development Manual. However, early on in the project MTE met with Triton to review the challenges and opportunities for the Site in regards to the typical quantity control SWM Design Criteria. Based on that meeting, Triton agreed that given the need to maintain a water balance to the existing GRCA Regulated Wetlands, the lack of runoff toward WR7 in the existing condition and the Site's proximity to the Grand River that post- to pre-development quantity control isn't reasonable to WR7. Therefore, an alternate quantity control SWM Design Criteria is warranted and acceptable since the WR7 storm sewer system is going to be designed to accommodate the flows from the Site.

During our meeting Maria mentioned that the GRCA would have typically expected post- to pre-development quantity control for the Site, however, the paragraph above gives some background on why an alternate quantity control SWM Design Criteria is proposed. Based on past MTE projects, the GRCA typically requests no quantity controls on properties in close proximity to the Grand River as implementing flow controls increases the drawdown time of the stormwater from sites and lags the hydrographs for the various storm events causing more conflict with the river's peak flow. We understand that this Site is not adjacent to the Grand River, however, it is only 490m north of it. With the proposed storm sewer, the concentration time in the pipe from the Site to the Grand River is only a few minutes, meaning the Site should be considered as adjacent to the Grand River and no quantity controls should be required as agreed by Triton.

Based on the comments from the first OPA and ZBA Application, and additional correspondence with Triton, they have requested further review of the proposed storm sewer outlet from Middlebrook Road to the Grand River. Based on our functional review, two storm outlet options appear to be available; 1. Extending the proposed storm sewer further down WR7 where it will daylight just upstream of the Grand River, 2. Directs flows from the proposed storm sewer to the Middlebrook Road roadside ditch which will convey the flow to an existing culvert crossing that outlets to the GRCA owned lands and ultimately to the Grand River, mimicking the existing flow route for runoff from WR7. These options were briefly discussed during our meeting but are discussed in more detail below for the GRCA's review.

<u>Outlet Option #1</u>
As mentioned above, Outlet Option #1 is extending the proposed storm sewer further down WR7 where it will daylight just upstream of the Grand River. The proposed storm sewer would need to cross Middlebrook Road to continue down WR7. The sewer would be located in the southwest boulevard of WR7 from Middlebrook to the WR7 bridge, minor regrading would be required to ensure cover over the storm sewer. The sewer would daylight just before the WR7 bridge where runoff would be conveyed overland for a short distance prior to reaching the Grand River. Erosion control measures would be required as Maria mentioned during our meeting either at the sewer outlet and/or between the outlet and the Grand River. See attached markup for illustration.

<u>Outlet Option #2</u>
As mentioned above, Outlet Option #2 directs flows from the proposed storm sewer to the Middlebrook Road roadside ditch which will convey the flow to an existing culvert crossing that outlets to the GRCA owned lands and ultimately to the Grand River, mimicking the existing flow route for runoff from WR7. The proposed storm sewer would end at the WR7 and Middlebrook Road intersection. The storm sewer would outlet to the existing roadside ditch along the north side of Middlebrook Road, and upgrades to the ditch may be required to ensure the proposed flow can be conveyed. Approximately 150m southwest of the intersection, flow would be conveyed through an existing culvert crossing Middlebrook Road towards the GRCA owned lands. This existing culvert may also need to be upsized to ensure it can convey the proposed flow. Flow would then travel overland across the GRCA owned lands where it would ultimately reach the Grand River. See attached markup for illustration. As discussed on our call, this outlet option will need to be reviewed by GRCA's property management department. It should be noted that this is the existing flow route for runoff for a portion of WR7, Middlebrook Road and other private lands. Given the low point in Middlebrook Road at this location, it is anticipated this flow route will always need to remain to accommodate the existing upstream catchment area.

Please review the information above and provide comment on both storm outlet options noting the design requirements for each and which option would be preferred by the GRCA. I want to reiterate that we are only at a functional/high level design stage at this time and will be resubmitting our OPA and ZBA Application at the end of this month. Therefore, we ask that the GRCA provides a timely response on this matter so we can incorporate the preferred option in our updated Functional Servicing and Stormwater Management (FS-SWM) Report for the Site. We would be happy to meet again if required to discuss the GRCA's review.

Thanks,
Tyler

Tyler Arndt, E.I.T. | **Designer**
MTE Consultants Inc.
T: 519-743-6500 x1386 | TArndt@mte85.com

From: Jessica Conroy <jconroy@grandriver.ca>
Sent: Friday, March 31, 2023 3:56 PM
To: Tyler Arndt <TArndt@mte85.com>
Subject: RE: 350 Wellington Road 7, Township of Elora - Storm Outlet Review

Hi Tyler,

Okay sounds good.

GRCA staff involved would be myself and Maria Vogiatzis, Water Resources Engineer (mvogiatzis@grandriver.ca), and Laura Warner (lwarner@grandriver.ca) may also attend.

Thank you and have a great weekend too.

Thank you,
Jessica

Jessica Conroy, MES Pl.
Resource Planner
Grand River Conservation Authority

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From: Tyler Arndt <TArndt@mte85.com>
Sent: Friday, March 31, 2023 3:49 PM
To: Jessica Conroy <jconroy@grandriver.ca>
Cc: Lynn Ingram <LIngram@mte85.com>
Subject: RE: 350 Wellington Road 7, Township of Elora - Storm Outlet Review

Hi Jessica,

Thank you for providing GRCA staff availability, April 5th 2-3pm works best for us.

This meeting will be virtual, please send us a meeting invite or inform us of what GRCA staff are required and we will send one out.

Have a great weekend,
Tyler

Tyler Arndt, E.I.T. | **Designer**
MTE Consultants Inc.
T: 519-743-6500 x1386 | TArndt@mte85.com

From: Jessica Conroy <jconroy@grandriver.ca>
Sent: Friday, March 31, 2023 2:54 PM
To: Tyler Arndt <TArndt@mte85.com>
Subject: RE: 350 Wellington Road 7, Township of Elora - Storm Outlet Review

Good afternoon Tyler,

Thank you for your email.

GRCA staff currently have availability at the following dates and times:

- April 5 between 1-3pm;
- April 6 between 9am and 12pm or between 1pm and 4pm;
- April 11 between 2:30 and 4pm;
- April 13 between 1pm and 4pm.

Please let me know what works best. Would this be a virtual meeting?

Thank you,
Jessica

Jessica Conroy, MES Pl.
Resource Planner
Grand River Conservation Authority

400 Clyde Road, PO Box 729
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Toll-free: 1-866-900-4722
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From: Tyler Arndt <TArndt@mte85.com>
Sent: Wednesday, March 29, 2023 11:29 AM
To: Laura Warner <lwarner@grandriver.ca>; Jessica Conroy <jconroy@grandriver.ca>
Cc: Lynn Ingram <LIngram@mte85.com>
Subject: RE: 350 Wellington Road 7, Township of Elora - Storm Outlet Review
Importance: High

Hi Laura,

Thank you for informing us and passing this request on, it is much appreciated.

Welcome to this project Jessica! Please provide the availability of required staff and yourself as soon as possible so we can get a meeting schedule for early to mid-next week.

Thanks,
Tyler

Tyler Arndt, E.I.T. | **Designer**
MTE Consultants Inc.
T: 519-743-6500 x1386 | TArndt@mte85.com

From: Laura Warner <lwarner@grandriver.ca>
Sent: Tuesday, March 28, 2023 10:20 AM
To: Tyler Arndt <TArndt@mte85.com>; Jessica Conroy <jconroy@grandriver.ca>
Cc: Lynn Ingram <LIngram@mte85.com>
Subject: RE: 350 Wellington Road 7, Township of Elora - Storm Outlet Review

Hi Tyler,

Jessica Conroy is now our Resource Planner covering the Township of Centre Wellington, so I'm passing your request over to her by way of this email. Jessica will need a bit of time to review the file and engage appropriate staff here, so a virtual meeting next week is more likely.

Jessica, the file is here for context.

Kind regards,
Laura

Laura Warner
Assistant Supervisor of Resource Planning
Grand River Conservation Authority

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From: Tyler Arndt <TArndt@mte85.com>
Sent: Monday, March 27, 2023 1:42 PM
To: Laura Warner <lwarner@grandriver.ca>
Cc: Lynn Ingram <LIngram@mte85.com>
Subject: 350 Wellington Road 7, Township of Elora - Storm Outlet Review

Hi Laura,

As you may know, MTE is the Civil Consultant for the proposed townhouse development proposed at 350 Wellington Road 7 in the Township of Elora which you provided GRCA comments for dated January 31, 2023. We have no concerns with the comments provided, however, we are hoping we could meet later this week to discuss the Site's storm outlet to the Grand River with the appropriate GRCA staff. Currently the majority of the Site drains to a GRCA regulated wetland southwest of the Site which we will be providing a surface runoff water balance to in the post development condition. In addition to maintaining the flows to the wetland, a new legal storm outlet for the Site will be established to Wellington Road 7 as part of the urbanization of Wellington Road 7 from the Site down to the intersection of Wellington

Road 7 and Middlebrook Road. The new storm outlet beyond this intersection to the Grand River is what we wish to discuss with the GRCA, see attached markup for reference.

Please let us know staffs availability for this week/early next week and we will send out a meeting invite accordingly.

Thanks,
Tyler

Tyler Arndt, E.I.T. | **Designer**
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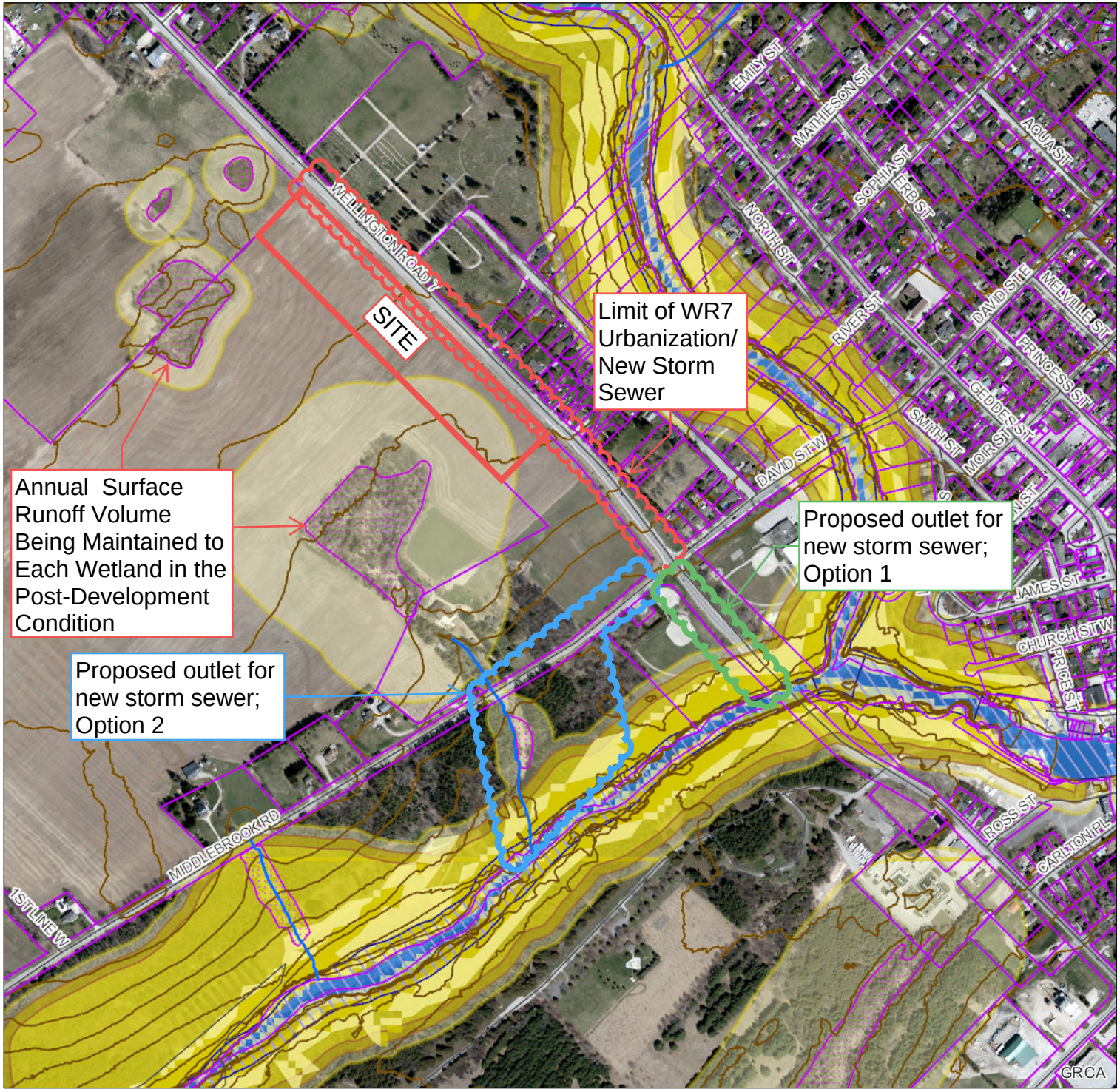

Grand River Conservation Authority

Date: Mar 27, 2023

Legend

- Regulation Limit (GRCA)
- Regulated Watercourse (GRCA)
- Regulated Waterbody (GRCA)
- Wetland (GRCA)
- Floodplain (GRCA)
  - Engineered
  - Estimated
  - Approximate
  - Special Policy Area
- Slope Valley (GRCA)
  - Steep
  - Oversteep
  - Steep
- Slope Erosion (GRCA)
  - Oversteep
  - Toe
- Lake Erie Flood (GRCA)
- Lake Erie Shoreline Reach (GRCA)
- Lake Erie Dynamic Beach (GRCA)
- Lake Erie Erosion (GRCA)
- Parcel - Assessment (MPAC/MNRF)

This legend is static and may not fully reflect the layers shown on the map. The text of Ontario Regulation 150/06 supercedes the mapping as represented by these layers.

0 45 90 180 270 Metres

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Map Centre (UTM NAD83 z17): 545,141.60 4,836,833.14

This map is not to be used for navigation | 2020 Ortho (ON)

NAD 1983 UTM Zone 17N

Scale: 7,879

New Storm Sewer from the North end of the Site to WR7 & Middlebrook Road Intersection.

Proposed Storm Sewer is extended from Middlebrook Road to the WR7 Bridge as shown. Minor boulevard regarding will be required to get cover over the sewer.

Erosion control measures to be implemented at the storm sewer outlet and/or between the outlet and the Grand River.

Approximate flow route from the storm sewer down to the Grand River based on review of the GRCA Web Map.

STORM OUTLET OPTION #1 MARKUP 2023-04-06

Middlebrook Rd

Wellington Rd 7

Elora Gorge Trail

Elora tubing launch

Elora Gorge Hole in the Rock

Elora River valley lookout (walk on…

Ex. Culvert Crossing Middlebrook Road (Approx Location), may need to be up-sized to convey the flow.

Flow from new strom sewer will be conveyed to the existing roadside ditch along Middlebrook Road as shown. Upgrades may be required to ensure the ditch can convey the flow.

New Storm Sewer from the North end of the Site to WR7 & Middlebrook Road Intersection.

Approximate flow routes from the culvert to the Grand River over GRCA Lands based on review of the GRCA Web Map.

STORM OUTLET OPTION #2 MARKUP 2023-04-06

Middlebrook Rd

Middlebrook Rd

David S

Wellington Rd 7

Wellington Rd 7

Elora Gorge Trail

Elora tubing launch

Elora Gorge Hole in the Rock

Elora River valley lookout (walk on...

Image © 2023 Maxar Technologies

Google Earth

1985

Imagery Date: 3/28/2022 17 T 545262.46 m E 4836806.09 m N elev 1275 ft eye alt 2921 ft

Appendix E

SWM Criteria Brief

Technical Memorandum

Project Name:	350 Wellington Road 7	**MTE File No.:**	51060-100
To:	Ray Kirtz & Dustin Lyttle Triton Engineering Services Limited	**Date:**	September 12, 2022
cc:	Bob & Colleen Forrest, We Merchandise Space Inc. Eldon Theodore, MHBC Planning Limited	**From:**	Tyler Arndt, E.I.T. Lynn Ingram, P.Eng.

RE: SWM Criteria Brief
350 Wellington Road 7, Elora ON

MTE Consultants Inc. has been retained to complete the preliminary grading, servicing, and stormwater management design for the proposed townhouse development, to be constructed at 350 Wellington Road 7 (herein referred to as 'the Site') in the Town of Elora, located in the Township of Centre Wellington.

The overall Site comprises of approximately 4.46ha of agricultural land and is located on Wellington Road 7 between Wellington Road 18/Woolwich Street West and Middlebrook Road/David Street West, approximately 490m north of the Grand River. The Site is bounded to the east by Wellington Road 7 and bounded to the north, south and west by existing agricultural land. Existing residential properties and the Elora municipal cemetery are located on the other side of Wellington Road 7, fronting the Site. In addition, there are four Grand River Conservation Authority (GRCA) regulated wetlands adjacent to the Site; three to the northwest and one to the southwest. The southwest wetland regulation limit extends into the southwest portion of the Site. Refer to the appended GRCA Web-Map figure for illustration of the exact Site location, surrounding wetlands and regulation limits.

The proposed concept for the Site is the construction of approximately 35 townhouse blocks complete with common drive aisles, surface parking, landscape and amenity areas. The development will create approximately 272 townhouse units varying from conventional, back to backs and double front live/work style units. In order to service the development, the existing municipal sanitary sewer and watermain will be extended from the Wellington Road 7 and David Street West intersection to the Site. The proposed storm servicing strategy is discussed in a following section in this memo.

The purpose of this technical memorandum is to review the Township's general requirements for stormwater management criteria, the Site specific constraints and to propose practical stormwater management design criteria for the subject Site for approval by the appropriate reviewing agencies.

Stormwater Management

General Stormwater Management Requirements

Based on the Township of Centre Wellington's draft Development Manual, and previous email correspondence with Triton Engineering Services Limited, general stormwater management design criteria is typically as follows:

i) Attenuation of the post-development peak flows for the 2-year through 100-year storm events to the pre-development (existing) peak flows;
ii) Implementation of water quality controls; and,
iii) Provide erosion and sediment controls.

We agree that the water quality control and erosion control criteria remain valid for this Site. However, it is our understanding that the Township's typical water quantity control requirement to attenuate post-development peak flows to pre-development (existing) peak flows is typically required in more urban/developed areas to mitigate capacity concerns with existing downstream municipal infrastructure. Given the rural cross-section of Wellington Road 7 (i.e., road side ditches), the Site's proximity to the Grand River and Site specific stormwater management constraints discussed below, we believe a deviation from the typical water quantity control requirement is warranted.

Existing Site Conditions/Constraints

To understand the Site constraints associated with the aforementioned wetlands, MTE has been working with Michalski Nielsen Associates Limited who has been retained to complete the Environmental Impact Assessment (EIS) for the Site. Through discussions regarding the natural functions of Wetland A and B within the area, it was determined that is necessary to maintain an annual surface runoff water balance to Wetland A and B to mimic the existing sheet flow from the Site in the post-development condition.

In the existing condition, the Site drains via broad sheet flow to four main drainage paths based on the existing contours; to the southwest towards Wetland A (Catchment 101), to the southeast towards the neighbouring agricultural lands (Catchment 102), to the north towards Wellington Road 7 (Catchment 103) and to the northwest towards Wetland B (Catchment 104). Refer to appended Figure 1.0 for illustration of the limits of the pre-development catchment areas directed to each drainage path. Based on these catchment areas, only around 7% of the Site currently drains to the Wellington Road 7 right-of-way to the north, 8% of the Site currently drains to the neighbouring agricultural lands to the southeast, while 18% and 67% (totaling to 85%) of the Site currently drains to Wetland B and A, respectively. Therefore, if the Township's typical water quantity control criterion was required for this Site, no flow would be allowed to drain to Wellington Road 7 towards the southeast (i.e., to the Grand River) and the majority of flow would need to be directed across the neighbouring property to the adjacent wetlands. Understanding the importance of establishing a legal outlet for green field developments such as this, the typical water quantity control criterion cannot be achieved.

Proposed Stormwater Management Strategy

Based on the existing Site conditions and constraints mentioned above, we propose the stormwater management design criteria for the Site be as follows:

i) Establish a legal outlet(s) for the Site;
ii) Maintain an annual surface runoff water balance to Wetland A and Wetland B;
iii) Attenuation of the post-development peak flows for the 2-year through 100-year storm events to the allowable flow rate using a C value of 0.75;
iv) Implementation of water quality controls; and,
v) Provide erosion and sediment controls.

A brief description has been provided below on how each criteria is anticipated to be met, and in some cases, justification for the proposed criteria has been provided.

Legal Outlet

In the existing condition, the majority of the runoff from the Site is directed across the neighbouring property via broad sheet flow to Wetland A and B. Generally, there is no right of drainage for surface water. Therefore, the only legal outlet for the Site in the existing condition is to the municipal right-of-way (Wellington Road 7).

In the post-development condition, it is proposed that the Site's private storm sewer system will outlet to the existing roadside ditch within the Wellington Road 7 right-of-way at the southeast corner of the Site. Through the Site grading design, the major overland flow route will also be directed to the Wellington Road 7 right-of-way. However, given the need to maintain a surface runoff water balance to Wetland A and B, an easement is currently being pursued with the neighbouring property owner to legally allow surface drainage across the adjacent property to these wetlands.

It should be noted that even if an easement is obtained, the primary legal outlet for the Site should still be to Wellington Road 7.

Water Balance

An annual surface runoff water balance to Wetland A and Wetland B will be achieved in the post-development condition by directing runoff from rooftop and landscape areas adjacent the west property line to the neighbouring property. From there, runoff will continue to sheet flow across the neighbouring property and into each wetland as it does in the existing condition. A preliminary annual surface runoff water balance analysis was completed for each wetland and the required catchment area to be directed to Wetland A and B is illustrated on the appended post-development catchment areas Figure 2.0 (Catchment 204 & 205, respectively).

It should be noted that being able to achieve a surface runoff water balance to Wetland A and B is conditional on obtaining an easement to allow surface drainage across the neighbouring property.

Water Quantity Control

In the pre-development condition, no surface runoff from the Site is directed toward the southeast to Wellington Road 7. However, it is imperative that an allowable flow rate be established to Wellington Road 7, south of the existing high point in the road, to support the appropriate legal outlet location for the Site.

Currently Wellington Road 7 has a rural cross-section with approximately four existing driveway/road crossing culverts between the Site and the Grand River. Given the limited infrastructure constraints, we believe an appropriate runoff coefficient should be utilized based on the proposed Site use, rather than the pre-development (existing) peak flows. Based on past experience, and the Region of Waterloo Design Guidelines and Supplemental Specifications for Municipal Services 2022 as a reference, typical runoff coefficients for residential row dwellings/townhouse blocks vary from 0.50 to 0.80. Considering the proximity to the Grand River, we believe a runoff coefficient of 0.75 is appropriate and would help allow the peak flow from the Site to occur in advance of the peak flow from the upstream drainage area. We understand that due to the increased flow to Wellington Road, road side ditch improvements and upsizing of any existing culverts may be required. If necessary, this could be completed during the necessary sanitary sewer and watermain extensions along Wellington Road 7 from the David Street West intersection to the Site. In the future when Wellington Road 7 is urbanized, the required storm sewers can be sized accordingly.

On-site quantity control requirements will be met through the use of an on-line orifice plate on the controlled catchment area (Catchment 201). Storage volume for the orifice plate will be provided via surface ponding in the drive aisles and parking areas, along with the implementation of underground storage tanks as required.

Water Quality Control

The quality control requirement will be met for the controlled catchment area (Catchment 201) through the installation of an oil-grit separator (OGS) unit on the private storm sewer system before outletting to the municipal ditch. Runoff from the frontage of the property and towards the wetlands will be from rooftop and landscape areas which are considered "clean", therefore no quality controls are required for those catchment areas (Catchment 202, 203, 204 and 205).

Erosion and Sediment Control

Precautions will need to be taken during construction to limit erosion and sedimentation. Typically, the following measures are recommended during construction for erosion and sedimentation control:

i) Erosion and sedimentation facilities are to be installed prior to any area grading operations;
ii) All erosion control measures are to be inspected and monitored by the contractor and repairs are to be completed as required;
iii) All materials and equipment used for the purpose of site preparation and project completion should be operated and stored in a manner that prevents any deleterious substance from leaving the site;
iv) Stripping and strategic placement of topsoil stockpiles. Placement of sediment control fencing around all stockpile areas;
v) Re-vegetation of completed areas as soon as possible after construction, including those areas not slated for construction, within 60 days of rough grading; and,
vi) To minimize the amount of mud being tracked onto the roadway, a mud mat should be installed at the primary construction entrance.

The exact erosion and sediment control measures will be determined during detailed design.

We trust the above provides rationale as to why the Township's general stormwater management design water quantity control criteria is not feasible for the subject Site. We respectfully request that the proposed alternate stormwater management criteria be reviewed and approved by the appropriate reviewing agencies. A functional servicing and SWM report and functional design drawings will be prepared and submitted once the stormwater management criteria is agreed upon.

Yours truly,

MTE Consultants Inc.

Tyler Arndt, E.I.T.
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Lynn Ingram, P.Eng.
Design Engineer
519-743-6500 ext.1381
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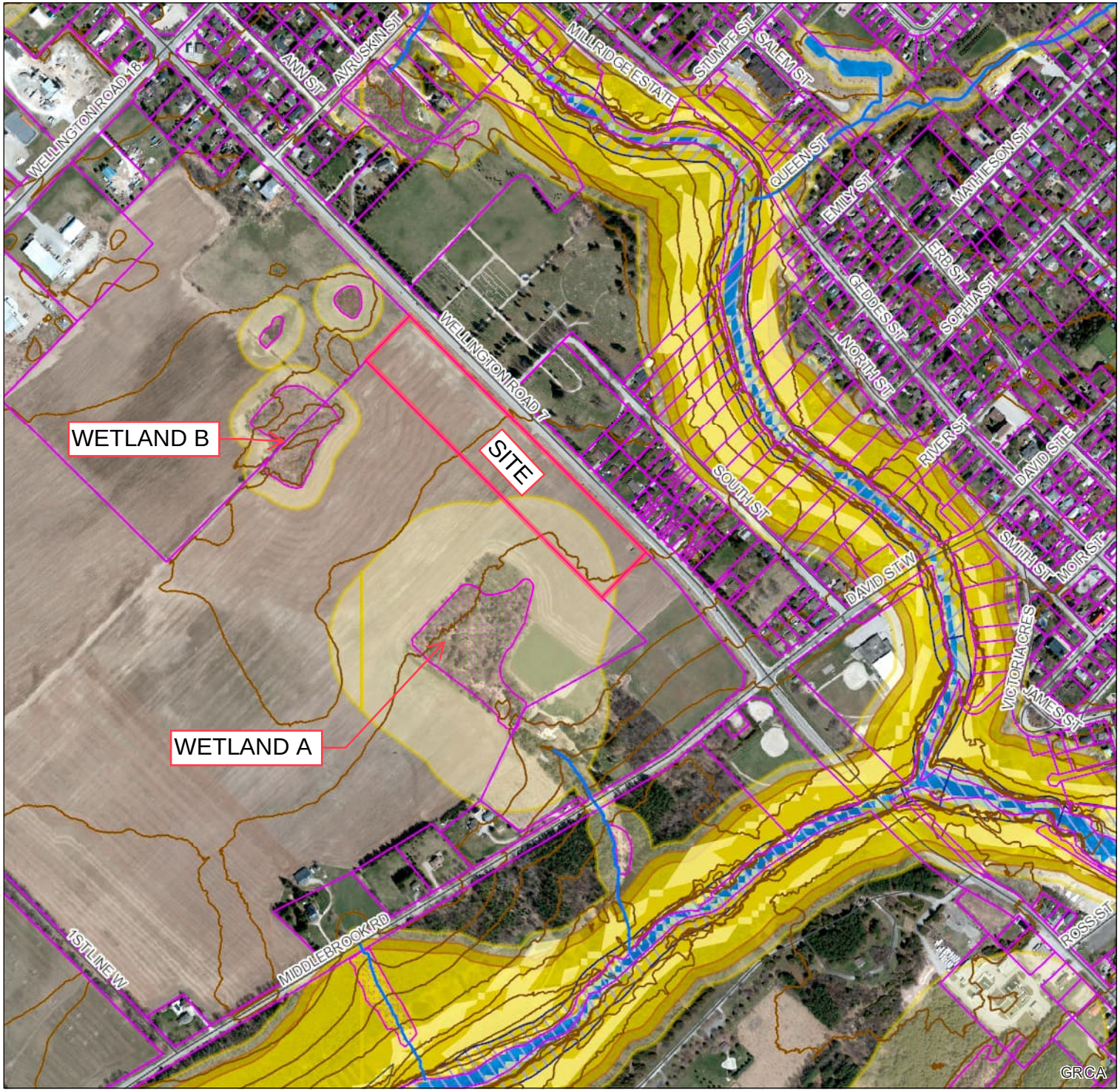
TMA:dlb
Encl.
M:\51060\100\Reports\SWM Criteria Brief\SWM Criteria Brief.docx



Map Centre (UTM NAD83 z17): 544,998.65 4,837,000.52

This map is not to be used for navigation | 2020 Ortho (ON)

Grand River Conservation Authority

Date: Sep 08, 2022

Legend

- Regulation Limit (GRCA)
- Regulated Watercourse (GRCA)
- Regulated Waterbody (GRCA)
- Wetland (GRCA)
- Floodplain (GRCA)
  - Engineered
  - Estimated
  - Approximate
  - Special Policy Area
- Slope Valley (GRCA)
  - Steep
  - Oversteep
  - Steep
- Slope Erosion (GRCA)
  - Oversteep
  - Toe
- Lake Erie Flood (GRCA)
- Lake Erie Shoreline Reach (GRCA)
- Lake Erie Dynamic Beach (GRCA)
- Lake Erie Erosion (GRCA)
- Parcel - Assessment (MPAC/MNRF)

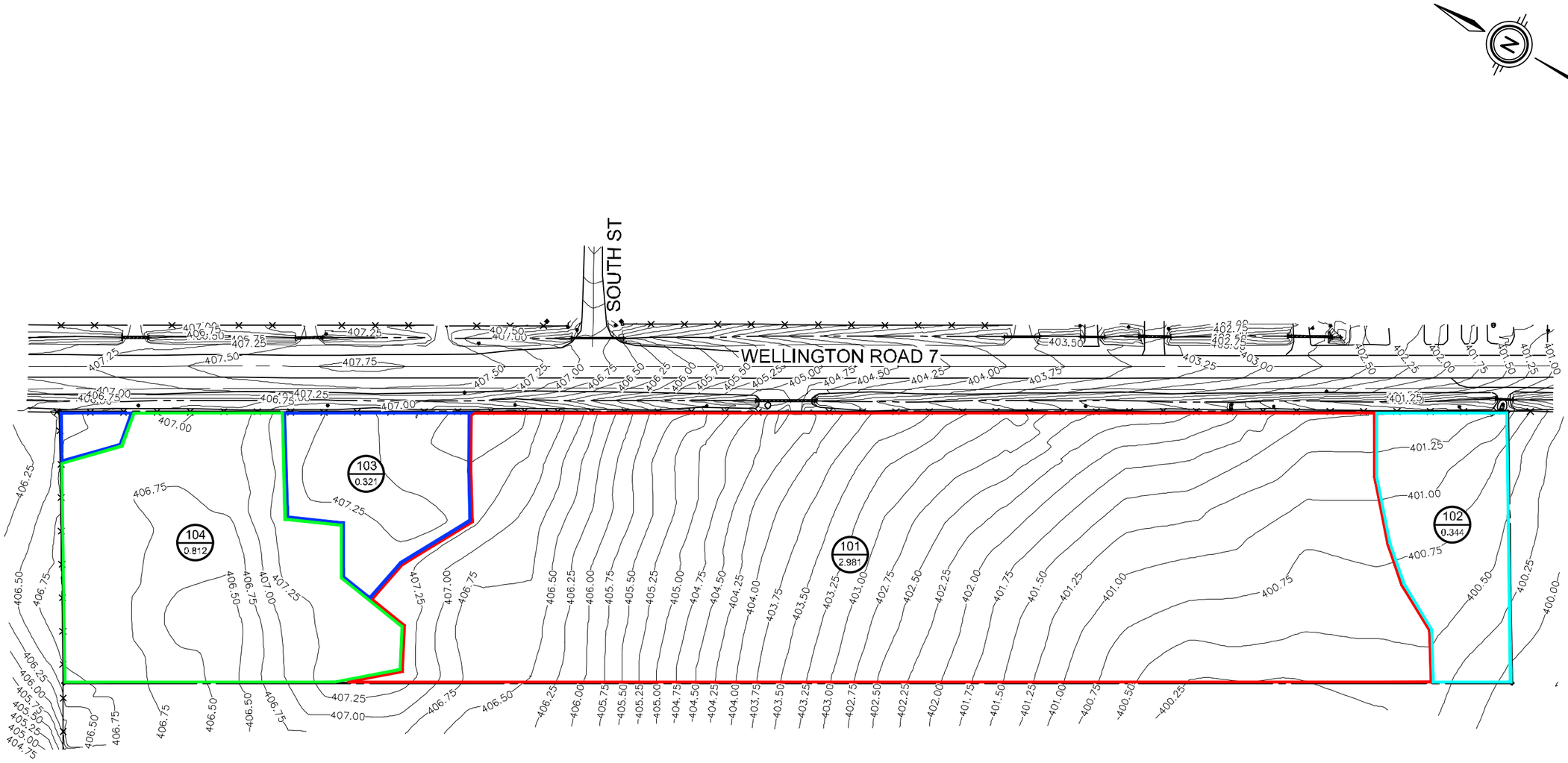
This legend is static and may not fully reflect the layers shown on the map. The text of Ontario Regulation 150/06 supercedes the mapping as represented by these layers.

0 50 100 200 300 Metres

N

NAD 1983 UTM Zone 17N

Scale: 8,174



LEGEND

- CATCHMENT 101
- CATCHMENT 102
- CATCHMENT 103
- CATCHMENT 104

101 / 2.981 — SUB-CATCHMENT NUMBER / AREA (ha.)

406.50 — EXISTING CONTOURS

FIGURE 1.0 Date: SEPT. 06/22 Scale: 1:1500

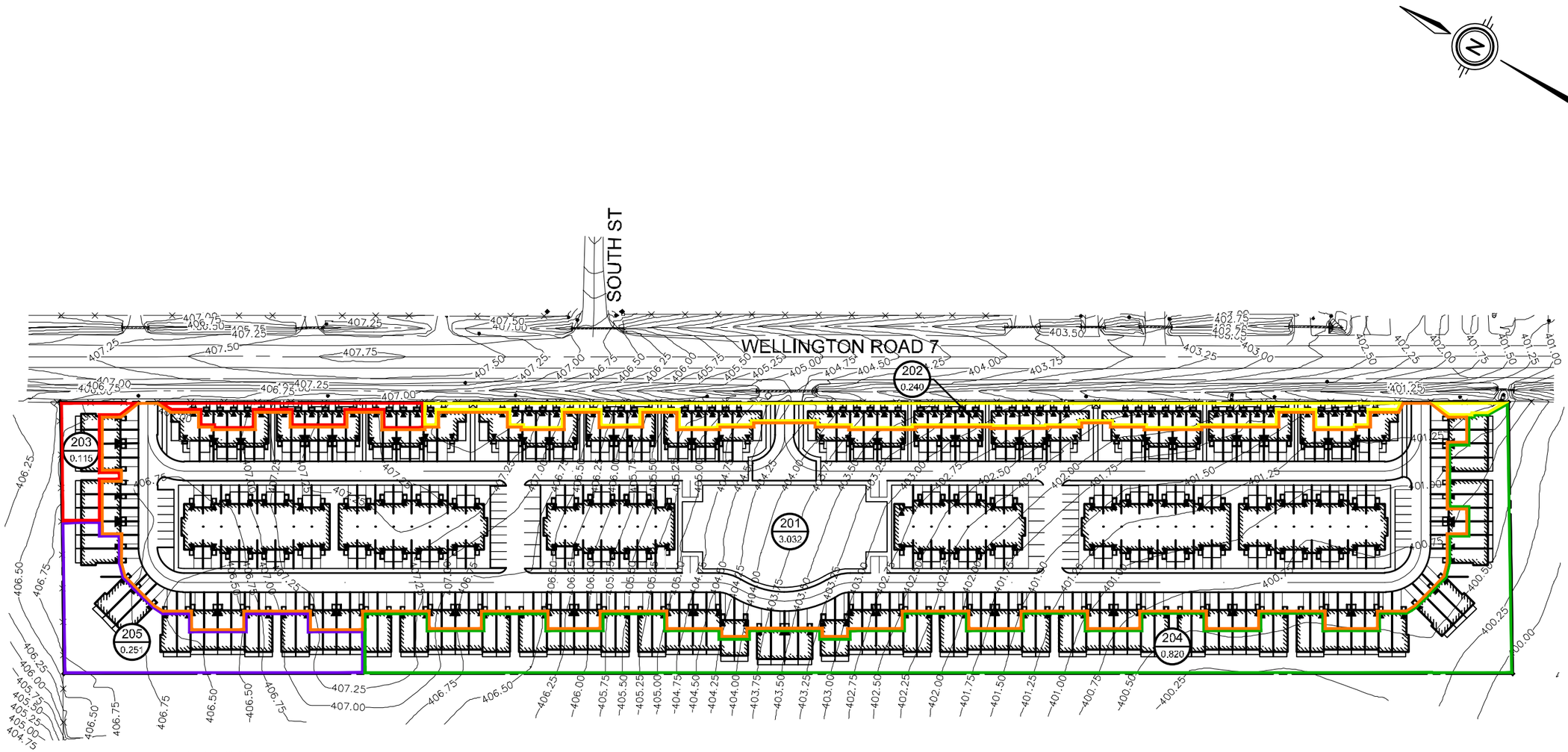
PRE-DEVELOPMENT CATCHMENT AREAS

MTE
Engineers, Scientists, Surveyors

Project No.: 51060-100

September 7, 2022 9:21 a.m. Plotted By: NDalal

P:\P\51060\100\51060-100-F1.0.dwg



LEGEND

- CATCHMENT 201
- CATCHMENT 202
- CATCHMENT 203
- CATCHMENT 204
- CATCHMENT 205

201 / 3.032 — SUB-CATCHMENT NUMBER / AREA (ha.)

401.50 — EXISTING CONTOURS

PROPOSED BUILDING

FIGURE 2.0

Date: SEPT. 06/22

Scale: 1:1500

POST-DEVELOPMENT CATCHMENT AREAS

MTE

Engineers, Scientists, Surveyors

Project No.: 51060-100

September 7, 2022 9:23 a.m. Plotted By: NDalal

P:\P\51060\100\51060-100-F2.0.dwg

Appendix F

Surface Runoff Water Balance Analysis

350 Wellington Road 7
WATER BALANCE (SURFACE RUNOFF) ANALYSIS
Elora, Ontario

Project Number: 51060-100
Date: August 4, 2023
Design By: TMA
Checked By: LEI
File: Q:\51060\100\Preliminary Design\Water Demand\51060-100_Site Water Demand & Fire Flow Analysis.xlsx

Hydrologic Cycle Component Values

Annual Precipitation = 924mm

	Pre-Development (Flat Lands - Moderately Rooted Crops)	Post-Development (Flat Lands - Urban Lawns)	Roof Areas
Fine Sandy Loam	579 mm Evapo-Transpiration	564 mm Evapo-Transpiration	214 mm Evapo-Transpiration
	104 mm Runoff	**126 mm Runoff**	**710 mm Net Runoff from roof (Based on 30mm)**
	242 mm Infiltration	234 mm Infiltration	0 mm Infiltration

SOUTHWEST WETLAND A - SURFACE RUNOFF

Location	Pre-development			Post-development						Comments
				Pervious			Impervious			
	Area Draining to Location	Runoff Rate	Runoff Volume	Area Draining to Location	Runoff Rate	Runoff Volume	Area Draining to Location	Runoff Rate	Runoff Volume	
	ha	*mm/yr/m^2*	*m^3/yr*	*ha*	*mm/yr/m^2*	*m^3/yr*	*ha*	*mm/yr/m^2*	*m^3/yr*	
Pre-Development (101)										
Landscape Area	2.981	104	3100							
Post-Development (204)										
Roof Area							0.372	710	2641	
Landscape Area				0.391	126	493				
Total	2.981	104	**3100**	0.391	126	**493**	0.372	710	**2641**	

Total Post-development Runoff	**3134**
Net Gain of Runoff	**34**

350 Wellington Road 7

WATER BALANCE (SURFACE RUNOFF) ANALYSIS

Elora, Ontario

Project Number: 51060-100
Date: August 4, 2023
Design By: TMA
Checked By: LEI
File: Q:\51060\100\Preliminary Design\Water Demand\51060-100_Site Water Demand & Fire Flow Analysis.xlsx

Hydrologic Cycle Component Values

Annual Precipitation = 924mm

	Pre-Development (Flat Lands - Moderately Rooted Crops)	Post-Development (Flat Lands - Urban Lawns)	Roof Areas
Fine Sandy Loam	579 mm Evapo-Transpiration	564 mm Evapo-Transpiration	214 mm Evapo-Transpiration
	104 mm Runoff	**126 mm Runoff**	**710 mm Net Runoff from roof (Based on 30mm)**
	242 mm Infiltration	234 mm Infiltration	0 mm Infiltration

NORTHWEST WETLAND B - SURFACE RUNOFF

Location	Pre-development			Post-development						Comments
				Pervious			Impervious			
	Area Draining to Location	Runoff Rate	Runoff Volume	Area Draining to Location	Runoff Rate	Runoff Volume	Area Draining to Location	Runoff Rate	Runoff Volume	
	ha	*mm/yr/m^2*	*m^3/yr*	*ha*	*mm/yr/m^2*	*m^3/yr*	*ha*	*mm/yr/m^2*	*m^3/yr*	
Pre-Development (104)										
Landscape Area	0.812	104	844							
Post-Development (205)										
Roof Area							0.100	710	710	
Landscape Area				0.160	126	202				
Total	0.812	104	**844**	0.160	126	**202**	0.100	710	**710**	

Total Post-development Runoff	**912**
Net Gain of Runoff	**67**

Appendix G

Storm Tank Sizing Sheets & MIDUSS Outputs

User Inputs

Chamber Model:	MC-3500
Outlet Control Structure:	Yes
Project Name:	350 Wellington Road 7
Engineer:	Tyler Arndt
Project Location:	Ontario
Measurement Type:	Metric
Required Storage Volume:	1000.01 cubic meters.
Stone Porosity:	40%
Stone Foundation Depth:	229 mm.
Stone Above Chambers:	305 mm.
Average Cover Over Chambers:	458 mm.
Design Constraint Dimensions:	(24.00 m. x 24.00 m.)

Results

System Volume and Bed Size

Installed Storage Volume:	605.43 cubic meters.
Storage Volume Per Chamber:	3.12 cubic meters.
Number Of Chambers Required:	110
Number Of End Caps Required:	22
Chamber Rows:	11
Maximum Length:	24.86 m.
Maximum Width:	23.84 m.
Approx. Bed Size Required:	588.27 square meters.

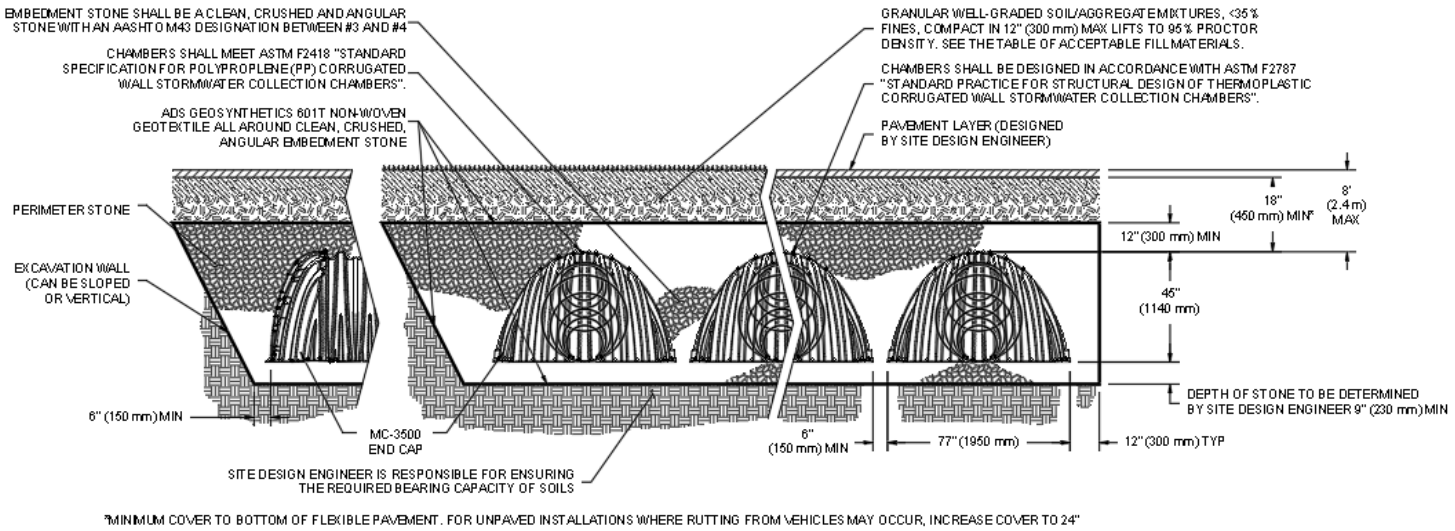
System Components

Amount Of Stone Required:	635 cubic meters
Volume Of Excavation (Not Including Fill):	987 cubic meters
Total Non-woven Geotextile Required:	2520 square meters
Woven Geotextile Required (excluding Isolator Row):	98 square meters
Woven Geotextile Required (Isolator Row):	74 square meters
Total Woven Geotextile Required:	172 square meters
Impervious Liner Required:	907 square meters

Impervious Liner notes:

Technical Note 6.50 : Thermoplastic Liners for Detention Systems

The impervious liner quantity shown is only an estimate. ADS does not provide or design impervious liners. Please contact a liner manufacturer for a final estimate.



User Inputs

Chamber Model:	MC-3500
Outlet Control Structure:	Yes
Project Name:	350 Wellington Road 7
Engineer:	Tyler Arndt
Project Location:	Ontario
Measurement Type:	Metric
Required Storage Volume:	1000.01 cubic meters.
Stone Porosity:	40%
Stone Foundation Depth:	229 mm.
Stone Above Chambers:	305 mm.
Average Cover Over Chambers:	458 mm.
Design Constraint Dimensions:	(18.01 m. x 27.50 m.)

Results

System Volume and Bed Size

Installed Storage Volume:	483.06 cubic meters.
Storage Volume Per Chamber:	3.12 cubic meters.
Number Of Chambers Required:	88
Number Of End Caps Required:	16
Chamber Rows:	8
Maximum Length:	27.05 m.
Maximum Width:	17.51 m.
Approx. Bed Size Required:	469.31 square meters.

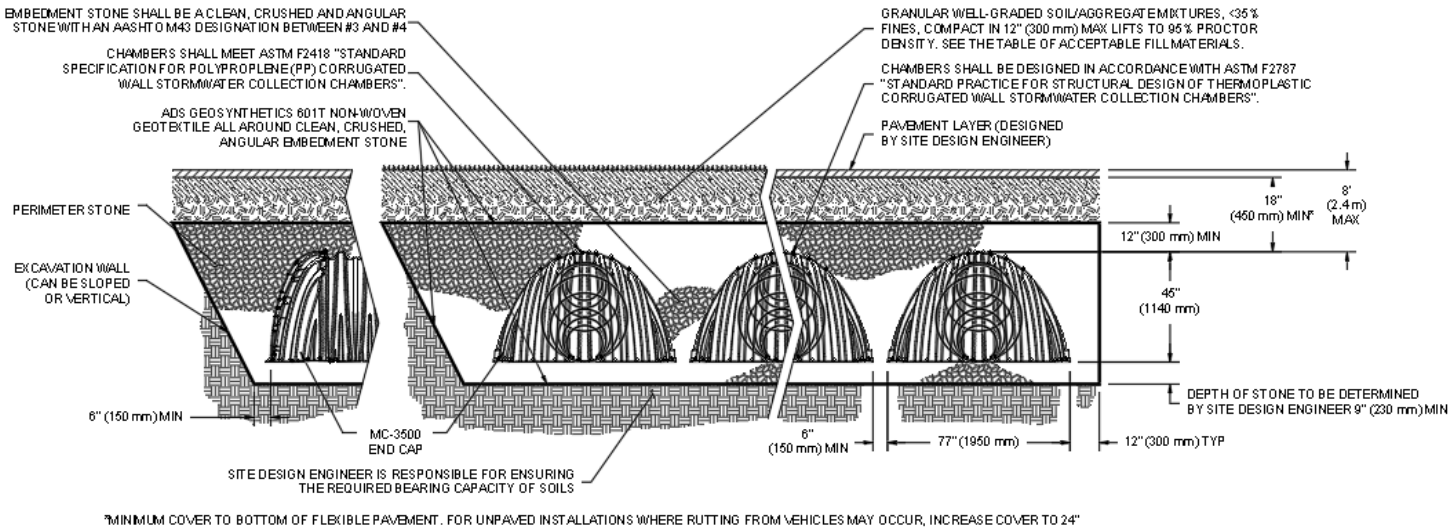
System Components

Amount Of Stone Required:	507 cubic meters
Volume Of Excavation (Not Including Fill):	787 cubic meters
Total Non-woven Geotextile Required:	2059 square meters
Woven Geotextile Required (excluding Isolator Row):	56 square meters
Woven Geotextile Required (Isolator Row):	81 square meters
Total Woven Geotextile Required:	137 square meters
Impervious Liner Required:	748 square meters

Impervious Liner notes:

Technical Note 6.50 : Thermoplastic Liners for Detention Systems

The impervious liner quantity shown is only an estimate. ADS does not provide or design impervious liners. Please contact a liner manufacturer for a final estimate.



Pre-Development

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"        2.000   Impervious slope"
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"        0.100   Pervious Ia/S coefficient"
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"        0.015   Impervious Manning 'n'"
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```

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"       50.000   Pervious length"
"        1.500   Pervious slope"
"        0.000   Impervious Area"
"       50.000   Impervious length"
"        1.500   Impervious slope"
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"             Surface Area           0.321      0.000      0.321      hectare"
"             Time of concentration  38.944     3.273      38.944     minutes"
"             Time to Centroid       150.729    92.946     150.729    minutes"
"             Rainfall depth         34.259     34.259     34.259     mm"
"             Rainfall volume        109.97     0.00       109.97     c.m"
"             Rainfall losses        28.237     5.510      28.237     mm"
"             Runoff depth           6.021      28.748     6.021      mm"
"             Runoff volume          19.33      0.00       19.33      c.m"
"             Runoff coefficient     0.176      0.000      0.176      "
"             Maximum flow           0.004      0.000      0.004      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.004     0.004     0.003     0.025"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.004     0.004     0.004     0.025"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
```

```
"               Total Site"
"             Maximum flow                  0.028    c.m/sec"
"             Hydrograph volume           219.529    c.m"
"                    0.004     0.004     0.004     0.028"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.004     0.000     0.004     0.028"
" 33          CATCHMENT 104"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          104   To the NW Wetland B"
"        0.000   % Impervious"
"        0.812   Total Area"
"       80.000   Flow length"
"        2.500   Overland Slope"
"        0.812   Pervious Area"
"       80.000   Pervious length"
"        2.500   Pervious slope"
"        0.000   Impervious Area"
"       80.000   Impervious length"
"        2.500   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.176   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.000   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                    0.009     0.000     0.004     0.028 c.m/sec"
"             Catchment 104          Pervious   Impervious Total Area "
"             Surface Area           0.812      0.000      0.812      hectare"
"             Time of concentration  44.295     3.722      44.295     minutes"
"             Time to Centroid       157.240    93.696     157.240    minutes"
"             Rainfall depth         34.259     34.259     34.259     mm"
"             Rainfall volume        278.18     0.00       278.18     c.m"
"             Rainfall losses        28.239     5.618      28.239     mm"
"             Runoff depth           6.020      28.641     6.020      mm"
"             Runoff volume          48.88      0.00       48.88      c.m"
"             Runoff coefficient     0.176      0.000      0.176      "
"             Maximum flow           0.009      0.000      0.009      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.009     0.009     0.004     0.028"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.009     0.009     0.009     0.028"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"               Total Site"
"             Maximum flow                  0.036    c.m/sec"
"             Hydrograph volume           268.408    c.m"
"                    0.009     0.009     0.009     0.036"
" 38          START/RE-START TOTALS 104"
"            3   Runoff Totals on EXIT"
```

```
"             Total Catchment area                    4.458    hectare"
"             Total Impervious area                   0.000    hectare"
"             Total % impervious                      0.000"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 7, 2010"
"           10   Units used:                                        ie METRIC"
"                Job folder:              Q:\51060\100\Preliminary Design\SWM\"
"                                                                    SWM Memo"
"                Output filename:                              5YR - PRE B.out"
"                Licensee name:                                             A"
"                Company                                                    "
"                Date & Time last used:               9/12/2022 at 9:18:02 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     1593.000   Coefficient A"
"       11.000   Constant B"
"        0.879   Exponent C"
"        0.400   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          139.288    mm/hr"
"             Total depth                 47.265    mm"
"            6   005hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 101"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          101   To Southwest Wetland A"
"        0.000   % Impervious"
"        2.981   Total Area"
"      200.000   Flow length"
"        3.500   Overland Slope"
"        2.981   Pervious Area"
"      200.000   Pervious length"
"        3.500   Pervious slope"
"        0.000   Impervious Area"
"      200.000   Impervious length"
"        3.500   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.258   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.000   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
```

```
"                    0.064     0.000     0.000     0.000 c.m/sec"
"             Catchment 101          Pervious   Impervious Total Area "
"             Surface Area           2.981      0.000      2.981      hectare"
"             Time of concentration  50.487     5.226      50.487     minutes"
"             Time to Centroid       160.521    93.566     160.521    minutes"
"             Rainfall depth         47.265     47.265     47.265     mm"
"             Rainfall volume        1408.96    0.00       1408.96    c.m"
"             Rainfall losses        35.078     5.507      35.078     mm"
"             Runoff depth           12.187     41.758     12.187     mm"
"             Runoff volume          363.29     0.00       363.29     c.m"
"             Runoff coefficient     0.258      0.000      0.258      "
"             Maximum flow           0.064      0.000      0.064      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.064     0.064     0.000     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.064     0.064     0.064     0.000"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Total Site"
"             Maximum flow                 0.064    c.m/sec"
"             Hydrograph volume          363.289    c.m"
"                    0.064     0.064     0.064     0.064"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.064     0.000     0.064     0.064"
" 33          CATCHMENT 102"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          102   To the South"
"        0.000   % Impervious"
"        0.344   Total Area"
"      100.000   Flow length"
"        2.000   Overland Slope"
"        0.344   Pervious Area"
"      100.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"      100.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.258   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
```

```
"        0.000   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.009     0.000     0.064     0.064 c.m/sec"
"             Catchment 102          Pervious   Impervious Total Area "
"             Surface Area           0.344      0.000      0.344      hectare"
"             Time of concentration  39.398     4.078      39.398     minutes"
"             Time to Centroid       146.826    91.941     146.825    minutes"
"             Rainfall depth         47.265     47.265     47.265     mm"
"             Rainfall volume        162.59     0.00       162.59     c.m"
"             Rainfall losses        35.075     5.720      35.075     mm"
"             Runoff depth           12.190     41.545     12.190     mm"
"             Runoff volume          41.93      0.00       41.93      c.m"
"             Runoff coefficient     0.258      0.000      0.258      "
"             Maximum flow           0.009      0.000      0.009      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.009     0.009     0.064     0.064"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.009     0.009     0.009     0.064"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Total Site"
"             Maximum flow                  0.072    c.m/sec"
"             Hydrograph volume           405.221    c.m"
"                     0.009     0.009     0.009     0.072"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.009     0.000     0.009     0.072"
" 33          CATCHMENT 103"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          103   To the north ROW"
"        0.000   % Impervious"
"        0.321   Total Area"
"       50.000   Flow length"
"        1.500   Overland Slope"
"        0.321   Pervious Area"
"       50.000   Pervious length"
"        1.500   Pervious slope"
"        0.000   Impervious Area"
"       50.000   Impervious length"
"        1.500   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.258   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
```

```
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.000   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.010     0.000     0.009     0.072 c.m/sec"
"             Catchment 103          Pervious   Impervious Total Area "
"             Surface Area           0.321      0.000      0.321      hectare"
"             Time of concentration  28.336     2.933      28.336     minutes"
"             Time to Centroid       133.168    90.243     133.168    minutes"
"             Rainfall depth         47.265     47.265     47.265     mm"
"             Rainfall volume        151.72     0.00       151.72     c.m"
"             Rainfall losses        35.083     5.984      35.083     mm"
"             Runoff depth           12.181     41.281     12.181     mm"
"             Runoff volume          39.10      0.00       39.10      c.m"
"             Runoff coefficient     0.258      0.000      0.258      "
"             Maximum flow           0.010      0.000      0.010      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.010     0.010     0.009     0.072"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.010     0.010     0.010     0.072"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Total Site"
"             Maximum flow                  0.080    c.m/sec"
"             Hydrograph volume           444.323    c.m"
"                     0.010     0.010     0.010     0.080"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.010     0.000     0.010     0.080"
" 33          CATCHMENT 104"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          104   To the NW Wetland B"
"        0.000   % Impervious"
"        0.812   Total Area"
"       80.000   Flow length"
"        2.500   Overland Slope"
"        0.812   Pervious Area"
"       80.000   Pervious length"
"        2.500   Pervious slope"
"        0.000   Impervious Area"
"       80.000   Impervious length"
"        2.500   Impervious slope"
"        0.250   Pervious Manning 'n'"
```

```
"       75.000   Pervious SCS Curve No."
"        0.258   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.000   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.024     0.000     0.010     0.080 c.m/sec"
"             Catchment 104          Pervious   Impervious Total Area "
"             Surface Area           0.812      0.000      0.812      hectare"
"             Time of concentration  32.230     3.336      32.229     minutes"
"             Time to Centroid       137.983    90.888     137.983    minutes"
"             Rainfall depth         47.265     47.265     47.265     mm"
"             Rainfall volume        383.79     0.00       383.79     c.m"
"             Rainfall losses        35.080     5.976      35.080     mm"
"             Runoff depth           12.184     41.288     12.184     mm"
"             Runoff volume          98.94      0.00       98.94      c.m"
"             Runoff coefficient     0.258      0.000      0.258      "
"             Maximum flow           0.024      0.000      0.024      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.024     0.024     0.010     0.080"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.024     0.024     0.024     0.080"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Total Site"
"             Maximum flow                 0.102    c.m/sec"
"             Hydrograph volume          543.261    c.m"
"                     0.024     0.024     0.024     0.102"
" 38          START/RE-START TOTALS 104"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                      4.458    hectare"
"             Total Impervious area                     0.000    hectare"
"             Total % impervious                        0.000"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 7, 2010"
"           10   Units used:                                        ie METRIC"
"                Job folder:              Q:\51060\100\Preliminary Design\SWM\"
"                                                                     SWM Memo"
"                Output filename:                              10YR - PRE B.out"
"                Licensee name:                                             A"
"                Company                                                     "
"                Date & Time last used:               9/12/2022 at 9:18:53 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     2221.000   Coefficient A"
"       12.000   Constant B"
"        0.908   Exponent C"
"        0.400   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          169.551    mm/hr"
"             Total depth                 56.290    mm"
"            6   010hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 101"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          101   To Southwest Wetland A"
"        0.000   % Impervious"
"        2.981   Total Area"
"      200.000   Flow length"
"        3.500   Overland Slope"
"        2.981   Pervious Area"
"      200.000   Pervious length"
"        3.500   Pervious slope"
"        0.000   Impervious Area"
"      200.000   Impervious length"
"        3.500   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.307   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.000   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
```

```
"                    0.107     0.000     0.000     0.000 c.m/sec"
"             Catchment 101          Pervious   Impervious Total Area "
"             Surface Area           2.981      0.000      2.981      hectare"
"             Time of concentration  42.571     4.808      42.571     minutes"
"             Time to Centroid       149.285    91.994     149.285    minutes"
"             Rainfall depth         56.290     56.290     56.290     mm"
"             Rainfall volume        1678.01    0.00       1678.01    c.m"
"             Rainfall losses        39.034     5.712      39.034     mm"
"             Runoff depth           17.256     50.579     17.256     mm"
"             Runoff volume          514.40     0.00       514.41     c.m"
"             Runoff coefficient     0.307      0.000      0.307      "
"             Maximum flow           0.107      0.000      0.107      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.107     0.107     0.000     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.107     0.107     0.107     0.000"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Total Site"
"             Maximum flow                 0.107    c.m/sec"
"             Hydrograph volume          514.405    c.m"
"                    0.107     0.107     0.107     0.107"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.107     0.000     0.107     0.107"
" 33          CATCHMENT 102"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          102   To the South"
"        0.000   % Impervious"
"        0.344   Total Area"
"      100.000   Flow length"
"        2.000   Overland Slope"
"        0.344   Pervious Area"
"      100.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"      100.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.307   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
```

```
"        0.000   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.015     0.000     0.107     0.107 c.m/sec"
"             Catchment 102          Pervious   Impervious Total Area "
"             Surface Area           0.344      0.000      0.344      hectare"
"             Time of concentration  33.220     3.752      33.220     minutes"
"             Time to Centroid       137.540    90.510     137.540    minutes"
"             Rainfall depth         56.290     56.290     56.290     mm"
"             Rainfall volume        193.64     0.00       193.64     c.m"
"             Rainfall losses        39.032     6.201      39.032     mm"
"             Runoff depth           17.258     50.089     17.258     mm"
"             Runoff volume          59.37      0.00       59.37      c.m"
"             Runoff coefficient     0.307      0.000      0.307      "
"             Maximum flow           0.015      0.000      0.015      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.015     0.015     0.107     0.107"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.015     0.015     0.015     0.107"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Total Site"
"             Maximum flow                  0.121    c.m/sec"
"             Hydrograph volume           573.773    c.m"
"                     0.015     0.015     0.015     0.121"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.015     0.000     0.015     0.121"
" 33          CATCHMENT 103"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          103   To the north ROW"
"        0.000   % Impervious"
"        0.321   Total Area"
"       50.000   Flow length"
"        1.500   Overland Slope"
"        0.321   Pervious Area"
"       50.000   Pervious length"
"        1.500   Pervious slope"
"        0.000   Impervious Area"
"       50.000   Impervious length"
"        1.500   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.307   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
```

```
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.000   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.017     0.000     0.015     0.121 c.m/sec"
"             Catchment 103          Pervious   Impervious Total Area "
"             Surface Area           0.321      0.000      0.321      hectare"
"             Time of concentration  23.893     2.698      23.893     minutes"
"             Time to Centroid       125.809    88.912     125.809    minutes"
"             Rainfall depth         56.290     56.290     56.290     mm"
"             Rainfall volume        180.69     0.00       180.69     c.m"
"             Rainfall losses        39.036     6.338      39.036     mm"
"             Runoff depth           17.254     49.953     17.254     mm"
"             Runoff volume          55.39      0.00       55.39      c.m"
"             Runoff coefficient     0.307      0.000      0.307      "
"             Maximum flow           0.017      0.000      0.017      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.017     0.017     0.015     0.121"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.017     0.017     0.017     0.121"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Total Site"
"             Maximum flow                  0.134    c.m/sec"
"             Hydrograph volume           629.160    c.m"
"                     0.017     0.017     0.017     0.134"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.017     0.000     0.017     0.134"
" 33          CATCHMENT 104"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          104   To the NW Wetland B"
"        0.000   % Impervious"
"        0.812   Total Area"
"       80.000   Flow length"
"        2.500   Overland Slope"
"        0.812   Pervious Area"
"       80.000   Pervious length"
"        2.500   Pervious slope"
"        0.000   Impervious Area"
"       80.000   Impervious length"
"        2.500   Impervious slope"
"        0.250   Pervious Manning 'n'"
```

```
"       75.000   Pervious SCS Curve No."
"        0.307   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.000   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.040     0.000     0.017     0.134 c.m/sec"
"             Catchment 104          Pervious   Impervious Total Area "
"             Surface Area           0.812      0.000      0.812      hectare"
"             Time of concentration  27.176     3.069      27.176     minutes"
"             Time to Centroid       129.929    89.471     129.929    minutes"
"             Rainfall depth         56.290     56.290     56.290     mm"
"             Rainfall volume        457.08     0.00       457.08     c.m"
"             Rainfall losses        39.031     6.208      39.031     mm"
"             Runoff depth           17.259     50.082     17.259     mm"
"             Runoff volume          140.15     0.00       140.15     c.m"
"             Runoff coefficient     0.307      0.000      0.307      "
"             Maximum flow           0.040      0.000      0.040      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.040     0.040     0.017     0.134"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.040     0.040     0.040     0.134"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Total Site"
"             Maximum flow                 0.171    c.m/sec"
"             Hydrograph volume          769.306    c.m"
"                     0.040     0.040     0.040     0.171"
" 38          START/RE-START TOTALS 104"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                      4.458    hectare"
"             Total Impervious area                     0.000    hectare"
"             Total % impervious                        0.000"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 7, 2010"
"           10   Units used:                                        ie METRIC"
"                Job folder:              Q:\51060\100\Preliminary Design\SWM\"
"                                                                    SWM Memo"
"                Output filename:                              25YR - PRE B.out"
"                Licensee name:                                             A"
"                Company                                                    "
"                Date & Time last used:                9/12/2022 at 9:19:46 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     3158.000   Coefficient A"
"       15.000   Constant B"
"        0.936   Exponent C"
"        0.400   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          191.557    mm/hr"
"             Total depth                 68.266    mm"
"            6   025hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 101"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          101   To Southwest Wetland A"
"        0.000   % Impervious"
"        2.981   Total Area"
"      200.000   Flow length"
"        3.500   Overland Slope"
"        2.981   Pervious Area"
"      200.000   Pervious length"
"        3.500   Pervious slope"
"        0.000   Impervious Area"
"      200.000   Impervious length"
"        3.500   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.362   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.000   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
```

```
"                    0.174     0.000     0.000     0.000 c.m/sec"
"             Catchment 101          Pervious   Impervious Total Area "
"             Surface Area           2.981      0.000      2.981      hectare"
"             Time of concentration  37.271     4.560      37.271     minutes"
"             Time to Centroid       141.084    91.030     141.084    minutes"
"             Rainfall depth         68.266     68.266     68.266     mm"
"             Rainfall volume        2035.01    0.00       2035.02    c.m"
"             Rainfall losses        43.524     5.797      43.524     mm"
"             Runoff depth           24.742     62.470     24.742     mm"
"             Runoff volume          737.55     0.00       737.56     c.m"
"             Runoff coefficient     0.362      0.000      0.362      "
"             Maximum flow           0.174      0.000      0.174      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.174     0.174     0.000     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.174     0.174     0.174     0.000"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Total Site"
"             Maximum flow                 0.174    c.m/sec"
"             Hydrograph volume          737.555    c.m"
"                    0.174     0.174     0.174     0.174"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.174     0.000     0.174     0.174"
" 33          CATCHMENT 102"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          102   To the South"
"        0.000   % Impervious"
"        0.344   Total Area"
"      100.000   Flow length"
"        2.000   Overland Slope"
"        0.344   Pervious Area"
"      100.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"      100.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.362   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
```

```
"        0.000   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.024     0.000     0.174     0.174 c.m/sec"
"             Catchment 102          Pervious   Impervious Total Area "
"             Surface Area           0.344      0.000      0.344      hectare"
"             Time of concentration  29.085     3.559      29.085     minutes"
"             Time to Centroid       130.864    89.678     130.863    minutes"
"             Rainfall depth         68.266     68.266     68.266     mm"
"             Rainfall volume        234.84     0.00       234.84     c.m"
"             Rainfall losses        43.536     6.654      43.536     mm"
"             Runoff depth           24.730     61.613     24.730     mm"
"             Runoff volume          85.07      0.00       85.07      c.m"
"             Runoff coefficient     0.362      0.000      0.362      "
"             Maximum flow           0.024      0.000      0.024      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.024     0.024     0.174     0.174"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.024     0.024     0.024     0.174"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Total Site"
"             Maximum flow                  0.197    c.m/sec"
"             Hydrograph volume           822.626    c.m"
"                     0.024     0.024     0.024     0.197"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.024     0.000     0.024     0.197"
" 33          CATCHMENT 103"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          103   To the north ROW"
"        0.000   % Impervious"
"        0.321   Total Area"
"       50.000   Flow length"
"        1.500   Overland Slope"
"        0.321   Pervious Area"
"       50.000   Pervious length"
"        1.500   Pervious slope"
"        0.000   Impervious Area"
"       50.000   Impervious length"
"        1.500   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.362   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
```

```
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.000   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.028     0.000     0.024     0.197 c.m/sec"
"             Catchment 103          Pervious   Impervious Total Area "
"             Surface Area           0.321      0.000      0.321      hectare"
"             Time of concentration  20.918     2.559      20.918     minutes"
"             Time to Centroid       120.675    88.180     120.675    minutes"
"             Rainfall depth         68.266     68.266     68.266     mm"
"             Rainfall volume        219.13     0.00       219.13     c.m"
"             Rainfall losses        43.527     6.542      43.527     mm"
"             Runoff depth           24.740     61.724     24.740     mm"
"             Runoff volume          79.41      0.00       79.41      c.m"
"             Runoff coefficient     0.362      0.000      0.362      "
"             Maximum flow           0.028      0.000      0.028      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.028     0.028     0.024     0.197"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.028     0.028     0.028     0.197"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Total Site"
"             Maximum flow                  0.219    c.m/sec"
"             Hydrograph volume           902.040    c.m"
"                     0.028     0.028     0.028     0.219"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.028     0.000     0.028     0.219"
" 33          CATCHMENT 104"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          104   To the NW Wetland B"
"        0.000   % Impervious"
"        0.812   Total Area"
"       80.000   Flow length"
"        2.500   Overland Slope"
"        0.812   Pervious Area"
"       80.000   Pervious length"
"        2.500   Pervious slope"
"        0.000   Impervious Area"
"       80.000   Impervious length"
"        2.500   Impervious slope"
"        0.250   Pervious Manning 'n'"
```

```
"       75.000   Pervious SCS Curve No."
"        0.362   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.000   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.064     0.000     0.028     0.219 c.m/sec"
"             Catchment 104          Pervious   Impervious Total Area "
"             Surface Area           0.812      0.000      0.812      hectare"
"             Time of concentration  23.793     2.911      23.793     minutes"
"             Time to Centroid       124.266    88.716     124.266    minutes"
"             Rainfall depth         68.266     68.266     68.266     mm"
"             Rainfall volume        554.32     0.00       554.32     c.m"
"             Rainfall losses        43.527     6.771      43.527     mm"
"             Runoff depth           24.739     61.496     24.739     mm"
"             Runoff volume          200.88     0.00       200.88     c.m"
"             Runoff coefficient     0.362      0.000      0.362      "
"             Maximum flow           0.064      0.000      0.064      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.064     0.064     0.028     0.219"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.064     0.064     0.064     0.219"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Total Site"
"             Maximum flow                  0.277    c.m/sec"
"             Hydrograph volume          1102.920    c.m"
"                     0.064     0.064     0.064     0.277"
" 38          START/RE-START TOTALS 104"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                        4.458    hectare"
"             Total Impervious area                       0.000    hectare"
"             Total % impervious                          0.000"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 7, 2010"
"           10   Units used:                                        ie METRIC"
"                Job folder:              Q:\51060\100\Preliminary Design\SWM\"
"                                                                    SWM Memo"
"                Output filename:                              50YR - PRE B.out"
"                Licensee name:                                             A"
"                Company                                                     "
"                Date & Time last used:                9/12/2022 at 9:20:34 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     3886.000   Coefficient A"
"       16.000   Constant B"
"        0.950   Exponent C"
"        0.400   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          215.802    mm/hr"
"             Total depth                 77.647    mm"
"            6   050hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 101"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          101   To Southwest Wetland A"
"        0.000   % Impervious"
"        2.981   Total Area"
"      200.000   Flow length"
"        3.500   Overland Slope"
"        2.981   Pervious Area"
"      200.000   Pervious length"
"        3.500   Pervious slope"
"        0.000   Impervious Area"
"      200.000   Impervious length"
"        3.500   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.400   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.000   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
```

```
"                    0.237     0.000     0.000     0.000 c.m/sec"
"             Catchment 101          Pervious   Impervious Total Area "
"             Surface Area           2.981      0.000      2.981      hectare"
"             Time of concentration  33.817     4.339      33.816     minutes"
"             Time to Centroid       135.954    90.329     135.954    minutes"
"             Rainfall depth         77.647     77.647     77.647     mm"
"             Rainfall volume        2314.67    0.00       2314.67    c.m"
"             Rainfall losses        46.553     6.059      46.553     mm"
"             Runoff depth           31.094     71.588     31.094     mm"
"             Runoff volume          926.91     0.00       926.91     c.m"
"             Runoff coefficient     0.400      0.000      0.400      "
"             Maximum flow           0.237      0.000      0.237      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.237     0.237     0.000     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.237     0.237     0.237     0.000"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Total Site"
"             Maximum flow                 0.237    c.m/sec"
"             Hydrograph volume           926.913    c.m"
"                    0.237     0.237     0.237     0.237"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.237     0.000     0.237     0.237"
" 33          CATCHMENT 102"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          102   To the South"
"        0.000   % Impervious"
"        0.344   Total Area"
"      100.000   Flow length"
"        2.000   Overland Slope"
"        0.344   Pervious Area"
"      100.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"      100.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.400   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
```

```
"        0.000   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.032     0.000     0.237     0.237 c.m/sec"
"             Catchment 102          Pervious   Impervious Total Area "
"             Surface Area           0.344      0.000      0.344      hectare"
"             Time of concentration  26.389     3.386      26.389     minutes"
"             Time to Centroid       126.646    89.011     126.646    minutes"
"             Rainfall depth         77.647     77.647     77.647     mm"
"             Rainfall volume        267.11     0.00       267.11     c.m"
"             Rainfall losses        46.561     6.769      46.561     mm"
"             Runoff depth           31.086     70.878     31.086     mm"
"             Runoff volume          106.94     0.00       106.94     c.m"
"             Runoff coefficient     0.400      0.000      0.400      "
"             Maximum flow           0.032      0.000      0.032      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.032     0.032     0.237     0.237"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.032     0.032     0.032     0.237"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Total Site"
"             Maximum flow                  0.267    c.m/sec"
"             Hydrograph volume          1033.849    c.m"
"                     0.032     0.032     0.032     0.267"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.032     0.000     0.032     0.267"
" 33          CATCHMENT 103"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          103   To the north ROW"
"        0.000   % Impervious"
"        0.321   Total Area"
"       50.000   Flow length"
"        1.500   Overland Slope"
"        0.321   Pervious Area"
"       50.000   Pervious length"
"        1.500   Pervious slope"
"        0.000   Impervious Area"
"       50.000   Impervious length"
"        1.500   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.400   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
```

```
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.000   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.037     0.000     0.032     0.267 c.m/sec"
"             Catchment 103          Pervious   Impervious Total Area "
"             Surface Area           0.321      0.000      0.321      hectare"
"             Time of concentration  18.980     2.435      18.980     minutes"
"             Time to Centroid       117.376    87.587     117.376    minutes"
"             Rainfall depth         77.647     77.647     77.647     mm"
"             Rainfall volume        249.25     0.00       249.25     c.m"
"             Rainfall losses        46.596     6.665      46.596     mm"
"             Runoff depth           31.052     70.982     31.052     mm"
"             Runoff volume          99.68      0.00       99.68      c.m"
"             Runoff coefficient     0.400      0.000      0.400      "
"             Maximum flow           0.037      0.000      0.037      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.037     0.037     0.032     0.267"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.037     0.037     0.037     0.267"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Total Site"
"             Maximum flow                  0.295    c.m/sec"
"             Hydrograph volume          1133.525    c.m"
"                     0.037     0.037     0.037     0.295"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.037     0.000     0.037     0.295"
" 33          CATCHMENT 104"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          104   To the NW Wetland B"
"        0.000   % Impervious"
"        0.812   Total Area"
"       80.000   Flow length"
"        2.500   Overland Slope"
"        0.812   Pervious Area"
"       80.000   Pervious length"
"        2.500   Pervious slope"
"        0.000   Impervious Area"
"       80.000   Impervious length"
"        2.500   Impervious slope"
"        0.250   Pervious Manning 'n'"
```

```
"       75.000   Pervious SCS Curve No."
"        0.400   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.000   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.089     0.000     0.037     0.295 c.m/sec"
"             Catchment 104          Pervious   Impervious Total Area "
"             Surface Area           0.812      0.000      0.812      hectare"
"             Time of concentration  21.588     2.770      21.588     minutes"
"             Time to Centroid       120.642    88.113     120.642    minutes"
"             Rainfall depth         77.647     77.647     77.647     mm"
"             Rainfall volume        630.50     0.00       630.50     c.m"
"             Rainfall losses        46.564     6.995      46.564     mm"
"             Runoff depth           31.083     70.652     31.083     mm"
"             Runoff volume          252.39     0.00       252.40     c.m"
"             Runoff coefficient     0.400      0.000      0.400      "
"             Maximum flow           0.089      0.000      0.089      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.089     0.089     0.037     0.295"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.089     0.089     0.089     0.295"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Total Site"
"             Maximum flow                  0.377    c.m/sec"
"             Hydrograph volume          1385.919    c.m"
"                     0.089     0.089     0.089     0.377"
" 38          START/RE-START TOTALS 104"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                       4.458    hectare"
"             Total Impervious area                      0.000    hectare"
"             Total % impervious                         0.000"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 7, 2010"
"           10   Units used:                                        ie METRIC"
"                Job folder:              Q:\51060\100\Preliminary Design\SWM\"
"                                                                    SWM Memo"
"                Output filename:                              100YR - PRE B.out"
"                Licensee name:                                             A"
"                Company                                                    "
"                Date & Time last used:                9/12/2022 at 9:21:23 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     4688.000   Coefficient A"
"       17.000   Constant B"
"        0.962   Exponent C"
"        0.400   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          239.354    mm/hr"
"             Total depth                 87.079    mm"
"            6   100hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 101"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          101   To Southwest Wetland A"
"        0.000   % Impervious"
"        2.981   Total Area"
"      200.000   Flow length"
"        3.500   Overland Slope"
"        2.981   Pervious Area"
"      200.000   Pervious length"
"        3.500   Pervious slope"
"        0.000   Impervious Area"
"      200.000   Impervious length"
"        3.500   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.434   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.000   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
```

```
"                    0.308     0.000     0.000     0.000 c.m/sec"
"             Catchment 101          Pervious   Impervious Total Area "
"             Surface Area           2.981      0.000      2.981      hectare"
"             Time of concentration  31.173     4.157      31.173     minutes"
"             Time to Centroid       131.911    89.743     131.911    minutes"
"             Rainfall depth         87.079     87.079     87.079     mm"
"             Rainfall volume        2595.83    0.00       2595.83    c.m"
"             Rainfall losses        49.263     6.252      49.263     mm"
"             Runoff depth           37.816     80.827     37.816     mm"
"             Runoff volume          1127.29    0.00       1127.29    c.m"
"             Runoff coefficient     0.434      0.000      0.434      "
"             Maximum flow           0.308      0.000      0.308      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.308     0.308     0.000     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.308     0.308     0.308     0.000"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Total Site"
"             Maximum flow                 0.308    c.m/sec"
"             Hydrograph volume         1127.289    c.m"
"                    0.308     0.308     0.308     0.308"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.308     0.000     0.308     0.308"
" 33          CATCHMENT 102"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          102   To the South"
"        0.000   % Impervious"
"        0.344   Total Area"
"      100.000   Flow length"
"        2.000   Overland Slope"
"        0.344   Pervious Area"
"      100.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"      100.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.434   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
```

```
"        0.000   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.042     0.000     0.308     0.308 c.m/sec"
"             Catchment 102          Pervious   Impervious Total Area "
"             Surface Area           0.344      0.000      0.344      hectare"
"             Time of concentration  24.326     3.244      24.326     minutes"
"             Time to Centroid       123.333    88.462     123.333    minutes"
"             Rainfall depth         87.079     87.079     87.079     mm"
"             Rainfall volume        299.55     0.00       299.55     c.m"
"             Rainfall losses        49.244     7.030      49.244     mm"
"             Runoff depth           37.835     80.049     37.835     mm"
"             Runoff volume          130.15     0.00       130.15     c.m"
"             Runoff coefficient     0.434      0.000      0.434      "
"             Maximum flow           0.042      0.000      0.042      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.042     0.042     0.308     0.308"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.042     0.042     0.042     0.308"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Total Site"
"             Maximum flow                  0.349    c.m/sec"
"             Hydrograph volume          1257.443    c.m"
"                     0.042     0.042     0.042     0.349"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.042     0.000     0.042     0.349"
" 33          CATCHMENT 103"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          103   To the north ROW"
"        0.000   % Impervious"
"        0.321   Total Area"
"       50.000   Flow length"
"        1.500   Overland Slope"
"        0.321   Pervious Area"
"       50.000   Pervious length"
"        1.500   Pervious slope"
"        0.000   Impervious Area"
"       50.000   Impervious length"
"        1.500   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.434   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
```

```
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.000   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.048     0.000     0.042     0.349 c.m/sec"
"             Catchment 103          Pervious   Impervious Total Area "
"             Surface Area           0.321      0.000      0.321      hectare"
"             Time of concentration  17.496     2.333      17.496     minutes"
"             Time to Centroid       114.753    87.102     114.753    minutes"
"             Rainfall depth         87.079     87.079     87.079     mm"
"             Rainfall volume        279.52     0.00       279.52     c.m"
"             Rainfall losses        49.274     6.793      49.274     mm"
"             Runoff depth           37.805     80.287     37.805     mm"
"             Runoff volume          121.35     0.00       121.35     c.m"
"             Runoff coefficient     0.434      0.000      0.434      "
"             Maximum flow           0.048      0.000      0.048      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.048     0.048     0.042     0.349"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.048     0.048     0.048     0.349"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Total Site"
"             Maximum flow                  0.389    c.m/sec"
"             Hydrograph volume          1378.798    c.m"
"                     0.048     0.048     0.048     0.389"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.048     0.000     0.048     0.389"
" 33          CATCHMENT 104"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          104   To the NW Wetland B"
"        0.000   % Impervious"
"        0.812   Total Area"
"       80.000   Flow length"
"        2.500   Overland Slope"
"        0.812   Pervious Area"
"       80.000   Pervious length"
"        2.500   Pervious slope"
"        0.000   Impervious Area"
"       80.000   Impervious length"
"        2.500   Impervious slope"
"        0.250   Pervious Manning 'n'"
```

```
"       75.000   Pervious SCS Curve No."
"        0.434   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.000   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.112     0.000     0.048     0.389 c.m/sec"
"             Catchment 104          Pervious   Impervious Total Area "
"             Surface Area           0.812      0.000      0.812      hectare"
"             Time of concentration  19.900     2.654      19.900     minutes"
"             Time to Centroid       117.773    87.596     117.773    minutes"
"             Rainfall depth         87.079     87.079     87.079     mm"
"             Rainfall volume        707.08     0.00       707.08     c.m"
"             Rainfall losses        49.297     7.107      49.297     mm"
"             Runoff depth           37.782     79.972     37.782     mm"
"             Runoff volume          306.79     0.00       306.79     c.m"
"             Runoff coefficient     0.434      0.000      0.434      "
"             Maximum flow           0.112      0.000      0.112      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.112     0.112     0.048     0.389"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.112     0.112     0.112     0.389"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Total Site"
"             Maximum flow                 0.491    c.m/sec"
"             Hydrograph volume         1685.582    c.m"
"                     0.112     0.112     0.112     0.491"
" 38          START/RE-START TOTALS 104"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                      4.458    hectare"
"             Total Impervious area                     0.000    hectare"
"             Total % impervious                        0.000"
" 19          EXIT"
```

Post-Development

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 7, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:              Q:\51060\100\Preliminary Design\SWM\"
"                                                          FS-SWM Report\Post"
"                Output filename:                          2YR - POST C.out"
"                Licensee name:                                             A"
"                Company                                                    "
"                Date & Time last used:                 8/4/2023 at 4:36:58 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"      743.000   Coefficient A"
"        6.000   Constant B"
"        0.799   Exponent C"
"        0.400   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          109.401    mm/hr"
"             Total depth                 34.276    mm"
"            6   002hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          201   Controlled Area to W.R.7 (Southeast)"
"       81.500   % Impervious"
"        3.071   Total Area"
"       30.000   Flow length"
"        2.000   Overland Slope"
"        0.568   Pervious Area"
"       30.000   Pervious length"
"        2.000   Pervious slope"
"        2.503   Impervious Area"
"       30.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.176   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.841   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.543     0.000     0.000     0.000 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           0.568      2.503      3.071      hectare"
"             Time of concentration  26.279     2.209      3.299      minutes"
"             Time to Centroid       135.317    91.265     93.260     minutes"
"             Rainfall depth         34.276     34.276     34.276     mm"
"             Rainfall volume        194.74     857.89     1052.63    c.m"
"             Rainfall losses        28.252     5.448      9.666      mm"
```

```
"             Runoff depth           6.024      28.829     24.610     mm"
"             Runoff volume          34.23      721.55     755.77     c.m"
"             Runoff coefficient     0.176      0.841      0.718      "
"             Maximum flow           0.008      0.542      0.543      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.543     0.543     0.000     0.000"
" 54          POND DESIGN"
"         0.543   Current peak flow    c.m/sec"
"         0.708   Target outflow    c.m/sec"
"         755.8   Hydrograph volume    c.m"
"            4.   Number of stages"
"       399.000   Minimum water level    metre"
"       402.190   Maximum water level    metre"
"       399.000   Starting water level    metre"
"             0   Keep Design Data: 1 = True; 0 = False"
"                   Level Discharge    Volume"
"                 399.000     0.000     0.000"
"                 399.300   0.04841  1.01E-05"
"                 401.000    0.4512  1088.490"
"                 402.190    0.5999  1088.490"
"            1.   OUTFLOW PIPE"
"                Upstream Downstr'm      Pipe      Pipe   Manning     Entry"
"                  invert    invert    Length  Diameter       'n'   loss Ke"
"                 399.000   398.800    20.000     0.450     0.013     0.500"
"             Peak outflow                  0.154    c.m/sec"
"             Maximum level               399.747    metre"
"             Maximum storage             286.532    c.m"
"             Centroidal lag                1.903   hours"
"                  0.543     0.543     0.154     0.000 c.m/sec"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                To W.R.7"
"             Maximum flow                  0.154    c.m/sec"
"             Hydrograph volume           753.694    c.m"
"                     0.543     0.543     0.154     0.154"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.543     0.000     0.154     0.154"
" 33          CATCHMENT 202"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          202   Uncontrolled Area to W.R.7 (Southeast)"
"       68.000   % Impervious"
"        0.240   Total Area"
"        5.000   Flow length"
"        2.000   Overland Slope"
"        0.077   Pervious Area"
"        5.000   Pervious length"
"        2.000   Pervious slope"
"        0.163   Impervious Area"
"        5.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.175   Pervious Runoff coefficient"
```

```
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.809   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.040     0.000     0.154     0.154 c.m/sec"
"             Catchment 202          Pervious   Impervious Total Area "
"             Surface Area           0.077      0.163      0.240      hectare"
"             Time of concentration  8.969      0.754      1.513      minutes"
"             Time to Centroid       114.270    89.306     91.613     minutes"
"             Rainfall depth         34.276     34.276     34.276     mm"
"             Rainfall volume        26.32      55.94      82.26      c.m"
"             Rainfall losses        28.278     6.551      13.504     mm"
"             Runoff depth           5.998      27.725     20.773     mm"
"             Runoff volume          4.61       45.25      49.85      c.m"
"             Runoff coefficient     0.175      0.809      0.606      "
"             Maximum flow           0.002      0.040      0.040      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.040     0.040     0.154     0.154"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.040     0.040     0.040     0.154"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                To W.R.7"
"             Maximum flow                  0.165    c.m/sec"
"             Hydrograph volume           803.548    c.m"
"                     0.040     0.040     0.040     0.165"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.040     0.000     0.040     0.165"
" 33          CATCHMENT 203"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          203   Uncontrolled to W.R.7 (Northeast)"
"       53.100   % Impervious"
"        0.124   Total Area"
"        5.000   Flow length"
"        2.000   Overland Slope"
"        0.058   Pervious Area"
"        5.000   Pervious length"
"        2.000   Pervious slope"
"        0.066   Impervious Area"
"        5.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.175   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.809   Impervious Runoff coefficient"
```

```
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.016     0.000     0.040     0.165 c.m/sec"
"             Catchment 203          Pervious   Impervious Total Area "
"             Surface Area           0.058      0.066      0.124      hectare"
"             Time of concentration  8.969      0.754      2.072      minutes"
"             Time to Centroid       114.270    89.306     93.311     minutes"
"             Rainfall depth         34.276     34.276     34.276     mm"
"             Rainfall volume        19.93      22.57      42.50      c.m"
"             Rainfall losses        28.278     6.551      16.741     mm"
"             Runoff depth           5.998      27.725     17.535     mm"
"             Runoff volume          3.49       18.26      21.74      c.m"
"             Runoff coefficient     0.175      0.809      0.512      "
"             Maximum flow           0.001      0.016      0.016      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.016     0.016     0.040     0.165"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.016     0.016     0.016     0.165"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                To W.R.7"
"             Maximum flow                  0.172    c.m/sec"
"             Hydrograph volume           825.292    c.m"
"                     0.016     0.016     0.016     0.172"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.016     0.000     0.016     0.172"
" 33          CATCHMENT 204"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          204   Uncontrolled to Wetland A (Southwest)"
"       48.800   % Impervious"
"        0.763   Total Area"
"       20.000   Flow length"
"        3.000   Overland Slope"
"        0.391   Pervious Area"
"       20.000   Pervious length"
"        3.000   Pervious slope"
"        0.372   Impervious Area"
"       20.000   Impervious length"
"        3.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.176   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.841   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.086     0.000     0.016     0.172 c.m/sec"
"             Catchment 204          Pervious   Impervious Total Area "
"             Surface Area           0.391      0.372      0.763      hectare"
```

```
"             Time of concentration  18.245     1.534      4.540      minutes"
"             Time to Centroid       125.534    90.158     96.523     minutes"
"             Rainfall depth         34.276     34.276     34.276     mm"
"             Rainfall volume        133.90     127.63     261.53     c.m"
"             Rainfall losses        28.251     5.462      17.130     mm"
"             Runoff depth           6.025      28.815     17.147     mm"
"             Runoff volume          23.54      107.29     130.83     c.m"
"             Runoff coefficient     0.176      0.841      0.500      "
"             Maximum flow           0.007      0.085      0.086      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.086     0.086     0.016     0.172"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.086     0.086     0.086     0.172"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                Total Site Area"
"             Maximum flow                 0.086    c.m/sec"
"             Hydrograph volume          130.828    c.m"
"                    0.086     0.086     0.086     0.086"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.086     0.000     0.086     0.086"
" 33          CATCHMENT 205"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          205   Uncontrolled Area to Wetland B (Northwest)"
"       38.500   % Impervious"
"        0.260   Total Area"
"       20.000   Flow length"
"        3.000   Overland Slope"
"        0.160   Pervious Area"
"       20.000   Pervious length"
"        3.000   Pervious slope"
"        0.100   Impervious Area"
"       20.000   Impervious length"
"        3.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.176   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.841   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                    0.023     0.000     0.086     0.086 c.m/sec"
"             Catchment 205          Pervious   Impervious Total Area "
"             Surface Area           0.160      0.100      0.260      hectare"
"             Time of concentration  18.245     1.534      5.718      minutes"
"             Time to Centroid       125.534    90.158     99.016     minutes"
"             Rainfall depth         34.276     34.276     34.276     mm"
"             Rainfall volume        54.81      34.31      89.12      c.m"
"             Rainfall losses        28.251     5.462      19.477     mm"
```

```
"             Runoff depth           6.025      28.815     14.799     mm"
"             Runoff volume          9.63       28.84      38.48      c.m"
"             Runoff coefficient     0.176      0.841      0.432      "
"             Maximum flow           0.003      0.023      0.023      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.023     0.023     0.086     0.086"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.023     0.023     0.023     0.086"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                Total Site Area"
"             Maximum flow                 0.109    c.m/sec"
"             Hydrograph volume          169.306    c.m"
"                    0.023     0.023     0.023     0.109"
" 40          HYDROGRAPH   Confluence    1"
"            7   Confluence "
"            1   Node #"
"                To W.R.7"
"             Maximum flow                 0.172    c.m/sec"
"             Hydrograph volume          825.292    c.m"
"                    0.023     0.172     0.023     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.023     0.172     0.172     0.000"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                Total Site Area"
"             Maximum flow                 0.255    c.m/sec"
"             Hydrograph volume          994.597    c.m"
"                    0.023     0.172     0.172     0.255"
" 38          START/RE-START TOTALS 1"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                    4.458    hectare"
"             Total Impervious area                   3.204    hectare"
"             Total % impervious                     71.879"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 7, 2010"
"           10   Units used:                                        ie METRIC"
"                Job folder:              Q:\51060\100\Preliminary Design\SWM\"
"                                                              FS-SWM Report\Post"
"                Output filename:                              5YR - POST C.out"
"                Licensee name:                                              A"
"                Company                                                      "
"                Date & Time last used:                 8/4/2023 at 4:34:49 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     1593.000   Coefficient A"
"       11.000   Constant B"
"        0.879   Exponent C"
"        0.400   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          139.288    mm/hr"
"             Total depth                 47.265    mm"
"            6   005hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          201   Controlled Area to W.R.7 (Southeast)"
"       81.500   % Impervious"
"        3.071   Total Area"
"       30.000   Flow length"
"        2.000   Overland Slope"
"        0.568   Pervious Area"
"       30.000   Pervious length"
"        2.000   Pervious slope"
"        2.503   Impervious Area"
"       30.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.257   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.879   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
```

```
"                    0.757     0.000     0.000     0.000 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           0.568      2.503      3.071      hectare"
"             Time of concentration  19.131     1.980      3.050      minutes"
"             Time to Centroid       121.799    88.785     90.843     minutes"
"             Rainfall depth         47.265     47.265     47.265     mm"
"             Rainfall volume        268.53     1182.97    1451.50    c.m"
"             Rainfall losses        35.099     5.742      11.173     mm"
"             Runoff depth           12.166     41.523     36.092     mm"
"             Runoff volume          69.12      1039.27    1108.39    c.m"
"             Runoff coefficient     0.257      0.879      0.764      "
"             Maximum flow           0.023      0.755      0.757      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.757     0.757     0.000     0.000"
" 54          POND DESIGN"
"         0.757   Current peak flow    c.m/sec"
"         0.708   Target outflow    c.m/sec"
"        1108.4   Hydrograph volume    c.m"
"           4.   Number of stages"
"       399.000   Minimum water level    metre"
"       402.190   Maximum water level    metre"
"       399.000   Starting water level    metre"
"             0   Keep Design Data: 1 = True; 0 = False"
"                   Level Discharge    Volume"
"                 399.000     0.000     0.000"
"                 399.300   0.04841  1.01E-05"
"                 401.000    0.4512  1088.490"
"                 402.190    0.5999  1088.490"
"            1.   OUTFLOW PIPE"
"                Upstream Downstr'm      Pipe      Pipe   Manning     Entry"
"                  invert    invert    Length  Diameter       'n'   loss Ke"
"                 399.000   398.800    20.000     0.450     0.013     0.500"
"             Peak outflow                  0.221    c.m/sec"
"             Maximum level               400.028    metre"
"             Maximum storage             466.384    c.m"
"             Centroidal lag                1.949   hours"
"                  0.757     0.757     0.221     0.000 c.m/sec"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                To W.R.7"
"             Maximum flow                  0.221    c.m/sec"
"             Hydrograph volume          1102.452    c.m"
"                    0.757     0.757     0.221     0.221"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.757     0.000     0.221     0.221"
" 33          CATCHMENT 202"
"            1   Triangular SCS"
```

```
"            1   Equal length"
"            1   SCS method"
"          202   Uncontrolled Area to W.R.7 (Southeast)"
"       68.000   % Impervious"
"        0.240   Total Area"
"        5.000   Flow length"
"        2.000   Overland Slope"
"        0.077   Pervious Area"
"        5.000   Pervious length"
"        2.000   Pervious slope"
"        0.163   Impervious Area"
"        5.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.255   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.831   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.054     0.000     0.221     0.221 c.m/sec"
"             Catchment 202          Pervious   Impervious Total Area "
"             Surface Area           0.077      0.163      0.240      hectare"
"             Time of concentration  6.529      0.676      1.415      minutes"
"             Time to Centroid       106.382    87.252     89.668     minutes"
"             Rainfall depth         47.265     47.265     47.265     mm"
"             Rainfall volume        36.30      77.14      113.44     c.m"
"             Rainfall losses        35.205     7.998      16.705     mm"
"             Runoff depth           12.059     39.266     30.560     mm"
"             Runoff volume          9.26       64.08      73.34      c.m"
"             Runoff coefficient     0.255      0.831      0.647      "
"             Maximum flow           0.005      0.052      0.054      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.054     0.054     0.221     0.221"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.054     0.054     0.054     0.221"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                To W.R.7"
"             Maximum flow                  0.236    c.m/sec"
"             Hydrograph volume          1175.797    c.m"
"                     0.054     0.054     0.054     0.236"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
```

```
"                    0.054     0.000     0.054     0.236"
" 33          CATCHMENT 203"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          203   Uncontrolled to W.R.7 (Northeast)"
"       53.100   % Impervious"
"        0.124   Total Area"
"        5.000   Flow length"
"        2.000   Overland Slope"
"        0.058   Pervious Area"
"        5.000   Pervious length"
"        2.000   Pervious slope"
"        0.066   Impervious Area"
"        5.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.255   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.831   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                    0.022     0.000     0.054     0.236 c.m/sec"
"             Catchment 203          Pervious   Impervious Total Area "
"             Surface Area           0.058      0.066      0.124      hectare"
"             Time of concentration  6.529      0.676      1.925      minutes"
"             Time to Centroid       106.382    87.252     91.334     minutes"
"             Rainfall depth         47.265     47.265     47.265     mm"
"             Rainfall volume        27.49      31.12      58.61      c.m"
"             Rainfall losses        35.205     7.998      20.758     mm"
"             Runoff depth           12.059     39.266     26.506     mm"
"             Runoff volume          7.01       25.85      32.87      c.m"
"             Runoff coefficient     0.255      0.831      0.561      "
"             Maximum flow           0.004      0.021      0.022      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.022     0.022     0.054     0.236"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.022     0.022     0.022     0.236"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                To W.R.7"
"             Maximum flow                 0.246    c.m/sec"
"             Hydrograph volume         1208.663    c.m"
```

```
"                    0.022     0.022     0.022     0.246"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.022     0.000     0.022     0.246"
" 33          CATCHMENT 204"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          204   Uncontrolled to Wetland A (Southwest)"
"       48.800   % Impervious"
"        0.763   Total Area"
"       20.000   Flow length"
"        3.000   Overland Slope"
"        0.391   Pervious Area"
"       20.000   Pervious length"
"        3.000   Pervious slope"
"        0.372   Impervious Area"
"       20.000   Impervious length"
"        3.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.257   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.875   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                    0.121     0.000     0.022     0.246 c.m/sec"
"             Catchment 204          Pervious   Impervious Total Area "
"             Surface Area           0.391      0.372      0.763      hectare"
"             Time of concentration  13.282     1.375      4.181      minutes"
"             Time to Centroid       114.600    87.893     94.187     minutes"
"             Rainfall depth         47.265     47.265     47.265     mm"
"             Rainfall volume        184.64     175.99     360.63     c.m"
"             Rainfall losses        35.106     5.889      20.848     mm"
"             Runoff depth           12.159     41.376     26.417     mm"
"             Runoff volume          47.50      154.06     201.56     c.m"
"             Runoff coefficient     0.257      0.875      0.559      "
"             Maximum flow           0.020      0.117      0.121      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.121     0.121     0.022     0.246"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.121     0.121     0.121     0.246"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
```

```
"               Total Site Area"
"             Maximum flow                  0.121    c.m/sec"
"             Hydrograph volume           201.560    c.m"
"                    0.121     0.121     0.121     0.121"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.121     0.000     0.121     0.121"
" 33          CATCHMENT 205"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          205   Uncontrolled Area to Wetland B (Northwest)"
"       38.500   % Impervious"
"        0.260   Total Area"
"       20.000   Flow length"
"        3.000   Overland Slope"
"        0.160   Pervious Area"
"       20.000   Pervious length"
"        3.000   Pervious slope"
"        0.100   Impervious Area"
"       20.000   Impervious length"
"        3.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.257   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.875   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                    0.033     0.000     0.121     0.121 c.m/sec"
"             Catchment 205          Pervious   Impervious Total Area "
"             Surface Area           0.160      0.100      0.260      hectare"
"             Time of concentration  13.282     1.375      5.179      minutes"
"             Time to Centroid       114.600    87.893     96.425     minutes"
"             Rainfall depth         47.265     47.265     47.265     mm"
"             Rainfall volume        75.58      47.31      122.89     c.m"
"             Rainfall losses        35.106     5.889      23.857     mm"
"             Runoff depth           12.159     41.376     23.407     mm"
"             Runoff volume          19.44      41.42      60.86      c.m"
"             Runoff coefficient     0.257      0.875      0.495      "
"             Maximum flow           0.008      0.032      0.033      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.033     0.033     0.121     0.121"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.033     0.033     0.033     0.121"
```

```
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                Total Site Area"
"             Maximum flow                  0.154    c.m/sec"
"             Hydrograph volume           262.419    c.m"
"                     0.033     0.033     0.033     0.154"
" 40          HYDROGRAPH   Confluence    1"
"            7   Confluence "
"            1   Node #"
"                To W.R.7"
"             Maximum flow                  0.246    c.m/sec"
"             Hydrograph volume          1208.663    c.m"
"                     0.033     0.246     0.033     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.033     0.246     0.246     0.000"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                Total Site Area"
"             Maximum flow                  0.350    c.m/sec"
"             Hydrograph volume          1471.083    c.m"
"                     0.033     0.246     0.246     0.350"
" 38          START/RE-START TOTALS 1"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                      4.458    hectare"
"             Total Impervious area                     3.204    hectare"
"             Total % impervious                       71.879"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 7, 2010"
"           10   Units used:                                        ie METRIC"
"                Job folder:              Q:\51060\100\Preliminary Design\SWM\"
"                                                                FS-SWM Report\Post"
"                Output filename:                                 10YR - POST C.out"
"                Licensee name:                                                A"
"                Company                                                        "
"                Date & Time last used:                 8/4/2023 at 4:30:50 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     2221.000   Coefficient A"
"       12.000   Constant B"
"        0.908   Exponent C"
"        0.400   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          169.551    mm/hr"
"             Total depth                 56.290    mm"
"            6   010hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          201   Controlled Area to W.R.7 (Southeast)"
"       81.500   % Impervious"
"        3.071   Total Area"
"       30.000   Flow length"
"        2.000   Overland Slope"
"        0.568   Pervious Area"
"       30.000   Pervious length"
"        2.000   Pervious slope"
"        2.503   Impervious Area"
"       30.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.306   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.894   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
```

```
"                    0.946     0.000     0.000     0.000 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           0.568      2.503      3.071      hectare"
"             Time of concentration  16.132     1.822      2.852      minutes"
"             Time to Centroid       116.081    87.573     89.626     minutes"
"             Rainfall depth         56.290     56.290     56.290     mm"
"             Rainfall volume        319.80     1408.87    1728.67    c.m"
"             Rainfall losses        39.079     5.945      12.075     mm"
"             Runoff depth           17.211     50.345     44.215     mm"
"             Runoff volume          97.78      1260.07    1357.85    c.m"
"             Runoff coefficient     0.306      0.894      0.785      "
"             Maximum flow           0.039      0.940      0.946      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.946     0.946     0.000     0.000"
" 54          POND DESIGN"
"         0.946   Current peak flow    c.m/sec"
"         0.708   Target outflow    c.m/sec"
"        1357.9   Hydrograph volume    c.m"
"           4.   Number of stages"
"       399.000   Minimum water level    metre"
"       402.190   Maximum water level    metre"
"       399.000   Starting water level    metre"
"             0   Keep Design Data: 1 = True; 0 = False"
"                   Level Discharge    Volume"
"                 399.000     0.000     0.000"
"                 399.300   0.04841  1.01E-05"
"                 401.000    0.4512  1088.490"
"                 402.190    0.5999  1088.490"
"            1.   OUTFLOW PIPE"
"                Upstream Downstr'm      Pipe      Pipe   Manning     Entry"
"                  invert    invert    Length  Diameter       'n'   loss Ke"
"                 399.000   398.800    20.000     0.450     0.013     0.500"
"             Peak outflow                  0.272    c.m/sec"
"             Maximum level               400.242    metre"
"             Maximum storage             603.055    c.m"
"             Centroidal lag                1.981   hours"
"                  0.946     0.946     0.272     0.000 c.m/sec"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                To W.R.7"
"             Maximum flow                  0.272    c.m/sec"
"             Hydrograph volume          1358.816    c.m"
"                    0.946     0.946     0.272     0.272"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.946     0.000     0.272     0.272"
" 33          CATCHMENT 202"
"            1   Triangular SCS"
```

```
"            1   Equal length"
"            1   SCS method"
"          202   Uncontrolled Area to W.R.7 (Southeast)"
"       68.000   % Impervious"
"        0.240   Total Area"
"        5.000   Flow length"
"        2.000   Overland Slope"
"        0.077   Pervious Area"
"        5.000   Pervious length"
"        2.000   Pervious slope"
"        0.163   Impervious Area"
"        5.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.305   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.836   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.068     0.000     0.272     0.272 c.m/sec"
"             Catchment 202          Pervious   Impervious Total Area "
"             Surface Area           0.077      0.163      0.240      hectare"
"             Time of concentration  5.505      0.622      1.337      minutes"
"             Time to Centroid       102.737    86.219     88.639     minutes"
"             Rainfall depth         56.290     56.290     56.290     mm"
"             Rainfall volume        43.23      91.87      135.10     c.m"
"             Rainfall losses        39.128     9.242      18.806     mm"
"             Runoff depth           17.162     47.048     37.485     mm"
"             Runoff volume          13.18      76.78      89.96      c.m"
"             Runoff coefficient     0.305      0.836      0.666      "
"             Maximum flow           0.008      0.064      0.068      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.068     0.068     0.272     0.272"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.068     0.068     0.068     0.272"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                To W.R.7"
"             Maximum flow                  0.291    c.m/sec"
"             Hydrograph volume          1448.779    c.m"
"                     0.068     0.068     0.068     0.291"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
```

```
"                    0.068     0.000     0.068     0.291"
" 33          CATCHMENT 203"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          203   Uncontrolled to W.R.7 (Northeast)"
"       53.100   % Impervious"
"        0.124   Total Area"
"        5.000   Flow length"
"        2.000   Overland Slope"
"        0.058   Pervious Area"
"        5.000   Pervious length"
"        2.000   Pervious slope"
"        0.066   Impervious Area"
"        5.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.305   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.836   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                    0.028     0.000     0.068     0.291 c.m/sec"
"             Catchment 203          Pervious   Impervious Total Area "
"             Surface Area           0.058      0.066      0.124      hectare"
"             Time of concentration  5.505      0.622      1.812      minutes"
"             Time to Centroid       102.737    86.219     90.244     minutes"
"             Rainfall depth         56.290     56.290     56.290     mm"
"             Rainfall volume        32.74      37.06      69.80      c.m"
"             Rainfall losses        39.128     9.242      23.259     mm"
"             Runoff depth           17.162     47.048     33.032     mm"
"             Runoff volume          9.98       30.98      40.96      c.m"
"             Runoff coefficient     0.305      0.836      0.587      "
"             Maximum flow           0.006      0.026      0.028      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.028     0.028     0.068     0.291"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.028     0.028     0.028     0.291"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                To W.R.7"
"             Maximum flow                 0.301    c.m/sec"
"             Hydrograph volume         1489.738    c.m"
```

```
"                    0.028     0.028     0.028     0.301"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.028     0.000     0.028     0.301"
" 33          CATCHMENT 204"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          204   Uncontrolled to Wetland A (Southwest)"
"       48.800   % Impervious"
"        0.763   Total Area"
"       20.000   Flow length"
"        3.000   Overland Slope"
"        0.391   Pervious Area"
"       20.000   Pervious length"
"        3.000   Pervious slope"
"        0.372   Impervious Area"
"       20.000   Impervious length"
"        3.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.306   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.889   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                    0.153     0.000     0.028     0.301 c.m/sec"
"             Catchment 204          Pervious   Impervious Total Area "
"             Surface Area           0.391      0.372      0.763      hectare"
"             Time of concentration  11.199     1.265      3.901      minutes"
"             Time to Centroid       109.843    86.789     92.906     minutes"
"             Rainfall depth         56.290     56.290     56.290     mm"
"             Rainfall volume        219.90     209.59     429.49     c.m"
"             Rainfall losses        39.065     6.254      23.053     mm"
"             Runoff depth           17.226     50.036     33.237     mm"
"             Runoff volume          67.29      186.31     253.60     c.m"
"             Runoff coefficient     0.306      0.889      0.590      "
"             Maximum flow           0.031      0.146      0.153      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.153     0.153     0.028     0.301"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.153     0.153     0.153     0.301"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
```

```
"               Total Site Area"
"             Maximum flow                  0.153    c.m/sec"
"             Hydrograph volume           253.600    c.m"
"                    0.153     0.153     0.153     0.153"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.153     0.000     0.153     0.153"
" 33          CATCHMENT 205"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          205   Uncontrolled Area to Wetland B (Northwest)"
"       38.500   % Impervious"
"        0.260   Total Area"
"       20.000   Flow length"
"        3.000   Overland Slope"
"        0.160   Pervious Area"
"       20.000   Pervious length"
"        3.000   Pervious slope"
"        0.100   Impervious Area"
"       20.000   Impervious length"
"        3.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.306   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.889   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                    0.042     0.000     0.153     0.153 c.m/sec"
"             Catchment 205          Pervious   Impervious Total Area "
"             Surface Area           0.160      0.100      0.260      hectare"
"             Time of concentration  11.199     1.265      4.790      minutes"
"             Time to Centroid       109.843    86.789     94.969     minutes"
"             Rainfall depth         56.290     56.290     56.290     mm"
"             Rainfall volume        90.01      56.35      146.35     c.m"
"             Rainfall losses        39.065     6.254      26.432     mm"
"             Runoff depth           17.226     50.036     29.858     mm"
"             Runoff volume          27.54      50.09      77.63      c.m"
"             Runoff coefficient     0.306      0.889      0.530      "
"             Maximum flow           0.013      0.039      0.042      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.042     0.042     0.153     0.153"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.042     0.042     0.042     0.153"
```

```
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                Total Site Area"
"             Maximum flow                  0.195    c.m/sec"
"             Hydrograph volume           331.230    c.m"
"                     0.042     0.042     0.042     0.195"
" 40          HYDROGRAPH   Confluence    1"
"            7   Confluence "
"            1   Node #"
"                To W.R.7"
"             Maximum flow                  0.301    c.m/sec"
"             Hydrograph volume          1489.738    c.m"
"                     0.042     0.301     0.042     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.042     0.301     0.301     0.000"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                Total Site Area"
"             Maximum flow                  0.439    c.m/sec"
"             Hydrograph volume          1820.968    c.m"
"                     0.042     0.301     0.301     0.439"
" 38          START/RE-START TOTALS 1"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                     4.458    hectare"
"             Total Impervious area                    3.204    hectare"
"             Total % impervious                      71.879"
" 19          EXIT"
```

```
"                MIDUSS Output ------------------------------------------------>"
"                MIDUSS version                            Version 2.25  rev. 473"
"                MIDUSS created                          Sunday, February 7, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:               Q:\51060\100\Preliminary Design\SWM\"
"                                                                  FS-SWM Report\Post"
"                Output filename:                                   25YR - POST C.out"
"                Licensee name:                                                  A"
"                Company                                                         "
"                Date & Time last used:                  8/4/2023 at 4:28:29 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     3158.000   Coefficient A"
"       15.000   Constant B"
"        0.936   Exponent C"
"        0.400   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          191.557    mm/hr"
"             Total depth                 68.266    mm"
"            6   025hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          201   Controlled Area to W.R.7 (Southeast)"
"       81.500   % Impervious"
"        3.071   Total Area"
"       30.000   Flow length"
"        2.000   Overland Slope"
"        0.568   Pervious Area"
"       30.000   Pervious length"
"        2.000   Pervious slope"
"        2.503   Impervious Area"
"       30.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.362   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.910   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
```

```
"                    1.113     0.000     0.000     0.000 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           0.568      2.503      3.071      hectare"
"             Time of concentration  14.123     1.728      2.754      minutes"
"             Time to Centroid       112.217    86.929     89.023     minutes"
"             Rainfall depth         68.266     68.266     68.266     mm"
"             Rainfall volume        387.84     1708.61    2096.46    c.m"
"             Rainfall losses        43.560     6.143      13.065     mm"
"             Runoff depth           24.707     62.124     55.202     mm"
"             Runoff volume          140.37     1554.87    1695.24    c.m"
"             Runoff coefficient     0.362      0.910      0.809      "
"             Maximum flow           0.062      1.102      1.113      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    1.113     1.113     0.000     0.000"
" 54          POND DESIGN"
"         1.113   Current peak flow    c.m/sec"
"         0.708   Target outflow    c.m/sec"
"        1695.2   Hydrograph volume    c.m"
"           4.   Number of stages"
"       399.000   Minimum water level    metre"
"       402.190   Maximum water level    metre"
"       399.000   Starting water level    metre"
"             0   Keep Design Data: 1 = True; 0 = False"
"                   Level Discharge    Volume"
"                 399.000     0.000     0.000"
"                 399.300   0.04841  1.01E-05"
"                 401.000    0.4512  1088.490"
"                 402.190    0.5999  1088.490"
"            1.   OUTFLOW PIPE"
"                Upstream Downstr'm      Pipe      Pipe   Manning     Entry"
"                  invert    invert    Length  Diameter       'n'   loss Ke"
"                 399.000   398.800    20.000     0.450     0.013     0.500"
"             Peak outflow                  0.331    c.m/sec"
"             Maximum level               400.499    metre"
"             Maximum storage             767.646    c.m"
"             Centroidal lag                2.009   hours"
"                  1.113     1.113     0.331     0.000 c.m/sec"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                To W.R.7"
"             Maximum flow                  0.331    c.m/sec"
"             Hydrograph volume          1698.618    c.m"
"                    1.113     1.113     0.331     0.331"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    1.113     0.000     0.331     0.331"
" 33          CATCHMENT 202"
"            1   Triangular SCS"
```

```
"            1   Equal length"
"            1   SCS method"
"          202   Uncontrolled Area to W.R.7 (Southeast)"
"       68.000   % Impervious"
"        0.240   Total Area"
"        5.000   Flow length"
"        2.000   Overland Slope"
"        0.077   Pervious Area"
"        5.000   Pervious length"
"        2.000   Pervious slope"
"        0.163   Impervious Area"
"        5.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.361   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.843   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.079     0.000     0.331     0.331 c.m/sec"
"             Catchment 202          Pervious   Impervious Total Area "
"             Surface Area           0.077      0.163      0.240      hectare"
"             Time of concentration  4.820      0.590      1.299      minutes"
"             Time to Centroid       100.624    85.735     88.230     minutes"
"             Rainfall depth         68.266     68.266     68.266     mm"
"             Rainfall volume        52.43      111.41     163.84     c.m"
"             Rainfall losses        43.648     10.724     21.260     mm"
"             Runoff depth           24.618     57.542     47.006     mm"
"             Runoff volume          18.91      93.91      112.82     c.m"
"             Runoff coefficient     0.361      0.843      0.689      "
"             Maximum flow           0.012      0.073      0.079      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.079     0.079     0.331     0.331"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.079     0.079     0.079     0.331"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                To W.R.7"
"             Maximum flow                 0.355    c.m/sec"
"             Hydrograph volume         1811.433    c.m"
"                     0.079     0.079     0.079     0.355"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
```

```
"                    0.079     0.000     0.079     0.355"
" 33          CATCHMENT 203"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          203   Uncontrolled to W.R.7 (Northeast)"
"       53.100   % Impervious"
"        0.124   Total Area"
"        5.000   Flow length"
"        2.000   Overland Slope"
"        0.058   Pervious Area"
"        5.000   Pervious length"
"        2.000   Pervious slope"
"        0.066   Impervious Area"
"        5.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.361   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.843   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                    0.034     0.000     0.079     0.355 c.m/sec"
"             Catchment 203          Pervious   Impervious Total Area "
"             Surface Area           0.058      0.066      0.124      hectare"
"             Time of concentration  4.820      0.590      1.750      minutes"
"             Time to Centroid       100.624    85.735     89.818     minutes"
"             Rainfall depth         68.266     68.266     68.266     mm"
"             Rainfall volume        39.70      44.95      84.65      c.m"
"             Rainfall losses        43.648     10.724     26.166     mm"
"             Runoff depth           24.618     57.542     42.101     mm"
"             Runoff volume          14.32      37.89      52.20      c.m"
"             Runoff coefficient     0.361      0.843      0.617      "
"             Maximum flow           0.009      0.030      0.034      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.034     0.034     0.079     0.355"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.034     0.034     0.034     0.355"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                To W.R.7"
"             Maximum flow                 0.367    c.m/sec"
"             Hydrograph volume         1863.638    c.m"
```

```
"                    0.034     0.034     0.034     0.367"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.034     0.000     0.034     0.367"
" 33          CATCHMENT 204"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          204   Uncontrolled to Wetland A (Southwest)"
"       48.800   % Impervious"
"        0.763   Total Area"
"       20.000   Flow length"
"        3.000   Overland Slope"
"        0.391   Pervious Area"
"       20.000   Pervious length"
"        3.000   Pervious slope"
"        0.372   Impervious Area"
"       20.000   Impervious length"
"        3.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.360   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.902   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                    0.182     0.000     0.034     0.367 c.m/sec"
"             Catchment 204          Pervious   Impervious Total Area "
"             Surface Area           0.391      0.372      0.763      hectare"
"             Time of concentration  9.805      1.200      3.740      minutes"
"             Time to Centroid       106.838    86.241     92.322     minutes"
"             Rainfall depth         68.266     68.266     68.266     mm"
"             Rainfall volume        266.69     254.19     520.87     c.m"
"             Rainfall losses        43.673     6.675      25.618     mm"
"             Runoff depth           24.593     61.591     42.648     mm"
"             Runoff volume          96.07      229.33     325.40     c.m"
"             Runoff coefficient     0.360      0.902      0.625      "
"             Maximum flow           0.049      0.169      0.182      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.182     0.182     0.034     0.367"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.182     0.182     0.182     0.367"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
```

```
"               Total Site Area"
"             Maximum flow                  0.182    c.m/sec"
"             Hydrograph volume           325.404    c.m"
"                     0.182     0.182     0.182     0.182"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.182     0.000     0.182     0.182"
" 33          CATCHMENT 205"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          205   Uncontrolled Area to Wetland B (Northwest)"
"       38.500   % Impervious"
"        0.260   Total Area"
"       20.000   Flow length"
"        3.000   Overland Slope"
"        0.160   Pervious Area"
"       20.000   Pervious length"
"        3.000   Pervious slope"
"        0.100   Impervious Area"
"       20.000   Impervious length"
"        3.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.360   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.902   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.051     0.000     0.182     0.182 c.m/sec"
"             Catchment 205          Pervious   Impervious Total Area "
"             Surface Area           0.160      0.100      0.260      hectare"
"             Time of concentration  9.805      1.200      4.551      minutes"
"             Time to Centroid       106.838    86.241     94.262     minutes"
"             Rainfall depth         68.266     68.266     68.266     mm"
"             Rainfall volume        109.16     68.33      177.49     c.m"
"             Rainfall losses        43.673     6.675      29.429     mm"
"             Runoff depth           24.593     61.591     38.837     mm"
"             Runoff volume          39.32      61.65      100.98     c.m"
"             Runoff coefficient     0.360      0.902      0.569      "
"             Maximum flow           0.020      0.045      0.051      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.051     0.051     0.182     0.182"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.051     0.051     0.051     0.182"
```

```
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                Total Site Area"
"             Maximum flow                  0.233    c.m/sec"
"             Hydrograph volume           426.380    c.m"
"                     0.051     0.051     0.051     0.233"
" 40          HYDROGRAPH   Confluence    1"
"            7   Confluence "
"            1   Node #"
"                To W.R.7"
"             Maximum flow                  0.367    c.m/sec"
"             Hydrograph volume          1863.638    c.m"
"                     0.051     0.367     0.051     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.051     0.367     0.367     0.000"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                Total Site Area"
"             Maximum flow                  0.545    c.m/sec"
"             Hydrograph volume          2290.018    c.m"
"                     0.051     0.367     0.367     0.545"
" 38          START/RE-START TOTALS 1"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                     4.458    hectare"
"             Total Impervious area                    3.204    hectare"
"             Total % impervious                      71.879"
" 19          EXIT"
```

```
"                MIDUSS Output ------------------------------------------------>"
"                MIDUSS version                            Version 2.25  rev. 473"
"                MIDUSS created                          Sunday, February 7, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:               Q:\51060\100\Preliminary Design\SWM\"
"                                                                 FS-SWM Report\Post"
"                Output filename:                                   50YR - POST C.out"
"                Licensee name:                                                  A"
"                Company                                                         "
"                Date & Time last used:                  8/4/2023 at 4:25:36 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     3886.000   Coefficient A"
"       16.000   Constant B"
"        0.950   Exponent C"
"        0.400   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          215.802    mm/hr"
"             Total depth                 77.647    mm"
"            6   050hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          201   Controlled Area to W.R.7 (Southeast)"
"       81.500   % Impervious"
"        3.071   Total Area"
"       30.000   Flow length"
"        2.000   Overland Slope"
"        0.568   Pervious Area"
"       30.000   Pervious length"
"        2.000   Pervious slope"
"        2.503   Impervious Area"
"       30.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.399   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.919   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
```

```
"                    1.279     0.000     0.000     0.000 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           0.568      2.503      3.071      hectare"
"             Time of concentration  12.814     1.644      2.647      minutes"
"             Time to Centroid       109.664    86.432     88.518     minutes"
"             Rainfall depth         77.647     77.647     77.647     mm"
"             Rainfall volume        441.14     1943.41    2384.55    c.m"
"             Rainfall losses        46.643     6.306      13.768     mm"
"             Runoff depth           31.004     71.341     63.879     mm"
"             Runoff volume          176.14     1785.58    1961.72    c.m"
"             Runoff coefficient     0.399      0.919      0.823      "
"             Maximum flow           0.080      1.262      1.279      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    1.279     1.279     0.000     0.000"
" 54          POND DESIGN"
"         1.279   Current peak flow    c.m/sec"
"         0.708   Target outflow    c.m/sec"
"        1961.7   Hydrograph volume    c.m"
"           4.   Number of stages"
"       399.000   Minimum water level    metre"
"       402.190   Maximum water level    metre"
"       399.000   Starting water level    metre"
"             0   Keep Design Data: 1 = True; 0 = False"
"                   Level Discharge    Volume"
"                 399.000     0.000     0.000"
"                 399.300   0.04841  1.01E-05"
"                 401.000    0.4512  1088.490"
"                 402.190    0.5999  1088.490"
"            1.   OUTFLOW PIPE"
"                Upstream Downstr'm      Pipe      Pipe   Manning     Entry"
"                  invert    invert    Length  Diameter       'n'   loss Ke"
"                 399.000   398.800    20.000     0.450     0.013     0.500"
"             Peak outflow                  0.382    c.m/sec"
"             Maximum level               400.715    metre"
"             Maximum storage             905.869    c.m"
"             Centroidal lag                2.020   hours"
"                  1.279     1.279     0.382     0.000 c.m/sec"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                To W.R.7"
"             Maximum flow                  0.382    c.m/sec"
"             Hydrograph volume          1962.929    c.m"
"                    1.279     1.279     0.382     0.382"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    1.279     0.000     0.382     0.382"
" 33          CATCHMENT 202"
"            1   Triangular SCS"
```

```
"            1   Equal length"
"            1   SCS method"
"          202   Uncontrolled Area to W.R.7 (Southeast)"
"       68.000   % Impervious"
"        0.240   Total Area"
"        5.000   Flow length"
"        2.000   Overland Slope"
"        0.077   Pervious Area"
"        5.000   Pervious length"
"        2.000   Pervious slope"
"        0.163   Impervious Area"
"        5.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.397   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.844   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.092     0.000     0.382     0.382 c.m/sec"
"             Catchment 202          Pervious   Impervious Total Area "
"             Surface Area           0.077      0.163      0.240      hectare"
"             Time of concentration  4.373      0.561      1.252      minutes"
"             Time to Centroid       99.145     85.312     87.818     minutes"
"             Rainfall depth         77.647     77.647     77.647     mm"
"             Rainfall volume        59.63      126.72     186.35     c.m"
"             Rainfall losses        46.830     12.078     23.199     mm"
"             Runoff depth           30.817     65.569     54.449     mm"
"             Runoff volume          23.67      107.01     130.68     c.m"
"             Runoff coefficient     0.397      0.844      0.701      "
"             Maximum flow           0.015      0.083      0.092      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.092     0.092     0.382     0.382"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.092     0.092     0.092     0.382"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                To W.R.7"
"             Maximum flow                  0.409    c.m/sec"
"             Hydrograph volume          2093.606    c.m"
"                     0.092     0.092     0.092     0.409"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
```

```
"                    0.092     0.000     0.092     0.409"
" 33          CATCHMENT 203"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          203   Uncontrolled to W.R.7 (Northeast)"
"       53.100   % Impervious"
"        0.124   Total Area"
"        5.000   Flow length"
"        2.000   Overland Slope"
"        0.058   Pervious Area"
"        5.000   Pervious length"
"        2.000   Pervious slope"
"        0.066   Impervious Area"
"        5.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.397   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.844   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                    0.040     0.000     0.092     0.409 c.m/sec"
"             Catchment 203          Pervious   Impervious Total Area "
"             Surface Area           0.058      0.066      0.124      hectare"
"             Time of concentration  4.373      0.561      1.679      minutes"
"             Time to Centroid       99.145     85.312     89.370     minutes"
"             Rainfall depth         77.647     77.647     77.647     mm"
"             Rainfall volume        45.16      51.13      96.28      c.m"
"             Rainfall losses        46.830     12.078     28.377     mm"
"             Runoff depth           30.817     65.569     49.271     mm"
"             Runoff volume          17.92      43.17      61.10      c.m"
"             Runoff coefficient     0.397      0.844      0.635      "
"             Maximum flow           0.012      0.033      0.040      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.040     0.040     0.092     0.409"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.040     0.040     0.040     0.409"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                To W.R.7"
"             Maximum flow                 0.423    c.m/sec"
"             Hydrograph volume         2154.702    c.m"
```

```
"                    0.040     0.040     0.040     0.423"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.040     0.000     0.040     0.423"
" 33          CATCHMENT 204"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          204   Uncontrolled to Wetland A (Southwest)"
"       48.800   % Impervious"
"        0.763   Total Area"
"       20.000   Flow length"
"        3.000   Overland Slope"
"        0.391   Pervious Area"
"       20.000   Pervious length"
"        3.000   Pervious slope"
"        0.372   Impervious Area"
"       20.000   Impervious length"
"        3.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.399   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.908   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                    0.212     0.000     0.040     0.423 c.m/sec"
"             Catchment 204          Pervious   Impervious Total Area "
"             Surface Area           0.391      0.372      0.763      hectare"
"             Time of concentration  8.896      1.142      3.586      minutes"
"             Time to Centroid       104.745    85.791     91.767     minutes"
"             Rainfall depth         77.647     77.647     77.647     mm"
"             Rainfall volume        303.33     289.12     592.45     c.m"
"             Rainfall losses        46.691     7.111      27.376     mm"
"             Runoff depth           30.956     70.537     50.272     mm"
"             Runoff volume          120.93     262.64     383.57     c.m"
"             Runoff coefficient     0.399      0.908      0.647      "
"             Maximum flow           0.065      0.192      0.212      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.212     0.212     0.040     0.423"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.212     0.212     0.212     0.423"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
```

```
"               Total Site Area"
"             Maximum flow                  0.212    c.m/sec"
"             Hydrograph volume           383.573    c.m"
"                     0.212     0.212     0.212     0.212"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.212     0.000     0.212     0.212"
" 33          CATCHMENT 205"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          205   Uncontrolled Area to Wetland B (Northwest)"
"       38.500   % Impervious"
"        0.260   Total Area"
"       20.000   Flow length"
"        3.000   Overland Slope"
"        0.160   Pervious Area"
"       20.000   Pervious length"
"        3.000   Pervious slope"
"        0.100   Impervious Area"
"       20.000   Impervious length"
"        3.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.399   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.908   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.060     0.000     0.212     0.212 c.m/sec"
"             Catchment 205          Pervious   Impervious Total Area "
"             Surface Area           0.160      0.100      0.260      hectare"
"             Time of concentration  8.896      1.142      4.338      minutes"
"             Time to Centroid       104.745    85.791     93.602     minutes"
"             Rainfall depth         77.647     77.647     77.647     mm"
"             Rainfall volume        124.16     77.73      201.88     c.m"
"             Rainfall losses        46.691     7.111      31.453     mm"
"             Runoff depth           30.956     70.537     46.195     mm"
"             Runoff volume          49.50      70.61      120.11     c.m"
"             Runoff coefficient     0.399      0.908      0.595      "
"             Maximum flow           0.027      0.052      0.060      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.060     0.060     0.212     0.212"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.060     0.060     0.060     0.212"
```

```
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                Total Site Area"
"             Maximum flow                  0.272    c.m/sec"
"             Hydrograph volume           503.680    c.m"
"                     0.060     0.060     0.060     0.272"
" 40          HYDROGRAPH   Confluence    1"
"            7   Confluence "
"            1   Node #"
"                To W.R.7"
"             Maximum flow                  0.423    c.m/sec"
"             Hydrograph volume          2154.702    c.m"
"                     0.060     0.423     0.060     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.060     0.423     0.423     0.000"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                Total Site Area"
"             Maximum flow                  0.640    c.m/sec"
"             Hydrograph volume          2658.382    c.m"
"                     0.060     0.423     0.423     0.640"
" 38          START/RE-START TOTALS 1"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                     4.458    hectare"
"             Total Impervious area                    3.204    hectare"
"             Total % impervious                      71.879"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                            Version 2.25  rev. 473"
"                MIDUSS created                          Sunday, February 7, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:               Q:\51060\100\Preliminary Design\SWM\"
"                                                                  FS-SWM Report\Post"
"                Output filename:                                  100YR - POST C.out"
"                Licensee name:                                                  A"
"                Company                                                         "
"                Date & Time last used:                  8/4/2023 at 3:53:57 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     4688.000   Coefficient A"
"       17.000   Constant B"
"        0.962   Exponent C"
"        0.400   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          239.650    mm/hr"
"             Total depth                 87.263    mm"
"            6   100hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          201   Controlled Area to W.R.7 (Southeast)"
"       81.500   % Impervious"
"        3.071   Total Area"
"       30.000   Flow length"
"        2.000   Overland Slope"
"        0.568   Pervious Area"
"       30.000   Pervious length"
"        2.000   Pervious slope"
"        2.503   Impervious Area"
"       30.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.434   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.925   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
```

```
"                    1.444     0.000     0.000     0.000 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           0.568      2.503      3.071      hectare"
"             Time of concentration  11.799     1.574      2.558      minutes"
"             Time to Centroid       107.618    86.019     88.096     minutes"
"             Rainfall depth         87.263     87.263     87.263     mm"
"             Rainfall volume        495.77     2184.09    2679.86    c.m"
"             Rainfall losses        49.406     6.508      14.444     mm"
"             Runoff depth           37.858     80.755     72.819     mm"
"             Runoff volume          215.08     2021.19    2236.27    c.m"
"             Runoff coefficient     0.434      0.925      0.834      "
"             Maximum flow           0.102      1.420      1.444      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    1.444     1.444     0.000     0.000"
" 54          POND DESIGN"
"         1.444   Current peak flow    c.m/sec"
"         0.708   Target outflow    c.m/sec"
"        2236.3   Hydrograph volume    c.m"
"           4.   Number of stages"
"       399.000   Minimum water level    metre"
"       402.190   Maximum water level    metre"
"       399.000   Starting water level    metre"
"             0   Keep Design Data: 1 = True; 0 = False"
"                   Level Discharge    Volume"
"                 399.000     0.000     0.000"
"                 399.300   0.04841  1.01E-05"
"                 401.000    0.4512  1088.490"
"                 402.190    0.5999  1088.490"
"             1.   OUTFLOW PIPE"
"                 Upstream Downstr'm      Pipe      Pipe   Manning     Entry"
"                   invert    invert    Length  Diameter       'n'   loss Ke"
"                 399.000   398.800    20.000     0.450     0.013     0.500"
"             Peak outflow                  0.435    c.m/sec"
"             Maximum level               400.937    metre"
"             Maximum storage            1047.949    c.m"
"             Centroidal lag                2.031   hours"
"                  1.444     1.444     0.435     0.000 c.m/sec"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                To W.R.7"
"             Maximum flow                  0.435    c.m/sec"
"             Hydrograph volume          2236.649    c.m"
"                    1.444     1.444     0.435     0.435"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    1.444     0.000     0.435     0.435"
" 33          CATCHMENT 202"
"            1   Triangular SCS"
```

```
"            1   Equal length"
"            1   SCS method"
"          202   Uncontrolled Area to W.R.7 (Southeast)"
"       68.000   % Impervious"
"        0.240   Total Area"
"        5.000   Flow length"
"        2.000   Overland Slope"
"        0.077   Pervious Area"
"        5.000   Pervious length"
"        2.000   Pervious slope"
"        0.163   Impervious Area"
"        5.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.429   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.845   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.104     0.000     0.435     0.435 c.m/sec"
"             Catchment 202          Pervious   Impervious Total Area "
"             Surface Area           0.077      0.163      0.240      hectare"
"             Time of concentration  4.027      0.537      1.210      minutes"
"             Time to Centroid       97.990     84.967     87.478     minutes"
"             Rainfall depth         87.263     87.263     87.263     mm"
"             Rainfall volume        67.02      142.41     209.43     c.m"
"             Rainfall losses        49.842     13.522     25.145     mm"
"             Runoff depth           37.422     73.741     62.119     mm"
"             Runoff volume          28.74      120.35     149.09     c.m"
"             Runoff coefficient     0.429      0.845      0.712      "
"             Maximum flow           0.019      0.092      0.104      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.104     0.104     0.435     0.435"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.104     0.104     0.104     0.435"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                To W.R.7"
"             Maximum flow                  0.465    c.m/sec"
"             Hydrograph volume          2385.735    c.m"
"                     0.104     0.104     0.104     0.465"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
```

```
"                    0.104     0.000     0.104     0.465"
" 33          CATCHMENT 203"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          203   Uncontrolled to W.R.7 (Northeast)"
"       53.100   % Impervious"
"        0.124   Total Area"
"        5.000   Flow length"
"        2.000   Overland Slope"
"        0.058   Pervious Area"
"        5.000   Pervious length"
"        2.000   Pervious slope"
"        0.066   Impervious Area"
"        5.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.429   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.845   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                    0.047     0.000     0.104     0.465 c.m/sec"
"             Catchment 203          Pervious   Impervious Total Area "
"             Surface Area           0.058      0.066      0.124      hectare"
"             Time of concentration  4.027      0.537      1.617      minutes"
"             Time to Centroid       97.990     84.967     88.998     minutes"
"             Rainfall depth         87.263     87.263     87.263     mm"
"             Rainfall volume        50.75      57.46      108.21     c.m"
"             Rainfall losses        49.841     13.522     30.556     mm"
"             Runoff depth           37.422     73.741     56.707     mm"
"             Runoff volume          21.76      48.55      70.32      c.m"
"             Runoff coefficient     0.429      0.845      0.650      "
"             Maximum flow           0.015      0.037      0.047      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.047     0.047     0.104     0.465"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.047     0.047     0.047     0.465"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                To W.R.7"
"             Maximum flow                 0.481    c.m/sec"
"             Hydrograph volume         2456.046    c.m"
```

```
"                    0.047     0.047     0.047     0.481"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.047     0.000     0.047     0.481"
" 33          CATCHMENT 204"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          204   Uncontrolled to Wetland A (Southwest)"
"       48.800   % Impervious"
"        0.763   Total Area"
"       20.000   Flow length"
"        3.000   Overland Slope"
"        0.391   Pervious Area"
"       20.000   Pervious length"
"        3.000   Pervious slope"
"        0.372   Impervious Area"
"       20.000   Impervious length"
"        3.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.434   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.913   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                    0.237     0.000     0.047     0.481 c.m/sec"
"             Catchment 204          Pervious   Impervious Total Area "
"             Surface Area           0.391      0.372      0.763      hectare"
"             Time of concentration  8.191      1.093      3.454      minutes"
"             Time to Centroid       103.148    85.426     91.321     minutes"
"             Rainfall depth         87.263     87.263     87.263     mm"
"             Rainfall volume        340.90     324.92     665.82     c.m"
"             Rainfall losses        49.403     7.569      28.988     mm"
"             Runoff depth           37.860     79.694     58.275     mm"
"             Runoff volume          147.90     296.74     444.64     c.m"
"             Runoff coefficient     0.434      0.913      0.668      "
"             Maximum flow           0.083      0.215      0.237      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.237     0.237     0.047     0.481"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.237     0.237     0.237     0.481"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
```

```
"               Total Site Area"
"             Maximum flow                  0.237    c.m/sec"
"             Hydrograph volume           444.640    c.m"
"                     0.237     0.237     0.237     0.237"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.237     0.000     0.237     0.237"
" 33          CATCHMENT 205"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          205   Uncontrolled Area to Wetland B (Northwest)"
"       38.500   % Impervious"
"        0.260   Total Area"
"       20.000   Flow length"
"        3.000   Overland Slope"
"        0.160   Pervious Area"
"       20.000   Pervious length"
"        3.000   Pervious slope"
"        0.100   Impervious Area"
"       20.000   Impervious length"
"        3.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.434   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.913   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.073     0.000     0.237     0.237 c.m/sec"
"             Catchment 205          Pervious   Impervious Total Area "
"             Surface Area           0.160      0.100      0.260      hectare"
"             Time of concentration  8.191      1.093      4.156      minutes"
"             Time to Centroid       103.148    85.426     93.072     minutes"
"             Rainfall depth         87.263     87.263     87.263     mm"
"             Rainfall volume        139.53     87.35      226.88     c.m"
"             Rainfall losses        49.403     7.569      33.297     mm"
"             Runoff depth           37.860     79.694     53.966     mm"
"             Runoff volume          60.54      79.77      140.31     c.m"
"             Runoff coefficient     0.434      0.913      0.618      "
"             Maximum flow           0.034      0.058      0.073      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.073     0.073     0.237     0.237"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.073     0.073     0.073     0.237"
```

```
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                Total Site Area"
"             Maximum flow                  0.304    c.m/sec"
"             Hydrograph volume           584.953    c.m"
"                     0.073     0.073     0.073     0.304"
" 40          HYDROGRAPH   Confluence    1"
"            7   Confluence "
"            1   Node #"
"                To W.R.7"
"             Maximum flow                  0.481    c.m/sec"
"             Hydrograph volume          2456.046    c.m"
"                     0.073     0.481     0.073     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.073     0.481     0.481     0.000"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                Total Site Area"
"             Maximum flow                  0.749    c.m/sec"
"             Hydrograph volume          3041.003    c.m"
"                     0.073     0.481     0.481     0.749"
" 38          START/RE-START TOTALS 1"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                     4.458    hectare"
"             Total Impervious area                    3.204    hectare"
"             Total % impervious                      71.879"
" 19          EXIT"
```

Appendix H

Stormceptor Sizing Output

Stormceptor®

Rinker MATERIALS™

Stormceptor® EF Sizing Report

Imbrium® Systems
ESTIMATED NET ANNUAL SEDIMENT (TSS) LOAD REDUCTION

08/04/2023

Province:	Ontario
City:	Elora
Nearest Rainfall Station:	WATERLOO WELLINGTON AP
Climate Station Id:	6149387
Years of Rainfall Data:	34

Site Name:	Catchment 201

Drainage Area (ha):	3.071
% Imperviousness:	81.50

Runoff Coefficient 'c': 0.78

Particle Size Distribution:	Fine
Target TSS Removal (%):	80.0

Required Water Quality Runoff Volume Capture (%):	90.00
Estimated Water Quality Flow Rate (L/s):	91.80
Oil / Fuel Spill Risk Site?	Yes
Upstream Flow Control?	No
Peak Conveyance (maximum) Flow Rate (L/s):	
Influent TSS Concentration (mg/L):	
Estimated Average Annual Sediment Volume (L/yr):	2391

Project Name:	350 Wellington Road 7
Project Number:	51060-100
Designer Name:	Tyler Arndt
Designer Company:	MTE Consultants
Designer Email:	tarndt@mte85.com
Designer Phone:	519-743-6500
EOR Name:	
EOR Company:	
EOR Email:	
EOR Phone:	

Net Annual Sediment (TSS) Load Reduction Sizing Summary

Stormceptor Model	TSS Removal Provided (%)
EFO4	52
EFO6	68
EFO8	78
EFO10	84
EFO12	88

Recommended Stormceptor EFO Model: EFO10

Estimated Net Annual Sediment (TSS) Load Reduction (%): 84

Water Quality Runoff Volume Capture (%): > 90

imbrium

THIRD-PARTY TESTING AND VERIFICATION

►**Stormceptor® EF and Stormceptor® EFO** are the latest evolutions in the Stormceptor® oil-grit separator (OGS) technology series, and are designed to remove a wide variety of pollutants from stormwater and snowmelt runoff. These technologies have been third-party tested in accordance with the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators** and performance has been third-party verified in accordance with the **ISO 14034 Environmental Technology Verification (ETV)** protocol.

PERFORMANCE

►**Stormceptor® EF and EFO** remove stormwater pollutants through gravity separation and floatation, and feature a patent-pending design that generates positive removal of total suspended solids (TSS) throughout each storm event, including high-intensity storms. Captured pollutants include sediment, free oils, and sediment-bound pollutants such as nutrients, heavy metals, and petroleum hydrocarbons. Stormceptor is sized to remove a high level of TSS from the frequent rainfall events that contribute the vast majority of annual runoff volume and pollutant load. The technology incorporates an internal bypass to convey excessive stormwater flows from high-intensity storms through the device without resuspension and washout (scour) of previously captured pollutants. Proper routine maintenance ensures high pollutant removal performance and protection of downstream waterwavs.

PARTICLE SIZE DISTRIBUTION (PSD)

►The **Canadian ETV PSD** shown in the table below was used, or in part, for this sizing. This is the identical PSD that is referenced in the Canadian ETV ***Procedure for Laboratory Testing of Oil-Grit Separators*** for both sediment removal testing and scour testing. The Canadian ETV PSD contains a wide range of particle sizes in the sand and silt fractions, and is considered reasonably representative of the particle size fractions found in typical urban stormwater runoff.

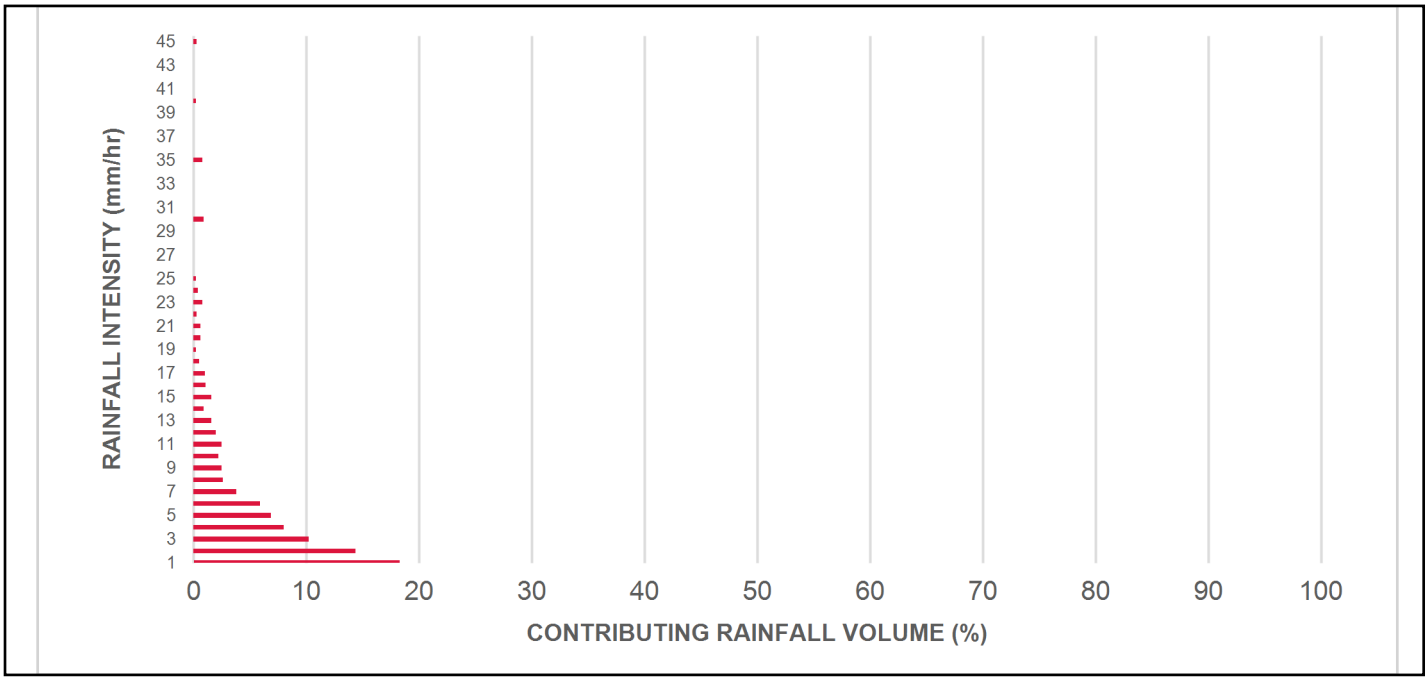
Particle Size (µm)	Percent Less Than	Particle Size Fraction (µm)	Percent
1000	100	500-1000	5
500	95	250-500	5
250	90	150-250	15
150	75	100-150	15
100	60	75-100	10
75	50	50-75	5
50	45	20-50	10
20	35	8-20	15
8	20	5-8	10
5	10	2-5	5
2	5	<2	5

Stormceptor® EF Sizing Report

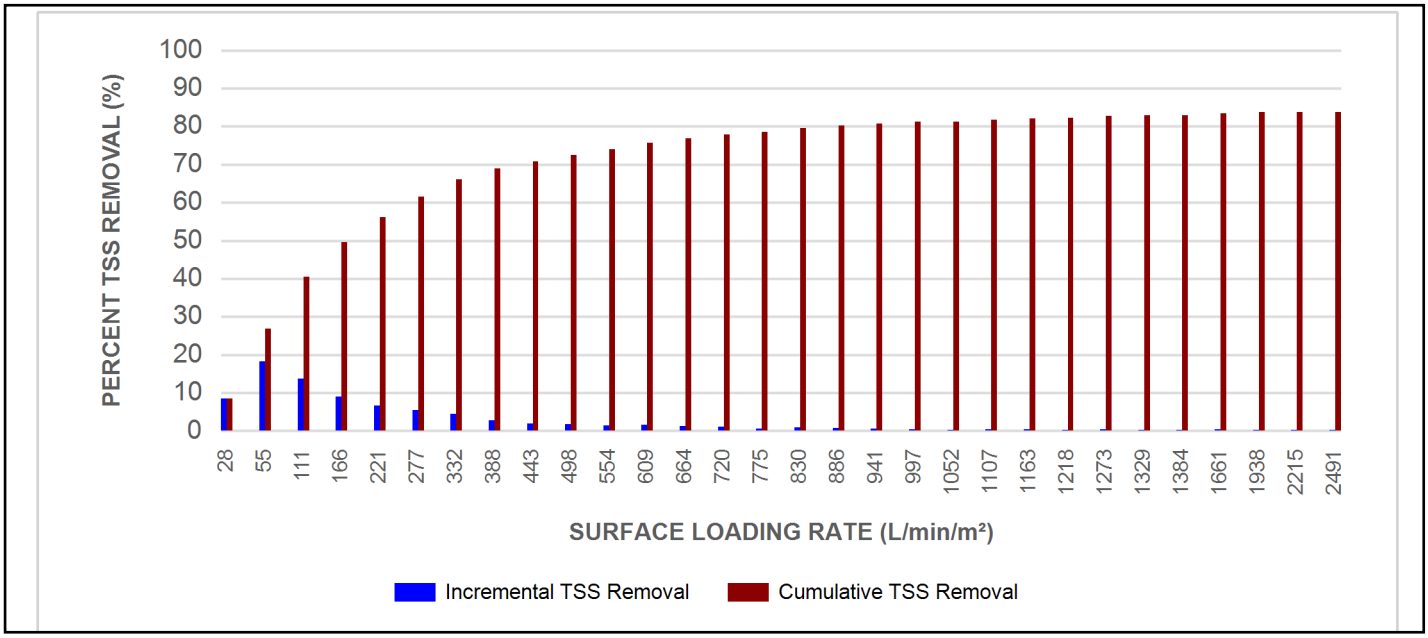
Rainfall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
0.50	8.5	8.5	3.37	202.0	28.0	100	8.5	8.5
1.00	18.3	26.8	6.74	404.0	55.0	100	18.3	26.8
2.00	14.4	41.3	13.47	808.0	111.0	95	13.7	40.5
3.00	10.2	51.5	20.21	1212.0	166.0	88	9.0	49.5
4.00	8.0	59.5	26.94	1617.0	221.0	82	6.6	56.1
5.00	6.9	66.4	33.68	2021.0	277.0	80	5.5	61.6
6.00	5.9	72.3	40.42	2425.0	332.0	77	4.5	66.1
7.00	3.8	76.1	47.15	2829.0	388.0	75	2.8	69.0
8.00	2.6	78.7	53.89	3233.0	443.0	72	1.9	70.8
9.00	2.5	81.1	60.62	3637.0	498.0	70	1.7	72.5
10.00	2.2	83.3	67.36	4042.0	554.0	67	1.5	74.0
11.00	2.5	85.8	74.10	4446.0	609.0	65	1.6	75.6
12.00	2.0	87.8	80.83	4850.0	664.0	64	1.3	76.9
13.00	1.6	89.4	87.57	5254.0	720.0	64	1.0	77.9
14.00	0.9	90.4	94.30	5658.0	775.0	63	0.6	78.5
15.00	1.6	91.9	101.04	6062.0	830.0	63	1.0	79.5
16.00	1.1	93.0	107.78	6467.0	886.0	62	0.7	80.2
17.00	1.0	94.0	114.51	6871.0	941.0	62	0.6	80.8
18.00	0.5	94.6	121.25	7275.0	997.0	62	0.3	81.2
19.00	0.2	94.8	127.98	7679.0	1052.0	60	0.1	81.3
20.00	0.6	95.4	134.72	8083.0	1107.0	59	0.4	81.7
21.00	0.6	96.1	141.46	8487.0	1163.0	58	0.4	82.0
22.00	0.3	96.4	148.19	8892.0	1218.0	57	0.2	82.2
23.00	0.8	97.2	154.93	9296.0	1273.0	55	0.5	82.7
24.00	0.4	97.6	161.66	9700.0	1329.0	54	0.2	82.9
25.00	0.2	97.8	168.40	10104.0	1384.0	53	0.1	83.0
30.00	0.9	98.7	202.08	12125.0	1661.0	44	0.4	83.4
35.00	0.8	99.5	235.76	14146.0	1938.0	38	0.3	83.7
40.00	0.2	99.7	269.44	16166.0	2215.0	33	0.1	83.8
45.00	0.3	100.0	303.12	18187.0	2491.0	29	0.1	83.8
Estimated Net Annual Sediment (TSS) Load Reduction =								**84 %**

Climate Station ID: 6149387 *Years of Rainfall Data*: 34

RAINFALL DATA FROM WATERLOO WELLINGTON AP RAINFALL STATION



INCREMENTAL AND CUMULATIVE TSS REMOVAL FOR THE RECOMMENDED STORMCEPTOR® MODEL



Maximum Pipe Diameter / Peak Conveyance

Stormceptor EF / EFO	Model Diameter		Min Angle Inlet / Outlet Pipes	Max Inlet Pipe Diameter		Max Outlet Pipe Diameter		Peak Conveyance Flow Rate	
	(m)	(ft)		(mm)	(in)	(mm)	(in)	(L/s)	(cfs)
EF4 / EFO4	1.2	4	90	609	24	609	24	425	15
EF6 / EFO6	1.8	6	90	914	36	914	36	990	35
EF8 / EFO8	2.4	8	90	1219	48	1219	48	1700	60
EF10 / EFO10	3.0	10	90	1828	72	1828	72	2830	100
EF12 / EFO12	3.6	12	90	1828	72	1828	72	2830	100

SCOUR PREVENTION AND ONLINE CONFIGURATION

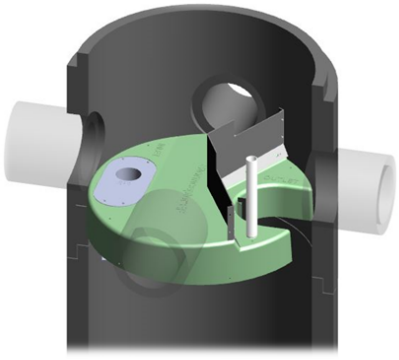
►**Stormceptor® EF and EFO** feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**, and the exceptional scour test performance has been third-party verified in accordance with the ISO 14034 ETV protocol. As a result, Stormceptor EF and EFO are approved for online installation, eliminating the need for costly additional bypass structures, piping, and installation expense.

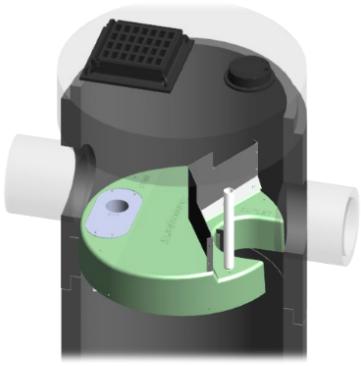
DESIGN FLEXIBILITY

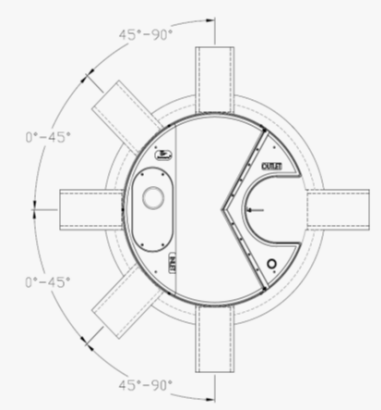
►**Stormceptor® EF** and **EFO** offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend angle, and can be modified to ensure performance in submerged conditions.

OIL CAPTURE AND RETENTION

►While Stormceptor® EF will capture and retain oil from dry weather spills and low intensity runoff, **Stormceptor® EFO** has demonstrated superior oil capture and greater than 99% oil retention in third-party testing according to the light liquid re-entrainment testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**. Stormceptor EFO is recommended for sites where oil capture and retention is a requirement.







INLET-TO-OUTLET DROP

Elevation differential between inlet and outlet pipe inverts is dictated by the angle at which the inlet pipe(s) enters the unit.
0° - 45° : The inlet pipe is 1-inch (25mm) higher than the outlet pipe.
45° - 90° : The inlet pipe is 2-inches (50mm) higher than the outlet pipe.

HEAD LOSS

The head loss through Stormceptor EF is similar to that of a 60-degree bend structure. The applicable K value for calculating minor losses through the unit is 1.1. For submerged conditions the applicable K value is 3.0.

Pollutant Capacity

Stormceptor EF / EFO	Model Diameter		Depth (Outlet Pipe Invert to Sump Floor)		Oil Volume		Recommended Sediment Maintenance Depth *		Maximum Sediment Volume *		Maximum Sediment Mass **	
	(m)	(ft)	(m)	(ft)	(L)	(Gal)	(mm)	(in)	(L)	(ft^3)	(kg)	(lb)
EF4 / EFO4	1.2	4	1.52	5.0	265	70	203	8	1190	42	1904	5250
EF6 / EFO6	1.8	6	1.93	6.3	610	160	305	12	3470	123	5552	15375
EF8 / EFO8	2.4	8	2.59	8.5	1070	280	610	24	8780	310	14048	38750
EF10 / EFO10	3.0	10	3.25	10.7	1670	440	610	24	17790	628	28464	78500
EF12 / EFO12	3.6	12	3.89	12.8	2475	655	610	24	31220	1103	49952	137875

*Increased sump depth may be added to increase sediment storage capacity
** Average density of wet packed sediment in sump = 1.6 kg/L (100 lb/ft^3)

Feature	Benefit	Feature Appeals To
Patent-pending enhanced flow treatment and scour prevention technology	Superior, verified third-party performance	Regulator, Specifying & Design Engineer
Third-party verified light liquid capture and retention for EFO version	Proven performance for fuel/oil hotspot locations	Regulator, Specifying & Design Engineer, Site Owner
Functions as bend, junction or inlet structure	Design flexibility	Specifying & Design Engineer
Minimal drop between inlet and outlet	Site installation ease	Contractor
Large diameter outlet riser for inspection and maintenance	Easy maintenance access from grade	Maintenance Contractor & Site Owner

STANDARD STORMCEPTOR EF/EFO DRAWINGS

For standard details, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

STANDARD STORMCEPTOR EF/EFO SPECIFICATION

For specifications, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

STANDARD PERFORMANCE SPECIFICATION FOR "OIL GRIT SEPARATOR" (OGS) STORMWATER QUALITY TREATMENT DEVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

This section specifies requirements for selecting, sizing, and designing an underground Oil Grit Separator (OGS) device for stormwater quality treatment, with third-party testing results and a Statement of Verification in accordance with ISO 14034 Environmental Management – Environmental Technology Verification (ETV).

1.2 REFERENCE STANDARDS & PROCEDURES

ISO 14034:2016 Environmental management – Environmental technology verification (ETV)

Canadian Environmental Technology Verification (ETV) Program's **Procedure for Laboratory Testing of Oil-Grit** S**eparators**

1.3 SUBMITTALS

1.3.1 All submittals, including sizing reports & shop drawings, shall be submitted upon request with each order to the contractor then forwarded to the Engineer of Record for review and acceptance. Shop drawings shall detail all OGS components, elevations, and sequence of construction.

1.3.2 Alternative devices shall have features identical to or greater than the specified device, including: treatment chamber diameter, treatment chamber wet volume, sediment storage volume, and oil storage volume.

1.3.3 Unless directed otherwise by the Engineer of Record, OGS stormwater quality treatment product substitutions or alternatives submitted within ten days prior to project bid shall not be accepted. All alternatives or substitutions submitted shall be signed and sealed by a local registered Professional Engineer, based on the exact same criteria detailed in Section 3, in entirety, subject to review and approval by the Engineer of Record.

PART 2 – PRODUCTS

2.1 OGS POLLUTANT STORAGE

The OGS device shall include a sump for sediment storage, and a protected volume for the capture and storage of petroleum hydrocarbons and buoyant gross pollutants. The minimum sediment & petroleum hydrocarbon storage capacity shall be as follows:

2.1.1	4 ft (1219 mm) Diameter OGS Units:	1.19 m^3 sediment / 265 L oil
	6 ft (1829 mm) Diameter OGS Units:	3.48 m^3 sediment / 609 L oil
	8 ft (2438 mm) Diameter OGS Units:	8.78 m^3 sediment / 1,071 L oil
	10 ft (3048 mm) Diameter OGS Units:	17.78 m^3 sediment / 1,673 L oil
	12 ft (3657 mm) Diameter OGS Units:	31.23 m^3 sediment / 2,476 L oil

PART 3 – PERFORMANCE & DESIGN

3.1 GENERAL

The OGS stormwater quality treatment device shall be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV). The OGS stormwater quality treatment device shall

remove oil, sediment and gross pollutants from stormwater runoff during frequent wet weather events, and retain these pollutants during less frequent high flow wet weather events below the insert within the OGS for later removal during maintenance. The Manufacturer shall have at least ten (10) years of local experience, history and success in engineering design, manufacturing and production and supply of OGS stormwater quality treatment device systems, acceptable to the Engineer of Record.

3.2 SIZING METHODOLOGY

The OGS device shall be engineered, designed and sized to provide stormwater quality treatment based on treating a minimum of 90 percent of the average annual runoff volume and a minimum removal of an annual average 60% of the sediment (TSS) load based on the Particle Size Distribution (PSD) specified in the sizing report for the specified device. Sizing of the OGS shall be determined by use of a minimum ten (10) years of local historical rainfall data provided by Environment Canada. Sizing shall also be determined by use of the sediment removal performance data derived from the ISO 14034 ETV third-party verified laboratory testing data from testing conducted in accordance with the Canadian ETV protocol Procedure for Laboratory Testing of Oil-Grit Separators, as follows:

3.2.1 Sediment removal efficiency for a given surface loading rate and its associated flow rate shall be based on sediment removal efficiency demonstrated at the seven (7) tested surface loading rates specified in the protocol, ranging 40 L/min/m^2 to 1400 L/min/m^2, and as stated in the ISO 14034 ETV Verification Statement for the OGS device.

3.2.2 Sediment removal efficiency for surface loading rates between 40 L/min/m^2 and 1400 L/min/m^2 shall be based on linear interpolation of data between consecutive tested surface loading rates.

3.2.3 Sediment removal efficiency for surface loading rates less than the lowest tested surface loading rate of 40 L/min/m^2 shall be assumed to be identical to the sediment removal efficiency at 40 L/min/m^2. No extrapolation shall be allowed that results in a sediment removal efficiency that is greater than that demonstrated at 40 L/min/m^2.

3.2.4 Sediment removal efficiency for surface loading rates greater than the highest tested surface loading rate of 1400 L/min/m^2 shall assume zero sediment removal for the portion of flow that exceeds 1400 L/min/m^2, and shall be calculated using a simple proportioning formula, with 1400 L/min/m^2 in the numerator and the higher surface loading rate in the denominator, and multiplying the resulting fraction times the sediment removal efficiency at 1400 L/min/m^2.

The OGS device shall also have sufficient annual sediment storage capacity as specified and calculated in Section 2.1.

3.3 CANADIAN ETV or ISO 14034 ETV VERIFICATION OF SCOUR TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of third-party scour testing conducted in accordance with the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.**

3.3.1 To be acceptable for on-line installation, the OGS device must demonstrate an average scour test effluent concentration less than 10 mg/L at each surface loading rate tested, up to and including 2600 L/min/m^2.

3.4 LIGHT LIQUID RE-ENTRAINMENT SIMULATION TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of completed third-party Light Liquid Re-entrainment Simulation Testing in accordance with the Canadian ETV **Program's Procedure for Laboratory Testing of Oil-Grit Separators,** with results reported within the Canadian ETV or ISO 14034 ETV verification. This re-entrainment testing is conducted with the device pre-loaded with low density polyethylene (LDPE) plastic beads as a surrogate for light liquids such as oil and fuel. Testing is conducted on the same OGS unit tested for sediment removal to

assess whether light liquids captured after a spill are effectively retained at high flow rates.

3.4.1 For an OGS device to be an acceptable stormwater treatment device on a site where vehicular traffic occurs and the potential for an oil or fuel spill exists, the OGS device must have reported verified performance results of greater than 99% cumulative retention of LDPE plastic beads for the five specified surface loading rates (ranging 200 L/min/m^2 to 2600 L/min/m^2) in accordance with the Light Liquid Re-entrainment Simulation Testing within the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.** However, an OGS device shall not be allowed if the Light Liquid Re-entrainment Simulation Testing was performed with screening components within the OGS device that are effective at retaining the LDPE plastic beads, but would not be expected to retain light liquids such as oil and fuel.