961 St. David Street North

Functional Servicing and Stormwater Management Report

Project Location:
961 St. David Street North, Fergus, ON

Prepared for:
2687734 Ontario Inc.
766 Hespeler Road
Cambridge, ON N3H 5L8

Prepared by:
MTE Consultants Inc.
520 Bingemans Centre Drive
Kitchener, ON N2B 3X9

July 15, 2022
Revised: November 10, 2023

MTE File No.: 48650-100

Engineers, Scientists, Surveyors.

Contents

Figures

Tables

Appendices

Drawings

1.0 INTRODUCTION

MTE Consultants Inc. was retained by 2687734 Ontario Inc. to complete a Functional Servicing and Stormwater Management (FSSWM) Report in support of the Zoning By-Law Amendment and Vacant Lot Condominium applications for the proposed residential development to be constructed at 961 St. David Street North/Highway 6 (herein referred to as 'the Site') in the Township of Centre Wellington.

The purpose of this study is to support the Zoning By-Law Amendment and Vacant Land Condominium 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. Pending approval of the applications, detailed design of the Site will commence and be submitted to the Township of Centre Wellington and other governing agencies in support of the applications and Site Plan Approval.

1.1 Site Description

The Site encompasses an area of 1.402ha, and is currently comprised of a single detached dwelling, several accessory buildings, and an asphalt driveway off 961 St. David Street North/Highway 6. The property is bounded to the west, south, and east by existing residential development, and to the northeast by St. David Street North/Highway 6. For the exact location of the Site refer to Figure 1.0.

The current zoning of the Site is Residential R1a Zone. A Zoning By-Law Amendment will be required to re-zone the Site to Residential R3 Zone to permit the proposed Vacant Land Condominium development.

1.2 Proposed Development

The proposed development for the Site is a Vacant Land Condominium, consisting of 12 single-detached houses, and 37 townhouse units, complete with a common element roadway and driveway entrance off St. David Street North/Highway 6.

MTE
Engineers, Scientists, Surveyors

PROJECT
961 ST.DAVID STREET NORTH

TITLE
LOCATION PLAN

Drawn: JMH	Scale: 1:1,500	Figure: **1.0**
Checked: NGK	Project No.: 48650-100	
Date: 2023-09-18	Rev No.: 0	

CAD: P:\P\48650\100\48650-100-F1.DWG

Plot Date: November 1, 2023 - 5:16 PM

2.0 EXISTING CONDITIONS

2.1 Topography

Existing topographic information for the Site was obtained from a detailed survey completed by MTE in February 2021. The Site's frontage along St. David Street North/Highway 6 has an approximate slope of 2% from west to east. There is an existing ditch along the south side of the highway along the Site's frontage, with an approximate slope of 1% from west to east. The road elevation is approximately 0.8m to 1.0m above the property line elevation along the Site's frontage. The northeast end of the Site is sloped towards St. David Street North/Highway 6, with high point elevations of 424.5mASL around the existing buildings, and a low point elevation of approximately 422.4mASL at the northeast corner of the Site. The southwest portion of the Site is sloped towards the southwest property line, with a high point elevation of 424.5mASL near the approximate center of the property, and a low point elevation of 422.6mASL along the southwest property line.

2.2 Existing Servicing

Existing servicing information within the surrounding right-of-way was obtained from the topographic survey, from plan and profile information provided by the Township of Centre Wellington, and from MTE plan and profile drawings.

2.2.1 Water

There is currently an existing 300mm diameter watermain on the far (north) side of St. David Street North/Highway 6. There is an existing 150mm diameter water service from this watermain that is extended underneath St. David Street North/Highway 6 to the property line near the northern corner of the Site.

There are two existing municipal fire hydrants located on the north side of St. David Street North/Highway 6 near the Site. One is located approximately 94m to the north of the existing driveway entrance, and one is located approximately 69m to the south of the existing driveway entrance. A flow test was performed at the aforementioned hydrants by Classic Fire and Life Safety on June 21, 2022. Refer to Table 2.1 below for a summary of the flow test results.

Table 2.1 – Results of Flow Tests

Results of Flow Tests Completed June 21, 2022 by Classic Fire & Life Safety					
Test #	**Outlet Inside Diameter (in.)**	**Number of Outlets**	**Pitot Pressure (PSI)**	**Residual Pressure (PSI)**	**Flow @ Residual (gal/min)**
1	n/a	n/a	n/a	46	0
2	2.5	1	20	40	751
3	2.5	2	12 + 14	38	1,209

Refer to Appendix A for further details.

2.2.2 Sanitary

There is an existing 300mm diameter municipal sanitary sewer along the far (north) side of St. David Street North/Highway 6 which drains southeast, at a depth of approximately 5.7m to 6.6m below the centreline elevation of the road. There is an existing 150mm diameter sanitary service from the Site to the 300mm diameter sewer, extended to an existing manhole near the northern corner of the Site. The depth of the 150mm diameter service at the manhole is approximately 4.8m.

2.2.3 Storm

There is an existing 500mm diameter Corrugated Metal Pipe (CMP) culvert underneath the existing driveway entrance, draining southeast in the ditch along the Site's frontage with St. David Street North/Highway 6. The culvert obvert is at a depth of approximately 1m below the existing grade of the driveway.

2.3 Existing Soils Information

A Geotechnical Investigation was completed for the Site by MTE in June 2023. Four boreholes were advanced to depths between 5.0 and 6.7m below grade. The investigation revealed the subsurface soil conditions as being generally comprised of surficial topsoil underlain by native silt and sand deposits.

Monitoring wells were installed in three of the boreholes to facilitate monitoring and measurement of groundwater elevations. Groundwater elevations measured in August 2023 were found to be between 1.7m-2.7mm below grade, at elevations of 421.2 to 421.8 meters above sea level (masl). Ongoing monitoring of the groundwater levels is being completed as part of a Hydrogeological Investigation for the Site, also being completed by MTE.

The complete Geotechnical Investigation and Hydrogeological Investigations are included in the resubmission package under separate cover.

The Tile Drainage layer on OMAFRA Ag-Maps GIS mapping indicates that systematic tile drainage may be present on the southwestern half of the Site.

2.4 Reviewing Agencies

2.4.1 Township of Centre Wellington

Functional grading, servicing and stormwater management designs as well as this Functional Servicing and Stormwater Management Report will be required for submission to the Township of Centre Wellington in support of the Zoning By-Law Amendment and Vacant Land Condominium applications. The Township will also be responsible for the review and approval of site plans, site grading, servicing, stormwater management, lighting and landscape design and ultimately issuing building permits.

2.4.2 Ministry of Transportation

St. David Street North is a part of Highway 6, a provincially maintained highway. As such, the Ministry of Transportation (MTO) will be circulated on the Zoning By-Law Amendment and Site Plan Applications and will need to approve the site grading, servicing and stormwater management designs. An entrance permit will need to be obtained from the MTO for the new entrance off St. David Street North/Highway 6.

2.4.3 Grand River Conservation Authority

The Site also falls within the area regulated by the Grand River Conservation Authority (GRCA). As such, the site engineering design will also be submitted to the GRCA for review and approval.

3.0 PROPOSED GRADING AND SERVICING STRATEGY

Preliminary grading and servicing strategies have been developed based on the topographic survey, plan and profile information, and the Concept Plan provided by MHBC, dated October 2, 2023. Refer to the enclosed MTE Drawings C2.1 and C2.2 for details. These grading and servicing strategies will be further refined during detailed design during the Site Plan Approval process.

3.1 Proposed Grading

The proposed vacant land condominium development consists of 12 single-detached houses and 37 townhouse units, complete with a common element roadway and driveway entrance from St. David Street North/Highway 6. The proposed grading strategy will respect the existing grades along St. David Street North/Highway 6, and all other property boundaries. The majority of the grading internal to the Site will involve directing stormwater runoff to the existing ditch along the south side of St. David Street North/Highway 6. Stormwater runoff will be conveyed to the existing ditch via an on-site storm sewer system, and via a rear-yard swale along the southeast property line. For the units along the south end of the Site, runoff from the rear of the units will continue to drain to the southwest property line. Refer to MTE Drawing C2.1 for an illustration of the functional grading design.

3.2 Proposed Servicing

The following sections provide details regarding the preliminary proposed water, sanitary and storm servicing for the proposed development. Refer to MTE Drawing C2.2 for an illustration of the functional servicing design.

3.2.1 Water

The existing 150mm diameter water service currently extended to the northern corner of the Site will service the proposed development. At the property line, the 150mm diameter watermain will be upsized to 250mm diameter, and will be extended in the common element roadway to service each unit. Each unit will be serviced off the proposed watermain with a 25mm diameter domestic water service connection. It is anticipated that two on-site fire hydrants will also be required for the proposed development, as shown on the enclosed MTE Drawing C2.2.

Water Demand

Various guidelines and references exist for calculating the required water supply for firefighting purposes. In Ontario, there are two standards/guidelines that are most often referenced:

- Ontario Building Code (OBC) – provincial codes and guidelines published by the Ministry of Municipal Affairs and Housing for the Province of Ontario; and
- The Fire Underwriters Survey (FUS) – an insurance industry guideline.

Many municipalities in Ontario use both the OBC and the FUS fire flow requirements for assessing firefighting water supply requirements. Ideally, fire flow demands for new developments are calculated based on the FUS criteria; however, it is not always reasonable to expect that the local existing municipal infrastructure has the operational capacity to supply water at the rates prescribed in the FUS guidelines. As a result, at no time shall the available fire flow be less than that required by the Ontario Building Code.

The pressures and flows at the proposed private hydrant must be sufficient for firefighting conditions as established by the Ontario Building Code (2012). The minimum residual pressure permitted under firefighting conditions is 140.0kPa (20.3psi) per OBC 2012 A-3.2.5.7 3(b).

The buildings are proposed to be of wood frame construction (combustible construction). For the purposes of this analysis, the worst-case scenario was determined to be the future townhouse building located on Units 28-32. This building has the largest allowable footprint, and in a firefighting scenario the hydrant furthest from the connection the municipal main will be utilized. The OBC and FUS requirements were calculated for this worst-case scenario for reference and are shown in Table 3.1. Refer to Appendix A for detailed calculations.

Table 3.1 – Required Fire Flow

Building	OBC (L/s)	FUS (L/s)
Proposed Building*	4,500	17,000

- A detailed analysis will need to be completed once the final building design has been completed Additional fire walls may be required once the final plans are developed.

For this design, pressure and flow information for the existing 300mm diameter municipal watermain in the St. David Street North/Highway 6 right-of-way was taken from the hydrant flow testing results as detailed in Section 2.2.1.

The minimum water supply flow rate for the proposed development is 283.0L/s (17,000L/min) based on the calculation method specified in the FUS. The residual pressures at the proposed hydrants are less than the minimum allowable pressure of 140kPa based on the FUS calculation method.

The minimum water supply flow rate for the proposed development is 75.0L/s (4,500L/min) based on the calculation method specified by the OBC. The residual pressure at the proposed hydrant was calculated to be 184kPa at a flow rate of 75.0L/s (4,500L/min), which is greater than the minimum allowable pressure of 140kPa per OBC 2012. Therefore, the proposed watermain configuration is expected to be sufficient. Based on a maximum day domestic demand of 0.44L/s and the fire flow demand of 75.0L/s, the total water demand for the Site is expected to be 75.4L/s.

The fire flow demand calculations completed in this report assume that the proposed buildings will have two above grade stories. Should the buildings increase to a height of 3-storeys as

design progresses, fire walls may be required to meet previously described pressure and flow requirements set forth by the OBC.

3.2.2 Sanitary

A sanitary flow design sheet has been prepared to determine the flows anticipated to be generated by the proposed development. With the 12 units proposed for detached homes and 37 units proposed for townhouses, the resulting peak flow rate from the Site is expected to be 2.42L/s. Refer to Appendix A for the Sanitary Flow Design Sheet.

A 150mm diameter private sanitary sewer will be connected to the existing sanitary manhole near the northern corner of the Site, and will be extended throughout the common element area of the Site, servicing each of the proposed units.

The proposed 150mm diameter sanitary sewer has a minimum design slope of slope of 1.00%, corresponding to a full flow pipe capacity of 15.22L/s. Therefore, the proposed 150mm diameter sanitary sewer has sufficient capacity for this development.

3.2.3 Storm

A private storm sewer system is proposed along the common element roadways within the proposed development. The storm sewer system, which will include several catchbasins, manholes, and catchbasin manholes, will convey runoff from the roadways, driveways, landscaped areas, and several of the building roofs through an oil and grit separator unit (OGS) before discharging to the existing ditch along the south side of St. David Street North/Highway 6. A storm sewer design sheet for the last pipe run from the Site is included in Appendix A. The major overland flow route for the Site will be to the existing ditch along St. David Street North/Highway 6.

Specifications and details of these proposed servicing strategies will be further refined during detailed design.

4.0 PRELIMINARY STORM WATER MANAGEMENT DESIGN

4.1 SWM Criteria

In the existing condition, stormwater runoff from the northeastern end of the Site is directed to the existing ditch along St. David Street North/Highway 6. Stormwater runoff from the southwestern end of the Site is directed to the southwest property line, where it subsequently sheet flows across the adjacent property before reaching a GRCA regulated wetland, and ultimately Municipal Drain No. 1.

The stormwater management design criteria for the Site, as established by the MTO, the GRCA, and the Township of Centre Wellington, are as follows:

i) Attenuation of the post-development peak flows for the 2-, 5-, 10-, 25-, 50-, and 100-year storm events to the pre-development (existing) peak flows;

ii) Implementation of Enhanced (Level 1) water quality controls;

iii) Implementation of Erosion and Sediment Control Measures; and

iv) Provide an infiltration water balance for the entire Site area, and a surface runoff water balance for the portion of the Site draining to the wetland.

4.2 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 allowable runoff rates using MIDUSS NET;

ii) Determine the percent impervious of the Site and catchment parameters for inclusion in MIDUSS NET modelling; and

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

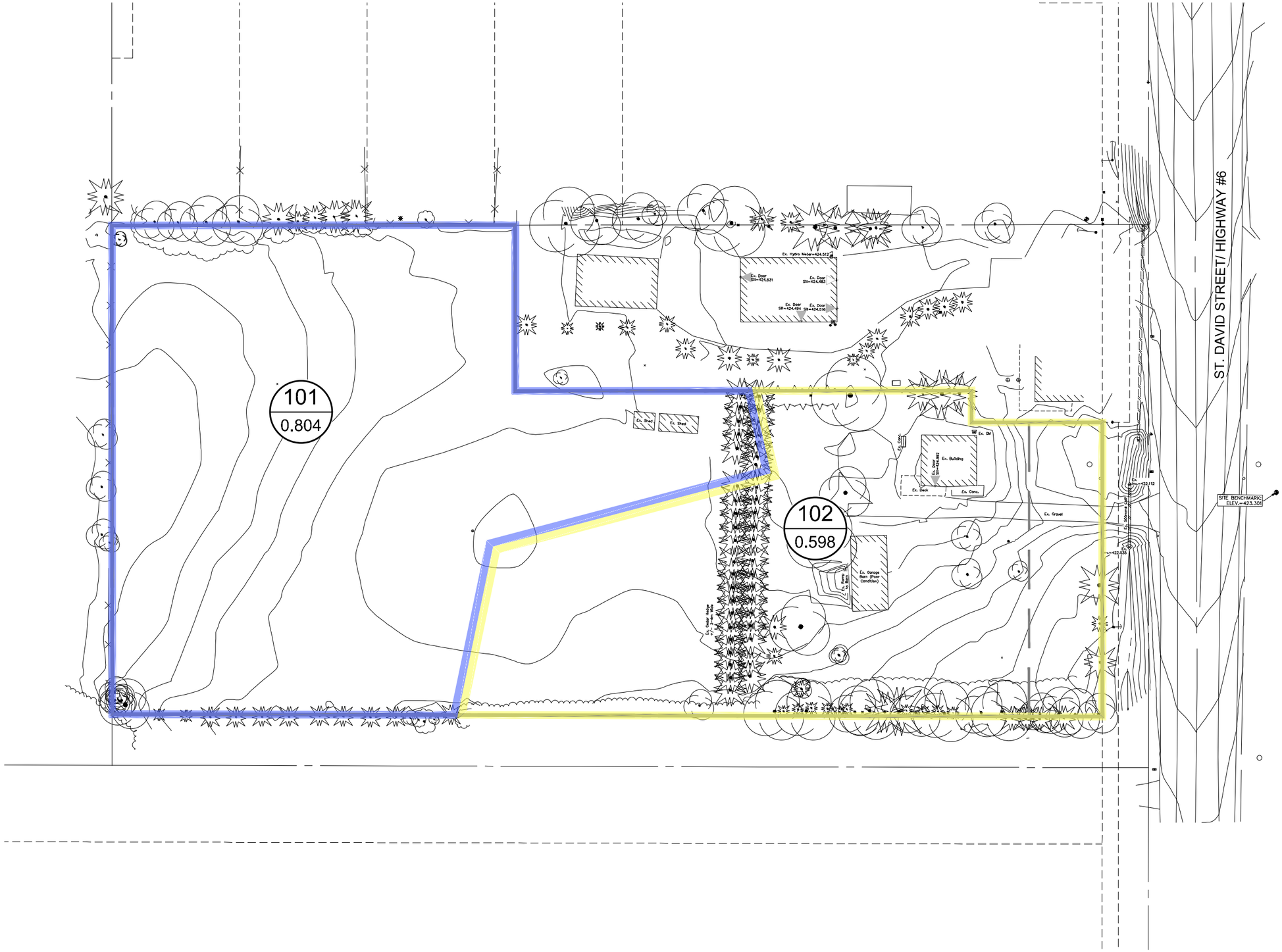
The following table summarizes the catchments used in modelling the Site. The pre-development condition was separated into two catchments areas: the southwestern portion of the Site that drains to the southwest property line and ultimately to the wetland, and the northeastern portion of the Site that drains to St. David Street North/Highway 6. The post-development condition was separated into three catchment areas: the uncontrolled area directed to the southwest property line, the controlled area directed to St. David Street North/Highway 6, and the uncontrolled area directed to St. David Street North/Highway 6. 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	Area to southwest property line, ultimately to wetland	0.804	0%	75	98	2.0	100
102	Area to Highway 6	0.598	9%	75	98	5.0	90
Post-Development Catchment Areas							
201	Uncontrolled Area to Southwest Property Line	0.136	46%	75	98	2.0	15
202	Controlled Area to Highway 6	0.962	70%	75	98	2.0	15
203	Uncontrolled Area to Highway 6	0.304	23%	75	98	2.0	120

As previously described, a geotechnical investigation was completed for the Site by MTE. Based on the underlaying sand and silt soils, a pervious CN of 75 for grassed areas is appropriate.

CAD: P:\P\48650\100\48650-100-F2.DWG



LEGEND

CATCHMENT 101

CATCHMENT 102

101 / 0.804 — SUB-CATCHMENT NUMBER / AREA (ha.)

0 7.5 15 22.5 30m

MTE
Engineers, Scientists, Surveyors

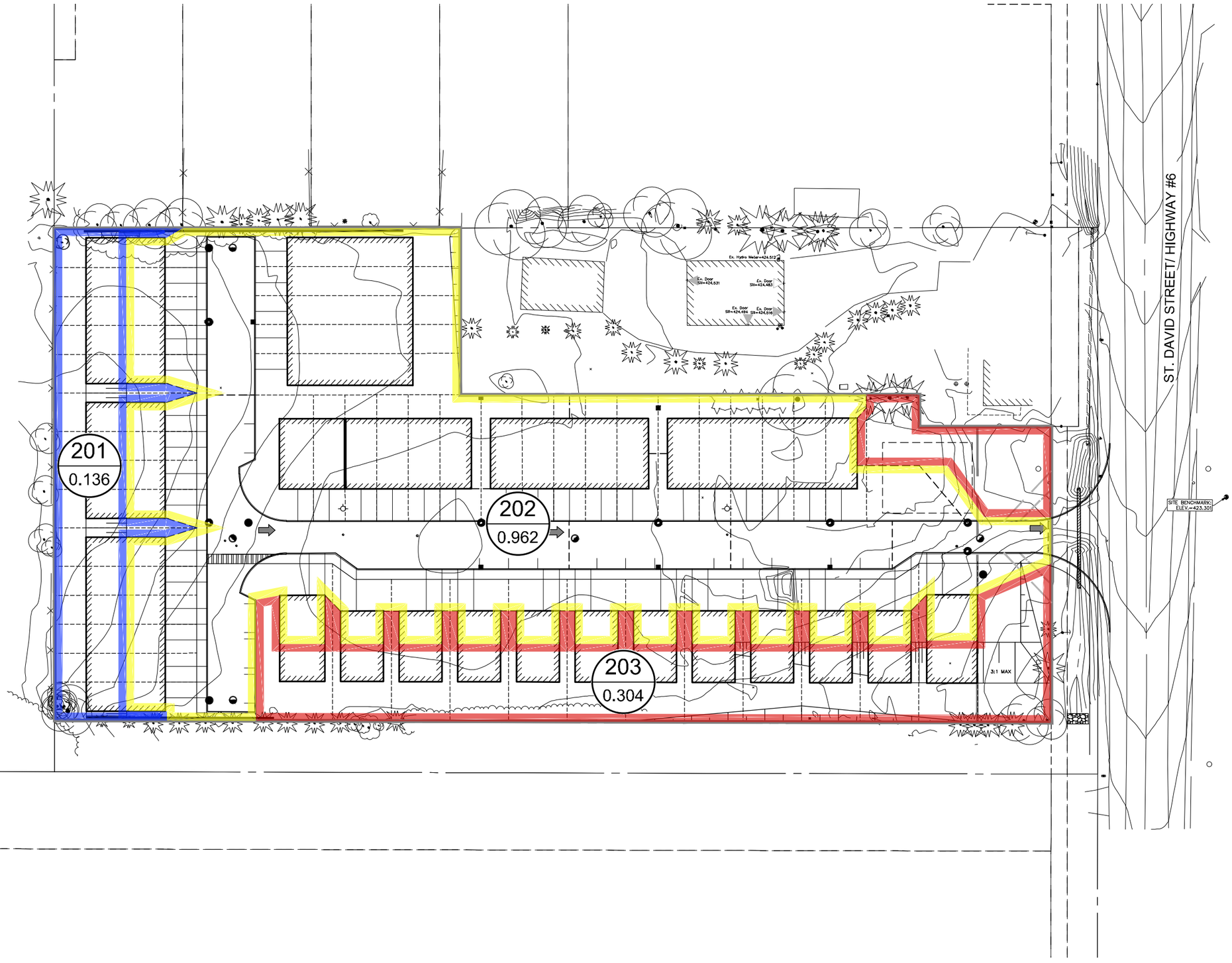
PROJECT
961 ST.DAVID STREET NORTH

TITLE
PRE-DEVELOPMENT CATCHMENT AREAS

Drawn: JMH	Scale: 1:750	Figure: **2.0**
Checked: NGK	Project No.: 48650-100	
Date: 2023-09-18	Rev No.: 0	

Plot Date: November 1, 2023 - 5:14 PM

CAD: P:\P\48650\100\48650-100-F2.DWG



LEGEND

- CATCHMENT 201
- CATCHMENT 202
- CATCHMENT 203

201 / 0.136 — SUB-CATCHMENT NUMBER / AREA (ha.)

0 7.5 15 22.5 30m

MTE
Engineers, Scientists, Surveyors

PROJECT
961 ST.DAVID STREET NORTH

TITLE
POST-DEVELOPMENT CATCHMENT AREAS

Drawn: JMH	Scale: 1:750	Figure: **3.0**
Checked: NGK	Project No.: 48650-100	
Date: 2023-09-18	Rev No.: 0	

Plot Date: November 1, 2023 – 5:15 PM

In order to achieve the stormwater requirements for the Site, runoff generated from Catchment's 201, and 203 and from the rear roofs of Catchment 202 will be directed to a 0.45m deep layer of amended topsoil in the landscaped areas of the units. The amended topsoil will allow for increased infiltration and runoff volume reduction in these catchments. Runoff generated from Catchment 202 will be conveyed to catchbasin manhole CBMH16, wherein the flow will be controlled with a 75mm orifice tube, and a 6.0m wide weir in the common element drive aisle Storage volume will be provided by an underground storage tank the storm sewers and structures, and by surface ponding on the surface of the common element driveway. The following table summarizes the flows generated by the Site for each storm event. The post-development flow rates are subject to change during detailed design.

Table 4.2 – Summary of Flows (MIDUSS Modelling)

Modeling Condition	Pre-Development (m^3/s)		Post-Development (m^3/s)	
	Area to Southwest Property Line	Area to Highway 6	Area to Southwest Property Line	Area to Highway 6
2-Year Storm Event	0.005	0.011	0.001	0.014
5-Year Storm Event	0.012	0.017	0.005	0.019
10-Year Storm Event	0.019	0.022	0.009	0.023
25-Year Storm Event	0.032	0.031	0.016	0.031
50-Year Storm Event	0.041	0.040	0.022	0.038
100-Year Storm Event	0.057	0.052	0.029	0.048

With the installation of the orifice tube, the post-development runoff from the controlled portion of the Site for the 2-, 10-, 25-, 50- and 100-year storm events is controlled to $0.012m^3/s$, $0.015m^3/s$, $0.017m^3/s$, $0.022m^3/s$, $0.022m^3/s$, and $0.037m^3/s$, respectively.

The total post-development peak flows to St. David Street North/Highway 6 exceed pre-development levels for the 2-, 5-, and 10-year storm events; however, a 75mm orifice tube is considered to be the minimum acceptable diameter, therefore additional reduction of the post-development peak flows is not considered to be feasible and the increased runoff is minimal.

The maximum ponding depth in the common element driveway is 0.17m for the 100-year storm event. As above, the ponding values are subject to change at detailed design. Please refer to Appendix B for the MIDUSS outputs.

4.3 Water Quality Control

A Stormceptor Model EFO4 will be installed on the storm sewer system to provide water quality control for the Site. The chosen unit is expected to provide Enhanced (Level 1) water quality control. Refer to Appendix C 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.

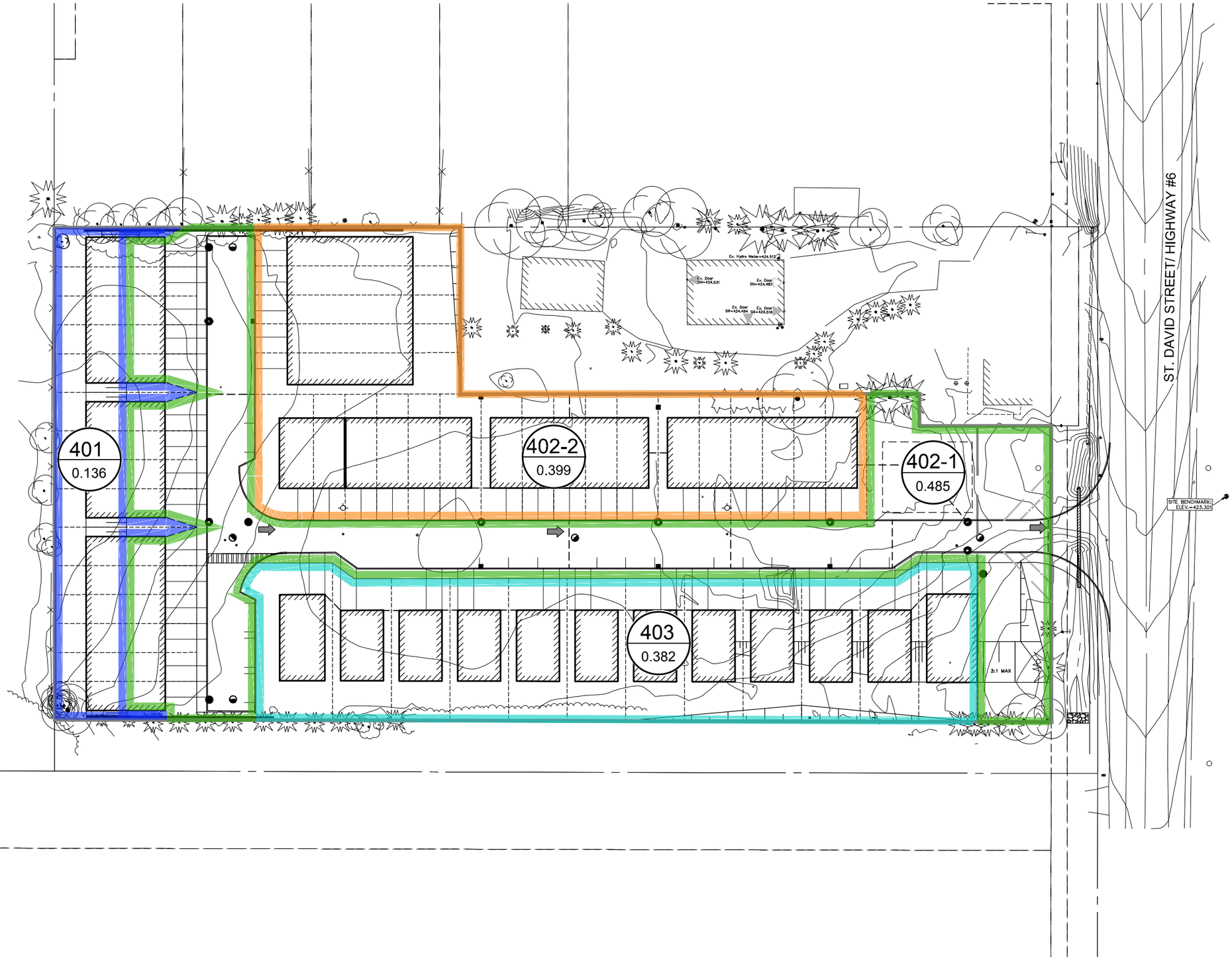
4.4 Water Balance

The GRCA requires that the Site's existing hydrologic patterns related to infiltration and the wetland be maintained. As previously discussed, in the pre-development condition runoff from Catchment 101 is conveyed overland southwest across the adjacent property to a GRCA regulated wetland. Runoff from the remainder of the Site (Catchment 102) is conveyed northeast to the existing ditch on St. David Street North/Highway 6. Based on feedback from the GRCA, it is understood that infiltration inputs across the whole Site, and surface runoff inputs to the wetland are required be maintained post-development.

As previously noted, the Tile Drainage layer on OMAFRA Ag-Maps GIS mapping indicates that systematic tile drainage may be present on the southwestern half of the Site. Mapping of any tile drainage on the Site was not available at the time of publishing this report. Based on the surrounding topography and extent of the Tile Drainage layer, should any tile drainage exist on the Site, it is expected to outlet to the wetland area southwest of the Site. Although tile drainage may decrease surface runoff, it is expected that the total water yield to the wetland (lateral groundwater flow + surface runoff + tile flow) from the Site in the existing condition is not expected to be significantly different than if the Site were not systematically tiled. Therefore for the purposes of the water balance, the existing runoff, infiltration, and evapotranspiration components will be calculated based on the soil type, land cover, and topography of the Site. As groundwater monitoring continues as part of the MTE hydrogeological investigation, the impact of any existing tile drainage on groundwater levels will be assessed, particularly in relation to proposed building basements and footings.

The pre-development water balance catchment areas for the Site are as per Table 4.1 and Figure 2.0. The post-development condition water balance was separated into four catchment areas: the rear roofs and yards of townhouse units along the southwest property line where runoff is conveyed to the wetland (Catchment 401); the front roofs and yards of these units, and the common element area (Catchment 402-1); the townhouse units where runoff is conveyed to Highway 6 (Catchment 402-2); and the single detached units (Catchment 403). Figure 4.0 illustrates the limits of the post-development catchment areas.

CAD: P:\P\48650\100\48650-100-F2.DWG



LEGEND

- CATCHMENT 401
- CATCHMENT 402–1
- CATCHMENT 402–2
- CATCHMENT 403

402-1 / 0.485 — SUB-CATCHMENT NUMBER; AREA (ha.)

0 7.5 15 22.5 30m

MTE
Engineers, Scientists, Surveyors

PROJECT
961 ST.DAVID STREET NORTH

TITLE
POST-DEVELOPMENT WATER BALANCE CATCHMENT AREAS

Drawn	Scale	Figure
TXT	1:750	4.0
Checked: NGK	Project No.: 48650-100	
Date: 2023-09-18	Rev No.: 0	

Plot Date: November 1, 2023 – 5:15 PM

Canadian Climate Normal data provides an annual precipitation estimate of 945.7mm/year for the Fergus Shand Dam, which was rounded to 946mm/year for the purposes of the water balance.

To achieve the water balance requirements for the Site, a 0.45m thick layer of amended topsoil will be placed in the landscaped areas of Catchments 401, 402, and 403. Runoff from rooftop areas in these catchments will be conveyed to the amended topsoil, increasing infiltration and decreasing runoff. The following table summarizes the pre- and post-development annual surface runoff and infiltration volumes from the Site. Refer to Appendix D for detailed calculations.

Table 4.3 – Yearly Water Balance Summary

		Pre-Development	Post-Development	Volume Change	Percentage Change
Runoff Volume (m^3/year)	Directed to Wetland	571	494	-77	-14%
	Directed to St. David Steet North/Highway 6	819	5,621	+4,802	-
Infiltration Volume (m^3/year)	Total Site	3,869	3,961	+91	+2%

In the existing condition the annual surface runoff volume to the wetland is 571m^3/year. In the post-development condition, the annual surface runoff volume decreases slightly to 494m^3/year, representing a decrease of 14%. Given the relatively small pre-development runoff volume, and the grading constraints of the proposed development that limit what drainage can be directed to the southwest property line while maintaining an overland flow route to the right-of-way, the 14% decrease is considered to be within the acceptable range of a balanced condition.

The post-development surface runoff volume to St. David Street North/Highway 6 represents an increase of 4,802m^3/year from the pre-development condition. An increase in runoff volume is to be expected when development occurs. As discussed in Section 4.2, there is only a minor increase in post development peak flow rates to St. David Street North/Highway 6 in the post-development condition during the 2-, 5-, and 10-year storm events. Therefore, the increase in runoff volume to the St. David Street North/Highway 6 ditch is considered to be acceptable.

In the existing condition, the annual infiltration volume from the Site is 3,869m^3/year. In the post-development condition, the annual infiltration volume is 3,961m^3/year, representing an increase of 2%, which is considered to be negligible.

4.5 Erosion and Sedimentation 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; and

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

5.0 CONCLUSIONS

Based on the foregoing, it is concluded that:

i) Municipal infrastructure for water and sanitary services is available along St. David Street North/Highway 6;

ii) A fire flow analysis has been completed and demonstrates that adequate flow and pressure is available from the proposed on-site hydrants;

iii) The water supply needs of the proposed development will not exceed what is available in the existing municipal water distribution system;

iv) The proposed grading design will respect the natural topography of the Site to achieve a reasonable cut/fill balance where possible and match into existing grades along all property boundaries; and

v) The SWM criteria can be satisfied with the implementation of on-site controls for water quantity and water quality.

Detailed grading and servicing designs and a detailed stormwater management design will be provided during detailed design in support of Site Plan Approval and Building Permits.

All of which is respectfully submitted,

MTE Consultants Inc.

Nathan Katerberg, E.I.T.
Designer
519-743-6500 ext. 1369
nkaterberg@mte85.com

Jeff Lerch, P.Eng.
Design Engineer
519-743-6500 ext. 1307
jlerch@mte85.com

NGK:zeg

M:\48650\100\Reports\FSSWM\rpt_2023-11-10_FSSWM.docx

Appendix A

Design Sheets

CLASSIC FIRE + LIFE SAFETY

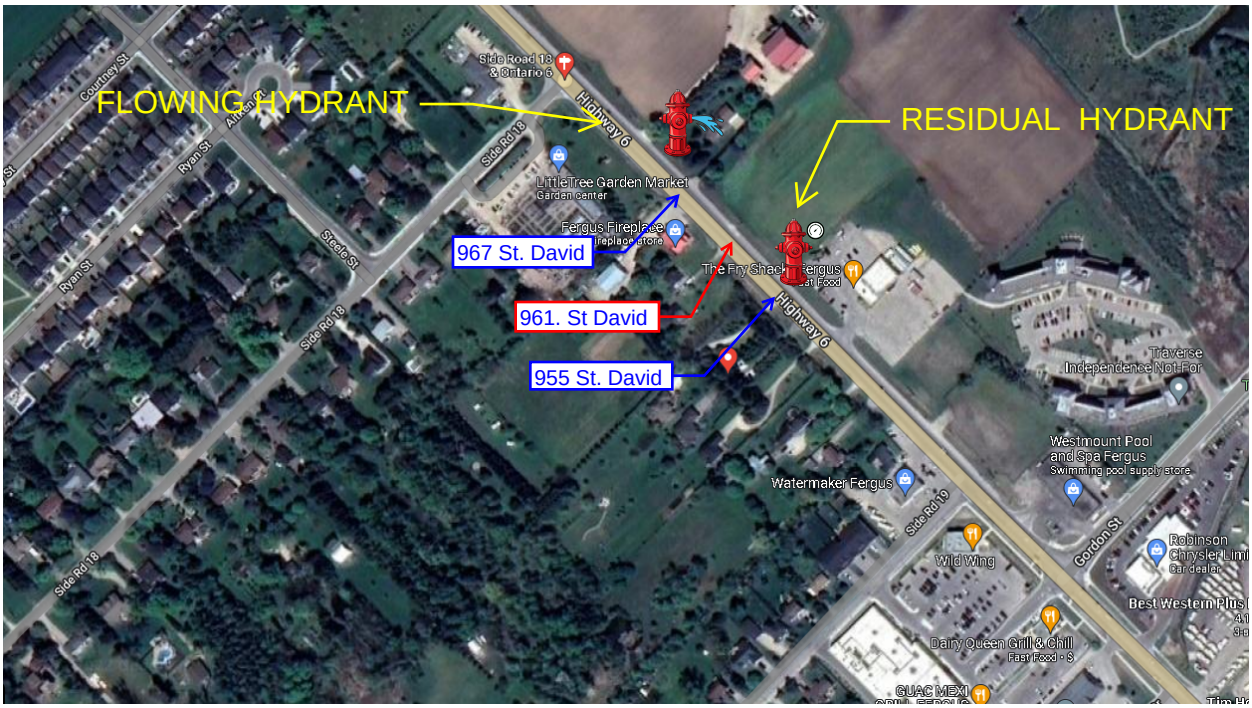
FLOW TEST REPORT

Form SD-003B RevDate: Nov 29, 2021

PROJECT INFORMATION			
Project Name:	Fergus Flow Test	Const. Project #:	22-CAM-690-0568
Site Address:	961 St. David Street/Highway 6 Fergus	Design Project #:	2022-CFLS-359
City Contact:	Mike Mullen	Phone #:	519-501-7252
CFLS Contact:	Dean Wanders	Phone #:	905-514-7417
Technical Contact:	**Andy Coghlin**	Phone #:	**519-476-0761**

SITE INFORMATION

SITE MAP



Note: If the main is a dead end, the flowing hydrant shall be closest to the dead end

ITEMS TO LABEL ON MAP	HYDRANTS USED	MAIN SIZE
☑ Static / Residual & Flow Hydrants	☑ City Hydrant(s)	City: 6"
☐ Flow Direction (if the main is dead end)	☐ Site Hydrant(s)	Site:

SITE NOTES

CLASSIC FIRE + LIFE SAFETY

FLOW TEST REPORT

Form SD-003B RevDate: Nov 29, 2021

TEST INFORMATION			
Minimum Required Flow:	NA	Min Ports:	2
CFLS Personnel Present:	Dean Wanders	Test Date:	2022-06-21
City / External Company:	Infrastructure Services	Test Time:	1:00pm

TEST EQUIPMENT	
☐ Hose Monsters with built in Pitot	Hose length used:
☐ Hand held pitot gauge	☑ Pollard diffuser elbow with built in Pitot
☐ Other:	

TEST RESULTS

Number of Ports	Outlet Size (IN)	Discharge Coefficient	Pitot Reading (PSI)	Total Flow (GPM)	Static / Residual Pressure (PSI)
0 Ports	**STATIC**				46
1 Port	2.5	0.9	20	751	40
2 Ports	2.5	0.9	12 / 14	1,209	38
3 Ports	2.5	0.9		0	
4 Ports	2.5	0.9		0	
0 Ports	**STATIC RE-CHECK**				46

TEST NOTES

HYDRAULIC ADJUSTMENTS (FOR OFFICE USE ONLY)			
ADJUSTMENTS FOR HYDRAULIC GRADE LINE (HGL)			
Reservoir HGL (m):		Site Elevation (m):	
Theoretical Static Head (PSI):	0	PSI to subtract from test pressures:	46
OTHER HYDRAULIC ADJUSTMENTS			
Other adjustment as required by the City / AHJ:			

961 St. David Street

FIRE FLOW DEMANDS

Kitchener, Ontario

Project #: 48650-100
Date: Revised: 2023-10-10
Date Printed: 10/10/2023
By: NGK

Development Information[1,2]								Fire Flow[2,3]														Domestic Flow[4,5,6]					
								Ontario Building Code						Fire Underwriters Survey													
Node ID / Area ID / Building #	F.F.E. (m.a.s.l.)	Description	# of Units	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)	MOE Guidelines	Average Day	Max Day	Peak Hour	Minimum Hour	Max Day + Fire Flow
				# 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*	*L/s*
Units 1-12		Detached Houses	12	39	135	270	1,316	23	1,316	2.00	60,548	2,700	45	1.50	270	5,422	-15%	0%	75%	8,000	133	133	0.102	0.102	0.134	0.419	0.041	134
Units 13-18		Townhouses	6	15	504	1,008	3,024	23	3,024	2.00	139,104	4,500	75	1.50	1,008	10,477	-15%	0%	75%	16,000	267	267	0.038	0.038	0.050	0.157	0.015	267
Units 19-22		Townhouses	4	10	336	672	2,016	23	2,016	2.00	92,736	2,700	45	1.50	672	8,555	-15%	0%	75%	13,000	217	217	0.025	0.025	0.034	0.105	0.010	217
Units 23-27		Townhouses	5	12	423	846	2,538	23	2,538	2.00	116,748	3,600	60	1.50	846	9,598	-15%	0%	75%	14,000	233	233	0.032	0.032	0.042	0.131	0.013	234
Units 28-32		Townhouses	5	12	580	1,160	3,480	23	3,480	2.00	160,080	4,500	75	1.50	1,160	11,239	-15%	0%	75%	17,000	283	283	0.032	0.032	0.042	0.131	0.013	284
Units 33-38		Townhouses	6	15	486	972	2,916	23	2,916	2.00	134,136	3,600	60	1.50	972	10,288	-15%	0%	75%	15,000	250	250	0.038	0.038	0.050	0.157	0.015	250
Units 39-43		Townhouses	5	12	400	800	2,400	23	2,400	2.00	110,400	3,600	60	1.50	800	9,334	-15%	0%	75%	14,000	233	233	0.032	0.032	0.042	0.131	0.013	234
Units 44-49		Townhouses	6	15	480	960	2,880	23	2,880	2.00	132,480	3,600	60	1.50	960	10,225	-15%	0%	75%	15,000	250	250	0.038	0.038	0.050	0.157	0.015	250
		TOTALS FOR SITE	**49**	**129**							**Max Fire Flow =**		**75**							**Max Fire Flow =**	**283**	**283**	**0.34**	**0.34**	**0.44**	**1.39**	**0.13**	**284**
																						Sum of Maximum Day Flows + Largest Fire Flow (L/s) =						**284**

Assumptions:

1 Number of units are based on the Conceptual Plan by MHBC Ltd., dated March 23, 2022

2 Residential population is calculated using a Persons Per Unit (PPU) count taken from "Region of Waterloo Water and Wastewater Monitoring Report" (WWWMR) (Region of Waterloo, June 2021)

Residential = 3.25 PPU for Single and Semi-Detached houses
Residential = 2.44 PPU for Townhouses

3 All buildings are classified as occupancy group C (Residential Occupancy)

4 Average Daily Demands for each building are based on "*Tri City Water Distribution Master Plan Final Report" by AECOM, Dated May 2009* :

Residential = 225 L/cap/day

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

Average Day = 1
Maximum Day = 2.75
Peak Hour = 4.13
Minimum Hour = 0.4

6 Maximum Day Demand is based on *"Centre Wellington Reserve Capacity Calculations (RCC) (2021)*

Maximum Day = 297 L/capita/day

961 St. David Street

FIRE FLOW ANALYSIS

Fergus, Ontario

Project Number: 48650-100

Date: Revised October 26, 2023

Design By: NGK

File: Q:\48650\100\Water\48650-100_Site Fire Flow Analysis with test results.xlsx

CALCULATION OF RESIDUAL PRESSURE AT ON-SITE HYDRANT

1. Boundary Conditions (Based on Fire Flow Test Results):

	Metric		Imperial		
P0 - Starting Pressure	32.35	*m*	46.0	*psi*	
P1 - Pressure at Q1	26.72	*m*	38.0	*psi*	
Q1 - From Fire Flow Test	4577	*L/min*	1209	*U.S. gal/min*	From: Hydrant Flow Test Results
Q2 - Required Flow	4500	*L/min*	1189	*U.S. gal/min*	From: Water Demand calculations by MTE
P-loss 1	5.63	*m*	8	*psi*	
P-loss 2	5.45	*m*	8	*psi*	
P2 - Residual Pressure	**26.90**	***m***	**38**	***psi***	

2. Friction Losses Through Water Service:

Hazen-Williams Equation	Metric		Imperial		
C_{hw} = Pipe Friction Factor	150		150		
k = conversion factor	10.675		4.727		
n = constant	1.852		1.852		
m = constant	4.8704		4.8704		
Q = Flow	4500	L/min			
Q = Flow	0.075	m^3/s	1189	*U.S. gal/min*	
d = Pipe Diameter (1)	150	mm	5.91	in	
	0.15	m			
d = Pipe Diameter (2)	250	mm	9.84	in	
	0.25	m			
p = Loss/Length (1)	0.0846	m/m	0.0367	psi/ft	
p = Loss/Length (2)	0.0070	m/m	0.0030	psi/ft	
Length (1)	36	m	118	ft	Service under road & hydrant lead
Length (2)	132	m	433	ft	
Loss	**3.98**	**m**	**5.7**	**psi**	
	39	**kPa**			

3. Friction Losses Through Apurtenances:

Apurtenances	Number	K	Velocity *m/s*	Head Loss *m*	Total Loss *m*	Total Loss *psi*
Site						
Valve - 150mm dia.	2	0.120	4.244	0.110	0.220	0.313
Expander - 150mm to 250mm dia.	1	2.127	4.244	1.953	1.953	2.777
45° Bend - 150mm dia.	1	0.240	4.244	0.220	0.220	0.313
45° Bend - 250mm dia.	3	0.224	1.528	0.027	0.080	0.114
250mm dia. Tee (through)	1	0.280	1.528	0.033	0.033	0.047
150mm dia. Tee (branch)	2	0.900	4.244	0.826	1.653	2.350
Total Minor Losses					**4.159**	**5.914**

4. Elevation - Elevational differences from existing hydrant to proposed hydrant

	Metric		Imperial	
Elevation at Boundary (i.e. Residual Hydrant):	424.00	m	1391	ft
Elevation at Site Hydrant:	424.00	m	1391	ft
Elevation Difference = Loss/Gain	**0**	**m**	**0.0**	**psi**

ANALYSIS SUMMARY

Total Losses	**8.135**	**m**			
	79.80	**kPa**	**11.6**	**psi**	
Residual Pressure after Losses	**18.76**	**m**			
	184	**kPa**	**26.7**	**psi**	**PASS**
Allowable Residual Pressure	*140*	*kPa*	*20.3*	*psi*	

961 St. David Street
Fergus, Ontario
TOWNSHIP OF CENTRE WELLINGTON

Project Number: 48650-100
Date: October 28, 2023
Design By: NGK
Checked By: JPL
File: Q:\48650\100\Sanitary\48650-100 Sanitary Sewer Design Sheet Waterloo (SSMS) Rev7.xls

SANITARY SEWER DESIGN SHEET

ENGINEERING AND PUBLIC WORKS

Drainage Area Plan No: n/a

Design Parameters

Average Daily Flow

Residential	350.00	L/capita/day
Commercial	1.16	L/s/ha
Industrial	0.50	L/s/ha
Inst. / School	0.25	L/s/ha

Mannings "*n*"	0.013	
Min. Velocity	0.6	m/sec
Max. Velocity	3.0	m/sec

Residential Harmon Peaking Factor (F) $F = 1 + 14/(4 + P^{0.5})$
Commercial Peaking Factor = 2.5
Residential Areas Infiltration[1] 0.15 L/s/ha

LOCATION				RESIDENTIAL AREAS AND POPULATION							SCHOOL, INSTITUTIONAL			COMMERCIAL			INDUSTRIAL				INFILTRATION			DESIGN						
											HECTARES AND FLOW OF EACH ZONING																			
											0.25 *L/s/ha*			1.16 *L/s/ha*			0.50 *L/s/ha*												
STREET	AREA NO.	MANHOLE LOCATION		AREA	No. UNITS @ 3.25 PPU	No. UNITS @ 2.44 PPU	POPUL.	CUMUL POPUL.	PEAK FACTOR "F"	PEAK RES. FLOW	AREA	CUMUL AREA	PEAK FLOW	AREA	CUMUL AREA	PEAK FLOW	AREA	CUMUL AREA	PEAK FLOW	TOTALS-C-I FLOW	AREA	CUMUL AREA	INFIL FLOW	TOTAL VOLUME FLOW	LENGTH	SLOPE	PIPE SIZE	CAPACITY	FULL FLOW VELOCITY
		FROM MH	TO MH	*ha*			*1000s*	*1000s*		*L/sec*	*ha*	*ha*	*L/sec*	*ha*	*ha*	*L/sec*	*ha*	*ha*	*L/sec*	*L/sec*	*ha*	*ha*	*L/sec*	*L/sec*	*m*	*%*	*mm*	*L/sec.*	*m/s*
Proposed development				1.402	12.00	37.00	0.129	0.129	4.211337	2.2055											1.402	1.402	0.2103	2.4158	50.0	1.00	150	15.2217	0.862

961 St. David Street
Fergus, Ontario
Township of Centre Wellington

STORM SEWER DESIGN SHEET

ENGINEERING AND PUBLIC WORKS

Project Number: 48650-100
Date: November 10, 2023
Design By: NGK
Checked By: JPL
File: Q:\48650\100\Storm\Storm Sewer Design Sheet Kitchener_Rev10.xlsx

Drainage Area Plan No:

Design Parameters

5 YEAR STORM

Q=kAIC, k=0.00278
Intensity (I) = a/(tc+b)^c
a = 500
b = 0.24
c = 0.6877

Manning's "n" 0.013
Min. Velocity 0.800 m/s
Max. Velocity 6.000 m/s

LOCATION				STORMWATER FLOW								DESIGN					
STREET	AREA NUMBER	MANHOLE LOCATION FROM MH	MANHOLE LOCATION TO MH	AREA (A)	RUNOFF COEFF. (C)	A x C	CUMUL. A x C	CONCENTRATION TIME TOTAL	CONCENTRATION TIME IN PIPE	RAIN INTENSITY (I)	FLOW (Q)	PIPE SIZE	LENGTH	SLOPE	CAPACITY	FULL FLOW VELOCITY	PIPE FULL
				ha		*ha*	*ha*	*min*	*min*	*mm/hr*	*L/s*	*mm*	*m*	*%*	*L/s*	*m/s*	*%*
Controlled Area				0.962				5-year flow taken from MIDUSS model			15.00000	250	10.0	0.50	42.04989	0.8566	35.67

Appendix B

MIDUSS Output

```
 1 "                MIDUSS Output ------------------------------------------------>"
 2 "                MIDUSS version                            Version 2.25  rev. 473"
 3 "                MIDUSS created                          Sunday, February 7, 2010"
 4 "           10   Units used:                                              ie METRIC"
 5 "                Job folder:                                    Q:\48650\100\SWM"
 6 "                Output filename:                                    2yr pre.Out"
 7 "                Licensee name:                                                A"
 8 "                Company                                                        "
 9 "                Date & Time last used:                10/27/2023 at 2:02:20 PM"
10 " 31          TIME PARAMETERS"
11 "        5.000   Time Step"
12 "      180.000   Max. Storm length"
13 "     1500.000   Max. Hydrograph"
14 " 32          STORM Chicago storm"
15 "            1   Chicago storm"
16 "      375.000   Coefficient A"
17 "        0.240   Constant B"
18 "        0.689   Exponent C"
19 "        0.400   Fraction R"
20 "      180.000   Duration"
21 "        1.000   Time step multiplier"
22 "             Maximum intensity           119.788    mm/hr"
23 "             Total depth                  31.396    mm"
24 "            6   002hyd   Hydrograph extension used in this file"
25 " 33          CATCHMENT 101"
26 "            1   Triangular SCS"
27 "            1   Equal length"
28 "            1   SCS method"
29 "          101   Area to southwest property line, ultimately to Mun. Drain #1"
30 "        0.000   % Impervious"
31 "        0.804   Total Area"
32 "      100.000   Flow length"
33 "        2.000   Overland Slope"
34 "        0.804   Pervious Area"
35 "      100.000   Pervious length"
36 "        2.000   Pervious slope"
37 "        0.000   Impervious Area"
38 "      100.000   Impervious length"
39 "        2.000   Impervious slope"
40 "        0.250   Pervious Manning 'n'"
41 "       75.000   Pervious SCS Curve No."
42 "        0.156   Pervious Runoff coefficient"
43 "        0.100   Pervious Ia/S coefficient"
44 "        8.467   Pervious Initial abstraction"
45 "        0.015   Impervious Manning 'n'"
46 "       98.000   Impervious SCS Curve No."
47 "        0.000   Impervious Runoff coefficient"
48 "        0.100   Impervious Ia/S coefficient"
49 "        0.518   Impervious Initial abstraction"
50 "                     0.005     0.000     0.000     0.000 c.m/sec"
51 "             Catchment 101          Pervious   Impervious Total Area "
52 "             Surface Area           0.804      0.000      0.804      hectare"
53 "             Time of concentration  56.110     4.409      56.110     minutes"
54 "             Time to Centroid       181.077    97.331     181.077    minutes"
55 "             Rainfall depth         31.396     31.396     31.396     mm"
56 "             Rainfall volume        252.42     0.00       252.42     c.m"
57 "             Rainfall losses        26.511     5.151      26.511     mm"
58 "             Runoff depth           4.885      26.245     4.885      mm"
59 "             Runoff volume          39.28      0.00       39.28      c.m"
60 "             Runoff coefficient     0.156      0.000      0.156      "
61 "             Maximum flow           0.005      0.000      0.005      c.m/sec"
62 " 40          HYDROGRAPH Start - New Tributary"
63 "            2   Start - New Tributary"
64 "                     0.005     0.000     0.000     0.000"
65 " 33          CATCHMENT 102"
66 "            1   Triangular SCS"
67 "            1   Equal length"
68 "            1   SCS method"
```

```
 69 "          102   Area to Highway 6"
 70 "        9.000   % Impervious"
 71 "        0.598   Total Area"
 72 "       90.000   Flow length"
 73 "        5.000   Overland Slope"
 74 "        0.544   Pervious Area"
 75 "       90.000   Pervious length"
 76 "        5.000   Pervious slope"
 77 "        0.054   Impervious Area"
 78 "       90.000   Impervious length"
 79 "        5.000   Impervious slope"
 80 "        0.250   Pervious Manning 'n'"
 81 "       75.000   Pervious SCS Curve No."
 82 "        0.156   Pervious Runoff coefficient"
 83 "        0.100   Pervious Ia/S coefficient"
 84 "        8.467   Pervious Initial abstraction"
 85 "        0.015   Impervious Manning 'n'"
 86 "       98.000   Impervious SCS Curve No."
 87 "        0.828   Impervious Runoff coefficient"
 88 "        0.100   Impervious Ia/S coefficient"
 89 "        0.518   Impervious Initial abstraction"
 90 "                    0.011     0.000     0.000     0.000 c.m/sec"
 91 "             Catchment 102          Pervious   Impervious Total Area "
 92 "             Surface Area           0.544      0.054      0.598      hectare"
 93 "             Time of concentration  40.013     3.144      27.299     minutes"
 94 "             Time to Centroid       160.212    95.266     137.817    minutes"
 95 "             Rainfall depth         31.396     31.396     31.396     mm"
 96 "             Rainfall volume        170.85     16.90      187.75     c.m"
 97 "             Rainfall losses        26.511     5.398      24.611     mm"
 98 "             Runoff depth           4.885      25.997     6.785      mm"
 99 "             Runoff volume          26.58      13.99      40.57      c.m"
100 "             Runoff coefficient     0.156      0.828      0.216      "
101 "             Maximum flow           0.004      0.010      0.011      c.m/sec"
102 " 38          START/RE-START TOTALS "
103 "            3   Runoff Totals on EXIT"
104 "             Total Catchment area                        0.000    hectare"
105 "             Total Impervious area                       0.000    hectare"
106 "             Total % impervious                          0.000"
107 " 19          EXIT"
```

```
 1 "                MIDUSS Output ------------------------------------------------>"
 2 "                MIDUSS version                              Version 2.25  rev. 473"
 3 "                MIDUSS created                            Sunday, February 7, 2010"
 4 "           10   Units used:                                                ie METRIC"
 5 "                Job folder:                                        Q:\48650\100\SWM"
 6 "                Output filename:                                        5yr pre.Out"
 7 "                Licensee name:                                                    A"
 8 "                Company                                                           "
 9 "                Date & Time last used:                  10/27/2023 at 2:01:23 PM"
10 " 31          TIME PARAMETERS"
11 "        5.000   Time Step"
12 "      180.000   Max. Storm length"
13 "     1500.000   Max. Hydrograph"
14 " 32          STORM Chicago storm"
15 "            1   Chicago storm"
16 "      500.000   Coefficient A"
17 "        0.240   Constant B"
18 "        0.688   Exponent C"
19 "        0.400   Fraction R"
20 "      180.000   Duration"
21 "        1.000   Time step multiplier"
22 "             Maximum intensity           160.061    mm/hr"
23 "             Total depth                  42.145    mm"
24 "            6   005hyd   Hydrograph extension used in this file"
25 " 33          CATCHMENT 101"
26 "            1   Triangular SCS"
27 "            1   Equal length"
28 "            1   SCS method"
29 "          101   Area to southwest property line, ultimately to Mun. Drain #1"
30 "        0.000   % Impervious"
31 "        0.804   Total Area"
32 "      100.000   Flow length"
33 "        2.000   Overland Slope"
34 "        0.804   Pervious Area"
35 "      100.000   Pervious length"
36 "        2.000   Pervious slope"
37 "        0.000   Impervious Area"
38 "      100.000   Impervious length"
39 "        2.000   Impervious slope"
40 "        0.250   Pervious Manning 'n'"
41 "       75.000   Pervious SCS Curve No."
42 "        0.227   Pervious Runoff coefficient"
43 "        0.100   Pervious Ia/S coefficient"
44 "        8.467   Pervious Initial abstraction"
45 "        0.015   Impervious Manning 'n'"
46 "       98.000   Impervious SCS Curve No."
47 "        0.000   Impervious Runoff coefficient"
48 "        0.100   Impervious Ia/S coefficient"
49 "        0.518   Impervious Initial abstraction"
50 "                     0.012     0.000     0.000     0.000 c.m/sec"
51 "             Catchment 101          Pervious   Impervious Total Area "
52 "             Surface Area           0.804      0.000      0.804      hectare"
53 "             Time of concentration  39.662     3.873      39.662     minutes"
54 "             Time to Centroid       160.316    95.565     160.316    minutes"
55 "             Rainfall depth         42.145     42.145     42.145     mm"
56 "             Rainfall volume        338.84     0.00       338.84     c.m"
57 "             Rainfall losses        32.561     5.881      32.561     mm"
58 "             Runoff depth           9.583      36.263     9.583      mm"
59 "             Runoff volume          77.05      0.00       77.05      c.m"
60 "             Runoff coefficient     0.227      0.000      0.227      "
61 "             Maximum flow           0.012      0.000      0.012      c.m/sec"
62 " 40          HYDROGRAPH Start - New Tributary"
63 "            2   Start - New Tributary"
64 "                     0.012     0.000     0.000     0.000"
65 " 33          CATCHMENT 102"
66 "            1   Triangular SCS"
67 "            1   Equal length"
68 "            1   SCS method"
```

```
 69 "          102   Area to Highway 6"
 70 "        9.000   % Impervious"
 71 "        0.598   Total Area"
 72 "       90.000   Flow length"
 73 "        5.000   Overland Slope"
 74 "        0.544   Pervious Area"
 75 "       90.000   Pervious length"
 76 "        5.000   Pervious slope"
 77 "        0.054   Impervious Area"
 78 "       90.000   Impervious length"
 79 "        5.000   Impervious slope"
 80 "        0.250   Pervious Manning 'n'"
 81 "       75.000   Pervious SCS Curve No."
 82 "        0.227   Pervious Runoff coefficient"
 83 "        0.100   Pervious Ia/S coefficient"
 84 "        8.467   Pervious Initial abstraction"
 85 "        0.015   Impervious Manning 'n'"
 86 "       98.000   Impervious SCS Curve No."
 87 "        0.869   Impervious Runoff coefficient"
 88 "        0.100   Impervious Ia/S coefficient"
 89 "        0.518   Impervious Initial abstraction"
 90 "                    0.017     0.000     0.000     0.000 c.m/sec"
 91 "             Catchment 102          Pervious   Impervious Total Area "
 92 "             Surface Area           0.544      0.054      0.598      hectare"
 93 "             Time of concentration  28.284     2.762      21.277     minutes"
 94 "             Time to Centroid       144.474    93.560     130.497    minutes"
 95 "             Rainfall depth         42.145     42.145     42.145     mm"
 96 "             Rainfall volume        229.34     22.68      252.02     c.m"
 97 "             Rainfall losses        32.570     5.508      30.134     mm"
 98 "             Runoff depth           9.575      36.636     12.011     mm"
 99 "             Runoff volume          52.11      19.72      71.82      c.m"
100 "             Runoff coefficient     0.227      0.869      0.285      "
101 "             Maximum flow           0.011      0.015      0.017      c.m/sec"
102 " 38          START/RE-START TOTALS "
103 "            3   Runoff Totals on EXIT"
104 "             Total Catchment area                        0.000    hectare"
105 "             Total Impervious area                       0.000    hectare"
106 "             Total % impervious                          0.000"
107 " 19          EXIT"
```

```
 1 "                MIDUSS Output ------------------------------------------------>"
 2 "                MIDUSS version                              Version 2.25  rev. 473"
 3 "                MIDUSS created                            Sunday, February 7, 2010"
 4 "           10   Units used:                                                ie METRIC"
 5 "                Job folder:                                        Q:\48650\100\SWM"
 6 "                Output filename:                                       10yr pre.Out"
 7 "                Licensee name:                                                    A"
 8 "                Company                                                           "
 9 "                Date & Time last used:                 10/27/2023 at 2:00:18 PM"
10 " 31          TIME PARAMETERS"
11 "        5.000   Time Step"
12 "      180.000   Max. Storm length"
13 "     1500.000   Max. Hydrograph"
14 " 32          STORM Chicago storm"
15 "            1   Chicago storm"
16 "      595.000   Coefficient A"
17 "        0.360   Constant B"
18 "        0.691   Exponent C"
19 "        0.400   Fraction R"
20 "      180.000   Duration"
21 "        1.000   Time step multiplier"
22 "             Maximum intensity           186.431    mm/hr"
23 "             Total depth                  49.226    mm"
24 "            6   010hyd   Hydrograph extension used in this file"
25 " 33          CATCHMENT 101"
26 "            1   Triangular SCS"
27 "            1   Equal length"
28 "            1   SCS method"
29 "          101   Area to southwest property line, ultimately to Mun. Drain #1"
30 "        0.000   % Impervious"
31 "        0.804   Total Area"
32 "      100.000   Flow length"
33 "        2.000   Overland Slope"
34 "        0.804   Pervious Area"
35 "      100.000   Pervious length"
36 "        2.000   Pervious slope"
37 "        0.000   Impervious Area"
38 "      100.000   Impervious length"
39 "        2.000   Impervious slope"
40 "        0.250   Pervious Manning 'n'"
41 "       75.000   Pervious SCS Curve No."
42 "        0.269   Pervious Runoff coefficient"
43 "        0.100   Pervious Ia/S coefficient"
44 "        8.467   Pervious Initial abstraction"
45 "        0.015   Impervious Manning 'n'"
46 "       98.000   Impervious SCS Curve No."
47 "        0.000   Impervious Runoff coefficient"
48 "        0.100   Impervious Ia/S coefficient"
49 "        0.518   Impervious Initial abstraction"
50 "                     0.019     0.000     0.000     0.000 c.m/sec"
51 "             Catchment 101          Pervious   Impervious Total Area "
52 "             Surface Area           0.804      0.000      0.804      hectare"
53 "             Time of concentration  34.073     3.625      34.073     minutes"
54 "             Time to Centroid       151.986    94.644     151.986    minutes"
55 "             Rainfall depth         49.226     49.226     49.226     mm"
56 "             Rainfall volume        395.78     0.00       395.78     c.m"
57 "             Rainfall losses        35.986     6.385      35.986     mm"
58 "             Runoff depth           13.240     42.841     13.240     mm"
59 "             Runoff volume          106.45     0.00       106.45     c.m"
60 "             Runoff coefficient     0.269      0.000      0.269      "
61 "             Maximum flow           0.019      0.000      0.019      c.m/sec"
62 " 40          HYDROGRAPH Start - New Tributary"
63 "            2   Start - New Tributary"
64 "                     0.019     0.000     0.000     0.000"
65 " 33          CATCHMENT 102"
66 "            1   Triangular SCS"
67 "            1   Equal length"
68 "            1   SCS method"
```

```
 69 "          102   Area to Highway 6"
 70 "        9.000   % Impervious"
 71 "        0.598   Total Area"
 72 "       90.000   Flow length"
 73 "        5.000   Overland Slope"
 74 "        0.544   Pervious Area"
 75 "       90.000   Pervious length"
 76 "        5.000   Pervious slope"
 77 "        0.054   Impervious Area"
 78 "       90.000   Impervious length"
 79 "        5.000   Impervious slope"
 80 "        0.250   Pervious Manning 'n'"
 81 "       75.000   Pervious SCS Curve No."
 82 "        0.269   Pervious Runoff coefficient"
 83 "        0.100   Pervious Ia/S coefficient"
 84 "        8.467   Pervious Initial abstraction"
 85 "        0.015   Impervious Manning 'n'"
 86 "       98.000   Impervious SCS Curve No."
 87 "        0.886   Impervious Runoff coefficient"
 88 "        0.100   Impervious Ia/S coefficient"
 89 "        0.518   Impervious Initial abstraction"
 90 "                    0.022     0.000     0.000     0.000 c.m/sec"
 91 "             Catchment 102          Pervious   Impervious Total Area "
 92 "             Surface Area           0.544      0.054      0.598      hectare"
 93 "             Time of concentration  24.298     2.585      18.962     minutes"
 94 "             Time to Centroid       138.081    92.658     126.916    minutes"
 95 "             Rainfall depth         49.226     49.226     49.226     mm"
 96 "             Rainfall volume        267.88     26.49      294.37     c.m"
 97 "             Rainfall losses        35.985     5.594      33.249     mm"
 98 "             Runoff depth           13.241     43.632     15.977     mm"
 99 "             Runoff volume          72.06      23.48      95.54      c.m"
100 "             Runoff coefficient     0.269      0.886      0.325      "
101 "             Maximum flow           0.018      0.018      0.022      c.m/sec"
102 " 38          START/RE-START TOTALS "
103 "            3   Runoff Totals on EXIT"
104 "             Total Catchment area                        0.000    hectare"
105 "             Total Impervious area                       0.000    hectare"
106 "             Total % impervious                          0.000"
107 " 19          EXIT"
```

```
 1 "                MIDUSS Output ------------------------------------------------>"
 2 "                MIDUSS version                            Version 2.25  rev. 473"
 3 "                MIDUSS created                          Sunday, February 7, 2010"
 4 "           10   Units used:                                              ie METRIC"
 5 "                Job folder:                                    Q:\48650\100\SWM"
 6 "                Output filename:                                   25yr pre.Out"
 7 "                Licensee name:                                                A"
 8 "                Company                                                        "
 9 "                Date & Time last used:                 10/27/2023 at 1:58:22 PM"
10 " 31          TIME PARAMETERS"
11 "        5.000   Time Step"
12 "      180.000   Max. Storm length"
13 "     1500.000   Max. Hydrograph"
14 " 32          STORM Chicago storm"
15 "            1   Chicago storm"
16 "      702.000   Coefficient A"
17 "        0.350   Constant B"
18 "        0.690   Exponent C"
19 "        0.400   Fraction R"
20 "      180.000   Duration"
21 "        1.000   Time step multiplier"
22 "             Maximum intensity           220.574    mm/hr"
23 "             Total depth                  58.353    mm"
24 "            6   025hyd   Hydrograph extension used in this file"
25 " 33          CATCHMENT 101"
26 "            1   Triangular SCS"
27 "            1   Equal length"
28 "            1   SCS method"
29 "          101   Area to southwest property line, ultimately to Mun. Drain #1"
30 "        0.000   % Impervious"
31 "        0.804   Total Area"
32 "      100.000   Flow length"
33 "        2.000   Overland Slope"
34 "        0.804   Pervious Area"
35 "      100.000   Pervious length"
36 "        2.000   Pervious slope"
37 "        0.000   Impervious Area"
38 "      100.000   Impervious length"
39 "        2.000   Impervious slope"
40 "        0.250   Pervious Manning 'n'"
41 "       75.000   Pervious SCS Curve No."
42 "        0.317   Pervious Runoff coefficient"
43 "        0.100   Pervious Ia/S coefficient"
44 "        8.467   Pervious Initial abstraction"
45 "        0.015   Impervious Manning 'n'"
46 "       98.000   Impervious SCS Curve No."
47 "        0.000   Impervious Runoff coefficient"
48 "        0.100   Impervious Ia/S coefficient"
49 "        0.518   Impervious Initial abstraction"
50 "                     0.032     0.000     0.000     0.000 c.m/sec"
51 "             Catchment 101          Pervious   Impervious Total Area "
52 "             Surface Area           0.804      0.000      0.804      hectare"
53 "             Time of concentration  29.275     3.375      29.275     minutes"
54 "             Time to Centroid       144.683    93.660     144.683    minutes"
55 "             Rainfall depth         58.353     58.353     58.353     mm"
56 "             Rainfall volume        469.16     0.00       469.16     c.m"
57 "             Rainfall losses        39.869     6.386      39.869     mm"
58 "             Runoff depth           18.484     51.966     18.484     mm"
59 "             Runoff volume          148.61     0.00       148.61     c.m"
60 "             Runoff coefficient     0.317      0.000      0.317      "
61 "             Maximum flow           0.032      0.000      0.032      c.m/sec"
62 " 40          HYDROGRAPH Start - New Tributary"
63 "            2   Start - New Tributary"
64 "                     0.032     0.000     0.000     0.000"
65 " 33          CATCHMENT 102"
66 "            1   Triangular SCS"
67 "            1   Equal length"
68 "            1   SCS method"
```

```
 69 "          102   Area to Highway 6"
 70 "        9.000   % Impervious"
 71 "        0.598   Total Area"
 72 "       90.000   Flow length"
 73 "        5.000   Overland Slope"
 74 "        0.544   Pervious Area"
 75 "       90.000   Pervious length"
 76 "        5.000   Pervious slope"
 77 "        0.054   Impervious Area"
 78 "       90.000   Impervious length"
 79 "        5.000   Impervious slope"
 80 "        0.250   Pervious Manning 'n'"
 81 "       75.000   Pervious SCS Curve No."
 82 "        0.317   Pervious Runoff coefficient"
 83 "        0.100   Pervious Ia/S coefficient"
 84 "        8.467   Pervious Initial abstraction"
 85 "        0.015   Impervious Manning 'n'"
 86 "       98.000   Impervious SCS Curve No."
 87 "        0.902   Impervious Runoff coefficient"
 88 "        0.100   Impervious Ia/S coefficient"
 89 "        0.518   Impervious Initial abstraction"
 90 "                    0.031     0.000     0.000     0.000 c.m/sec"
 91 "             Catchment 102          Pervious   Impervious Total Area "
 92 "             Surface Area           0.544      0.054      0.598      hectare"
 93 "             Time of concentration  20.876     2.407      16.818     minutes"
 94 "             Time to Centroid       132.461    91.887     123.546    minutes"
 95 "             Rainfall depth         58.353     58.353     58.353     mm"
 96 "             Rainfall volume        317.54     31.41      348.95     c.m"
 97 "             Rainfall losses        39.869     5.725      36.796     mm"
 98 "             Runoff depth           18.484     52.628     21.557     mm"
 99 "             Runoff volume          100.58     28.32      128.91     c.m"
100 "             Runoff coefficient     0.317      0.902      0.369      "
101 "             Maximum flow           0.028      0.022      0.031      c.m/sec"
102 " 38          START/RE-START TOTALS "
103 "            3   Runoff Totals on EXIT"
104 "             Total Catchment area                        0.000    hectare"
105 "             Total Impervious area                       0.000    hectare"
106 "             Total % impervious                          0.000"
107 " 19          EXIT"
```

```
 1 "                MIDUSS Output ------------------------------------------------>"
 2 "                MIDUSS version                              Version 2.25  rev. 473"
 3 "                MIDUSS created                            Sunday, February 7, 2010"
 4 "           10   Units used:                                                ie METRIC"
 5 "                Job folder:                                        Q:\48650\100\SWM"
 6 "                Output filename:                                       50yr pre.Out"
 7 "                Licensee name:                                                    A"
 8 "                Company                                                           "
 9 "                Date & Time last used:                 10/27/2023 at 1:59:30 PM"
10 " 31          TIME PARAMETERS"
11 "        5.000   Time Step"
12 "      180.000   Max. Storm length"
13 "     1500.000   Max. Hydrograph"
14 " 32          STORM Chicago storm"
15 "            1   Chicago storm"
16 "      780.000   Coefficient A"
17 "        0.360   Constant B"
18 "        0.690   Exponent C"
19 "        0.400   Fraction R"
20 "      180.000   Duration"
21 "        1.000   Time step multiplier"
22 "             Maximum intensity           244.972    mm/hr"
23 "             Total depth                  65.003    mm"
24 "            6   050hyd   Hydrograph extension used in this file"
25 " 33          CATCHMENT 101"
26 "            1   Triangular SCS"
27 "            1   Equal length"
28 "            1   SCS method"
29 "          101   Area to southwest property line, ultimately to Mun. Drain #1"
30 "        0.000   % Impervious"
31 "        0.804   Total Area"
32 "      100.000   Flow length"
33 "        2.000   Overland Slope"
34 "        0.804   Pervious Area"
35 "      100.000   Pervious length"
36 "        2.000   Pervious slope"
37 "        0.000   Impervious Area"
38 "      100.000   Impervious length"
39 "        2.000   Impervious slope"
40 "        0.250   Pervious Manning 'n'"
41 "       75.000   Pervious SCS Curve No."
42 "        0.348   Pervious Runoff coefficient"
43 "        0.100   Pervious Ia/S coefficient"
44 "        8.467   Pervious Initial abstraction"
45 "        0.015   Impervious Manning 'n'"
46 "       98.000   Impervious SCS Curve No."
47 "        0.000   Impervious Runoff coefficient"
48 "        0.100   Impervious Ia/S coefficient"
49 "        0.518   Impervious Initial abstraction"
50 "                     0.041     0.000     0.000     0.000 c.m/sec"
51 "             Catchment 101          Pervious   Impervious Total Area "
52 "             Surface Area           0.804      0.000      0.804      hectare"
53 "             Time of concentration  26.777     3.229      26.777     minutes"
54 "             Time to Centroid       140.702    93.078     140.702    minutes"
55 "             Rainfall depth         65.003     65.003     65.003     mm"
56 "             Rainfall volume        522.62     0.00       522.62     c.m"
57 "             Rainfall losses        42.373     6.372      42.373     mm"
58 "             Runoff depth           22.629     58.631     22.629     mm"
59 "             Runoff volume          181.94     0.00       181.94     c.m"
60 "             Runoff coefficient     0.348      0.000      0.348      "
61 "             Maximum flow           0.041      0.000      0.041      c.m/sec"
62 " 40          HYDROGRAPH Start - New Tributary"
63 "            2   Start - New Tributary"
64 "                     0.041     0.000     0.000     0.000"
65 " 33          CATCHMENT 102"
66 "            1   Triangular SCS"
67 "            1   Equal length"
68 "            1   SCS method"
```

```
 69 "          102   Area to Highway 6"
 70 "        9.000   % Impervious"
 71 "        0.598   Total Area"
 72 "       90.000   Flow length"
 73 "        5.000   Overland Slope"
 74 "        0.544   Pervious Area"
 75 "       90.000   Pervious length"
 76 "        5.000   Pervious slope"
 77 "        0.054   Impervious Area"
 78 "       90.000   Impervious length"
 79 "        5.000   Impervious slope"
 80 "        0.250   Pervious Manning 'n'"
 81 "       75.000   Pervious SCS Curve No."
 82 "        0.347   Pervious Runoff coefficient"
 83 "        0.100   Pervious Ia/S coefficient"
 84 "        8.467   Pervious Initial abstraction"
 85 "        0.015   Impervious Manning 'n'"
 86 "       98.000   Impervious SCS Curve No."
 87 "        0.910   Impervious Runoff coefficient"
 88 "        0.100   Impervious Ia/S coefficient"
 89 "        0.518   Impervious Initial abstraction"
 90 "                    0.040     0.000     0.000     0.000 c.m/sec"
 91 "             Catchment 102          Pervious   Impervious Total Area "
 92 "             Surface Area           0.544      0.054      0.598      hectare"
 93 "             Time of concentration  19.095     2.302      15.639     minutes"
 94 "             Time to Centroid       129.423    91.468     121.612    minutes"
 95 "             Rainfall depth         65.003     65.003     65.003     mm"
 96 "             Rainfall volume        353.73     34.98      388.72     c.m"
 97 "             Rainfall losses        42.415     5.826      39.122     mm"
 98 "             Runoff depth           22.587     59.176     25.880     mm"
 99 "             Runoff volume          122.92     31.85      154.76     c.m"
100 "             Runoff coefficient     0.347      0.910      0.398      "
101 "             Maximum flow           0.036      0.025      0.040      c.m/sec"
102 " 38          START/RE-START TOTALS "
103 "            3   Runoff Totals on EXIT"
104 "             Total Catchment area                        0.000    hectare"
105 "             Total Impervious area                       0.000    hectare"
106 "             Total % impervious                          0.000"
107 " 19          EXIT"
```

```
 1 "                MIDUSS Output ------------------------------------------------>"
 2 "                MIDUSS version                              Version 2.25  rev. 473"
 3 "                MIDUSS created                            Sunday, February 7, 2010"
 4 "           10   Units used:                                                ie METRIC"
 5 "                Job folder:                                        Q:\48650\100\SWM"
 6 "                Output filename:                                      100yr pre.Out"
 7 "                Licensee name:                                                   A"
 8 "                Company                                                          "
 9 "                Date & Time last used:                 10/27/2023 at 3:55:18 PM"
10 " 31          TIME PARAMETERS"
11 "        5.000   Time Step"
12 "      180.000   Max. Storm length"
13 "     1500.000   Max. Hydrograph"
14 " 32          STORM Chicago storm"
15 "            1   Chicago storm"
16 "      851.000   Coefficient A"
17 "        0.290   Constant B"
18 "        0.687   Exponent C"
19 "        0.400   Fraction R"
20 "      180.000   Duration"
21 "        1.000   Time step multiplier"
22 "             Maximum intensity           270.786    mm/hr"
23 "             Total depth                  71.828    mm"
24 "            6   100hyd   Hydrograph extension used in this file"
25 " 33          CATCHMENT 101"
26 "            1   Triangular SCS"
27 "            1   Equal length"
28 "            1   SCS method"
29 "          101   Area to southwest property line, ultimately to Mun. Drain #1"
30 "        0.000   % Impervious"
31 "        0.804   Total Area"
32 "      100.000   Flow length"
33 "        2.000   Overland Slope"
34 "        0.804   Pervious Area"
35 "      100.000   Pervious length"
36 "        2.000   Pervious slope"
37 "        0.000   Impervious Area"
38 "      100.000   Impervious length"
39 "        2.000   Impervious slope"
40 "        0.250   Pervious Manning 'n'"
41 "       75.000   Pervious SCS Curve No."
42 "        0.377   Pervious Runoff coefficient"
43 "        0.100   Pervious Ia/S coefficient"
44 "        8.467   Pervious Initial abstraction"
45 "        0.015   Impervious Manning 'n'"
46 "       98.000   Impervious SCS Curve No."
47 "        0.000   Impervious Runoff coefficient"
48 "        0.100   Impervious Ia/S coefficient"
49 "        0.518   Impervious Initial abstraction"
50 "                     0.056     0.000     0.000     0.000 c.m/sec"
51 "             Catchment 101          Pervious   Impervious Total Area "
52 "             Surface Area           0.804      0.000      0.804      hectare"
53 "             Time of concentration  24.716     3.096      24.715     minutes"
54 "             Time to Centroid       137.449    92.639     137.449    minutes"
55 "             Rainfall depth         71.828     71.828     71.828     mm"
56 "             Rainfall volume        577.50     0.00       577.50     c.m"
57 "             Rainfall losses        44.722     6.351      44.722     mm"
58 "             Runoff depth           27.106     65.478     27.106     mm"
59 "             Runoff volume          217.93     0.00       217.93     c.m"
60 "             Runoff coefficient     0.377      0.000      0.377      "
61 "             Maximum flow           0.056      0.000      0.056      c.m/sec"
62 " 40          HYDROGRAPH Start - New Tributary"
63 "            2   Start - New Tributary"
64 "                     0.056     0.000     0.000     0.000"
65 " 33          CATCHMENT 102"
66 "            1   Triangular SCS"
67 "            1   Equal length"
68 "            1   SCS method"
```

```
 69 "          102   Area to Highway 6"
 70 "        9.000   % Impervious"
 71 "        0.598   Total Area"
 72 "       90.000   Flow length"
 73 "        5.000   Overland Slope"
 74 "        0.544   Pervious Area"
 75 "       90.000   Pervious length"
 76 "        5.000   Pervious slope"
 77 "        0.054   Impervious Area"
 78 "       90.000   Impervious length"
 79 "        5.000   Impervious slope"
 80 "        0.250   Pervious Manning 'n'"
 81 "       75.000   Pervious SCS Curve No."
 82 "        0.377   Pervious Runoff coefficient"
 83 "        0.100   Pervious Ia/S coefficient"
 84 "        8.467   Pervious Initial abstraction"
 85 "        0.015   Impervious Manning 'n'"
 86 "       98.000   Impervious SCS Curve No."
 87 "        0.917   Impervious Runoff coefficient"
 88 "        0.100   Impervious Ia/S coefficient"
 89 "        0.518   Impervious Initial abstraction"
 90 "                    0.052     0.000     0.000     0.000 c.m/sec"
 91 "             Catchment 102          Pervious   Impervious Total Area "
 92 "             Surface Area           0.544      0.054      0.598      hectare"
 93 "             Time of concentration  17.625     2.208      14.639     minutes"
 94 "             Time to Centroid       126.874    91.122     119.949    minutes"
 95 "             Rainfall depth         71.828     71.828     71.828     mm"
 96 "             Rainfall volume        390.88     38.66      429.53     c.m"
 97 "             Rainfall losses        44.716     5.977      41.230     mm"
 98 "             Runoff depth           27.112     65.851     30.599     mm"
 99 "             Runoff volume          147.54     35.44      182.98     c.m"
100 "             Runoff coefficient     0.377      0.917      0.426      "
101 "             Maximum flow           0.045      0.028      0.052      c.m/sec"
102 " 38          START/RE-START TOTALS "
103 "            3   Runoff Totals on EXIT"
104 "             Total Catchment area                        0.000    hectare"
105 "             Total Impervious area                       0.000    hectare"
106 "             Total % impervious                          0.000"
107 " 19          EXIT"
```

```
 1 "                MIDUSS Output ------------------------------------------------>"
 2 "                MIDUSS version                              Version 2.25  rev. 473"
 3 "                MIDUSS created                            Sunday, February 7, 2010"
 4 "           10   Units used:                                                ie METRIC"
 5 "                Job folder:                                        Q:\48650\100\SWM"
 6 "                Output filename:                                    2yr post r4.out"
 7 "                Licensee name:                                                   A"
 8 "                Company                                                          "
 9 "                Date & Time last used:                  10/27/2023 at 4:01:22 PM"
10 " 31          TIME PARAMETERS"
11 "        5.000   Time Step"
12 "      180.000   Max. Storm length"
13 "     1500.000   Max. Hydrograph"
14 " 32          STORM Chicago storm"
15 "            1   Chicago storm"
16 "      375.000   Coefficient A"
17 "        0.240   Constant B"
18 "        0.689   Exponent C"
19 "        0.400   Fraction R"
20 "      180.000   Duration"
21 "        1.000   Time step multiplier"
22 "             Maximum intensity           119.788    mm/hr"
23 "             Total depth                  31.396    mm"
24 "            6   002hyd   Hydrograph extension used in this file"
25 " 81          ADD COMMENT==================================================="
26 "          2  Lines of comment"
27 "             IA increased to 20mm to account for roof and landscape area "
28 "             runoff reduction due to amended topsoil"
29 " 33          CATCHMENT 201"
30 "            1   Triangular SCS"
31 "            1   Equal length"
32 "            1   SCS method"
33 "          201   Area to southwest property line, ultimately to Mun Drain #1"
34 "       46.000   % Impervious"
35 "        0.136   Total Area"
36 "       15.000   Flow length"
37 "        2.000   Overland Slope"
38 "        0.073   Pervious Area"
39 "       15.000   Pervious length"
40 "        2.000   Pervious slope"
41 "        0.063   Impervious Area"
42 "       15.000   Impervious length"
43 "        2.000   Impervious slope"
44 "        0.250   Pervious Manning 'n'"
45 "       75.000   Pervious SCS Curve No."
46 "        0.043   Pervious Runoff coefficient"
47 "        0.236   Pervious Ia/S coefficient"
48 "       19.981   Pervious Initial abstraction"
49 "        0.015   Impervious Manning 'n'"
50 "       98.000   Impervious SCS Curve No."
51 "        0.248   Impervious Runoff coefficient"
52 "        3.858   Impervious Ia/S coefficient"
53 "       19.999   Impervious Initial abstraction"
54 "                     0.001     0.000     0.000     0.000 c.m/sec"
55 "             Catchment 201          Pervious   Impervious Total Area "
56 "             Surface Area           0.073      0.063      0.136      hectare"
57 "             Time of concentration  52.330     4.179      12.363     minutes"
58 "             Time to Centroid       172.140    128.081    135.570    minutes"
59 "             Rainfall depth         31.396     31.396     31.396     mm"
60 "             Rainfall volume        23.06      19.64      42.70      c.m"
61 "             Rainfall losses        30.040     23.624     27.089     mm"
62 "             Runoff depth           1.356      7.771      4.307      mm"
63 "             Runoff volume          1.00       4.86       5.86       c.m"
64 "             Runoff coefficient     0.043      0.248      0.137      "
65 "             Maximum flow           0.000      0.001      0.001      c.m/sec"
66 " 40          HYDROGRAPH Start - New Tributary"
67 "            2   Start - New Tributary"
68 "                     0.001     0.000     0.000     0.000"
```

```
 69 " 81          ADD COMMENT================================================="
 70 "          2  Lines of comment"
 71 "             IA increased to 20mm to account for roof and landscape area "
 72 "             runoff reduction due to amended topsoil"
 73 " 33          CATCHMENT 202"
 74 "            1   Triangular SCS"
 75 "            1   Equal length"
 76 "            1   SCS method"
 77 "          202   Controlled area to Highway 6"
 78 "       70.000   % Impervious"
 79 "        0.962   Total Area"
 80 "       15.000   Flow length"
 81 "        2.000   Overland Slope"
 82 "        0.289   Pervious Area"
 83 "       15.000   Pervious length"
 84 "        2.000   Pervious slope"
 85 "        0.673   Impervious Area"
 86 "       15.000   Impervious length"
 87 "        2.000   Impervious slope"
 88 "        0.250   Pervious Manning 'n'"
 89 "       75.000   Pervious SCS Curve No."
 90 "        0.043   Pervious Runoff coefficient"
 91 "        0.236   Pervious Ia/S coefficient"
 92 "       19.981   Pervious Initial abstraction"
 93 "        0.015   Impervious Manning 'n'"
 94 "       98.000   Impervious SCS Curve No."
 95 "        0.825   Impervious Runoff coefficient"
 96 "        0.100   Impervious Ia/S coefficient"
 97 "        0.518   Impervious Initial abstraction"
 98 "                     0.159     0.000     0.000     0.000 c.m/sec"
 99 "             Catchment 202          Pervious   Impervious Total Area "
100 "             Surface Area           0.289      0.673      0.962      hectare"
101 "             Time of concentration  52.330     1.412      2.530      minutes"
102 "             Time to Centroid       172.140    92.372     94.123     minutes"
103 "             Rainfall depth         31.396     31.396     31.396     mm"
104 "             Rainfall volume        90.61      211.42     302.03     c.m"
105 "             Rainfall losses        30.040     5.505      12.866     mm"
106 "             Runoff depth           1.356      25.891     18.530     mm"
107 "             Runoff volume          3.91       174.35     178.26     c.m"
108 "             Runoff coefficient     0.043      0.825      0.590      "
109 "             Maximum flow           0.001      0.159      0.159      c.m/sec"
110 " 40          HYDROGRAPH Add Runoff "
111 "            4   Add Runoff "
112 "                     0.159     0.159     0.000     0.000"
113 " 54          POND DESIGN"
114 "        0.159   Current peak flow    c.m/sec"
115 "        0.207   Target outflow    c.m/sec"
116 "        178.3   Hydrograph volume    c.m"
117 "           9.   Number of stages"
118 "      421.990   Minimum water level    metre"
119 "      424.030   Maximum water level    metre"
120 "      421.990   Starting water level    metre"
121 "            0   Keep Design Data: 1 = True; 0 = False"
122 "                  Level Discharge    Volume"
123 "                421.990     0.000     0.000"
124 "                422.200   0.00642  1.01E-05"
125 "                422.600   0.01201    85.000"
126 "                423.000   0.01572   170.000"
127 "                423.500   0.01939   211.987"
128 "                423.830   0.02147   221.426"
129 "                423.930   0.02206   239.726"
130 "                423.980   0.02235   270.251"
131 "                424.030   0.06480   325.201"
132 "          1.   WEIRS"
133 "                  Crest      Weir     Crest      Left     Right"
134 "              elevation coefficie   breadth sideslope sideslope"
135 "                423.980     0.900     0.600    50.000    50.000"
136 "          1.   ORIFICES"
```

```
137 "               Orifice   Orifice   Orifice Number of"
138 "                invert coefficie  diameter  orifices"
139 "               421.990     0.820    0.0750     1.000"
140 "             Peak outflow                  0.012    c.m/sec"
141 "             Maximum level               422.646    metre"
142 "             Maximum storage              94.734    c.m"
143 "             Centroidal lag                3.033   hours"
144 "                  0.159     0.159     0.012     0.000 c.m/sec"
145 " 40          HYDROGRAPH   Combine    1"
146 "            6   Combine "
147 "            1   Node #"
148 "                Total to Highway #6"
149 "             Maximum flow                  0.012    c.m/sec"
150 "             Hydrograph volume           178.968    c.m"
151 "                     0.159     0.159     0.012     0.012"
152 " 40          HYDROGRAPH Start - New Tributary"
153 "            2   Start - New Tributary"
154 "                     0.159     0.000     0.012     0.012"
155 " 81          ADD COMMENT================================================="
156 "          2  Lines of comment"
157 "             IA increased to 20mm to account for roof and landscape area "
158 "             runoff reduction due to amended topsoil"
159 " 33          CATCHMENT 203"
160 "            1   Triangular SCS"
161 "            1   Equal length"
162 "            1   SCS method"
163 "          203   Uncontrolled to Highway 6"
164 "       23.000   % Impervious"
165 "        0.304   Total Area"
166 "      120.000   Flow length"
167 "        2.000   Overland Slope"
168 "        0.234   Pervious Area"
169 "      120.000   Pervious length"
170 "        2.000   Pervious slope"
171 "        0.070   Impervious Area"
172 "      120.000   Impervious length"
173 "        2.000   Impervious slope"
174 "        0.250   Pervious Manning 'n'"
175 "       75.000   Pervious SCS Curve No."
176 "        0.043   Pervious Runoff coefficient"
177 "        0.236   Pervious Ia/S coefficient"
178 "       19.981   Pervious Initial abstraction"
179 "        0.015   Impervious Manning 'n'"
180 "       98.000   Impervious SCS Curve No."
181 "        0.249   Impervious Runoff coefficient"
182 "        3.858   Impervious Ia/S coefficient"
183 "       19.999   Impervious Initial abstraction"
184 "                     0.001     0.000     0.012     0.012 c.m/sec"
185 "             Catchment 203          Pervious   Impervious Total Area "
186 "             Surface Area           0.234      0.070      0.304      hectare"
187 "             Time of concentration  182.223    14.553     76.159     minutes"
188 "             Time to Centroid       271.867    137.008    186.559    minutes"
189 "             Rainfall depth         31.396     31.396     31.396     mm"
190 "             Rainfall volume        73.49      21.95      95.44      c.m"
191 "             Rainfall losses        30.040     23.580     28.554     mm"
192 "             Runoff depth           1.356      7.816      2.842      mm"
193 "             Runoff volume          3.17       5.46       8.64       c.m"
194 "             Runoff coefficient     0.043      0.249      0.091      "
195 "             Maximum flow           0.000      0.001      0.001      c.m/sec"
196 " 40          HYDROGRAPH Add Runoff "
197 "            4   Add Runoff "
198 "                     0.001     0.001     0.012     0.012"
199 " 40          HYDROGRAPH Copy to Outflow"
200 "            8   Copy to Outflow"
201 "                     0.001     0.001     0.001     0.012"
202 " 40          HYDROGRAPH   Combine    1"
203 "            6   Combine "
204 "            1   Node #"
```

```
205 "               Total to Highway #6"
206 "             Maximum flow                  0.014    c.m/sec"
207 "             Hydrograph volume           187.607    c.m"
208 "                     0.001     0.001     0.001     0.014"
209 " 38          START/RE-START TOTALS 203"
210 "            3   Runoff Totals on EXIT"
211 "             Total Catchment area                      1.266    hectare"
212 "             Total Impervious area                     0.743    hectare"
213 "             Total % impervious                       58.714"
214 " 19          EXIT"
```

```
 1 "                MIDUSS Output ------------------------------------------------>"
 2 "                MIDUSS version                            Version 2.25  rev. 473"
 3 "                MIDUSS created                          Sunday, February 7, 2010"
 4 "           10   Units used:                                              ie METRIC"
 5 "                Job folder:                                    Q:\48650\100\SWM"
 6 "                Output filename:                                5yr post r4.out"
 7 "                Licensee name:                                                A"
 8 "                Company                                                       "
 9 "                Date & Time last used:                 10/27/2023 at 4:00:16 PM"
10 " 31          TIME PARAMETERS"
11 "        5.000   Time Step"
12 "      180.000   Max. Storm length"
13 "     1500.000   Max. Hydrograph"
14 " 32          STORM Chicago storm"
15 "            1   Chicago storm"
16 "      500.000   Coefficient A"
17 "        0.240   Constant B"
18 "        0.688   Exponent C"
19 "        0.400   Fraction R"
20 "      180.000   Duration"
21 "        1.000   Time step multiplier"
22 "             Maximum intensity           160.061    mm/hr"
23 "             Total depth                  42.145    mm"
24 "            6   005hyd   Hydrograph extension used in this file"
25 " 81          ADD COMMENT==================================================="
26 "          2  Lines of comment"
27 "             IA increased to 20mm to account for roof and landscape area "
28 "             runoff reduction due to amended topsoil"
29 " 33          CATCHMENT 201"
30 "            1   Triangular SCS"
31 "            1   Equal length"
32 "            1   SCS method"
33 "          201   Area to southwest property line, ultimately to Mun Drain #1"
34 "       46.000   % Impervious"
35 "        0.136   Total Area"
36 "       15.000   Flow length"
37 "        2.000   Overland Slope"
38 "        0.073   Pervious Area"
39 "       15.000   Pervious length"
40 "        2.000   Pervious slope"
41 "        0.063   Impervious Area"
42 "       15.000   Impervious length"
43 "        2.000   Impervious slope"
44 "        0.250   Pervious Manning 'n'"
45 "       75.000   Pervious SCS Curve No."
46 "        0.109   Pervious Runoff coefficient"
47 "        0.236   Pervious Ia/S coefficient"
48 "       19.981   Pervious Initial abstraction"
49 "        0.015   Impervious Manning 'n'"
50 "       98.000   Impervious SCS Curve No."
51 "        0.417   Impervious Runoff coefficient"
52 "        3.858   Impervious Ia/S coefficient"
53 "       19.999   Impervious Initial abstraction"
54 "                    0.005     0.000     0.000     0.000 c.m/sec"
55 "             Catchment 201          Pervious   Impervious Total Area "
56 "             Surface Area           0.073      0.063      0.136      hectare"
57 "             Time of concentration  26.171     2.385      7.965      minutes"
58 "             Time to Centroid       143.656    111.673    119.176    minutes"
59 "             Rainfall depth         42.145     42.145     42.145     mm"
60 "             Rainfall volume        30.95      26.37      57.32      c.m"
61 "             Rainfall losses        37.551     24.551     31.571     mm"
62 "             Runoff depth           4.593      17.594     10.574     mm"
63 "             Runoff volume          3.37       11.01      14.38      c.m"
64 "             Runoff coefficient     0.109      0.417      0.251      "
65 "             Maximum flow           0.001      0.005      0.005      c.m/sec"
66 " 40          HYDROGRAPH Start - New Tributary"
67 "            2   Start - New Tributary"
68 "                    0.005     0.000     0.000     0.000"
```

```
 69 " 81          ADD COMMENT================================================="
 70 "          2  Lines of comment"
 71 "             IA increased to 20mm to account for roof and landscape area "
 72 "             runoff reduction due to amended topsoil"
 73 " 33          CATCHMENT 202"
 74 "             1   Triangular SCS"
 75 "             1   Equal length"
 76 "             1   SCS method"
 77 "           202   Controlled area to Highway 6"
 78 "        70.000   % Impervious"
 79 "         0.962   Total Area"
 80 "        15.000   Flow length"
 81 "         2.000   Overland Slope"
 82 "         0.289   Pervious Area"
 83 "        15.000   Pervious length"
 84 "         2.000   Pervious slope"
 85 "         0.673   Impervious Area"
 86 "        15.000   Impervious length"
 87 "         2.000   Impervious slope"
 88 "         0.250   Pervious Manning 'n'"
 89 "        75.000   Pervious SCS Curve No."
 90 "         0.109   Pervious Runoff coefficient"
 91 "         0.236   Pervious Ia/S coefficient"
 92 "        19.981   Pervious Initial abstraction"
 93 "         0.015   Impervious Manning 'n'"
 94 "        98.000   Impervious SCS Curve No."
 95 "         0.855   Impervious Runoff coefficient"
 96 "         0.100   Impervious Ia/S coefficient"
 97 "         0.518   Impervious Initial abstraction"
 98 "                      0.226     0.000     0.000     0.000 c.m/sec"
 99 "             Catchment 202          Pervious   Impervious Total Area "
100 "             Surface Area           0.289      0.673      0.962      hectare"
101 "             Time of concentration  26.171     1.241      2.533      minutes"
102 "             Time to Centroid       143.656    91.016     93.743     minutes"
103 "             Rainfall depth         42.145     42.145     42.145     mm"
104 "             Rainfall volume        121.63     283.80     405.43     c.m"
105 "             Rainfall losses        37.551     6.117      15.548     mm"
106 "             Runoff depth           4.593      36.027     26.597     mm"
107 "             Runoff volume          13.26      242.61     255.86     c.m"
108 "             Runoff coefficient     0.109      0.855      0.631      "
109 "             Maximum flow           0.002      0.226      0.226      c.m/sec"
110 " 40          HYDROGRAPH Add Runoff "
111 "             4   Add Runoff "
112 "                      0.226     0.226     0.000     0.000"
113 " 54          POND DESIGN"
114 "         0.226   Current peak flow    c.m/sec"
115 "         0.207   Target outflow    c.m/sec"
116 "         255.9   Hydrograph volume    c.m"
117 "            9.   Number of stages"
118 "       421.990   Minimum water level    metre"
119 "       424.030   Maximum water level    metre"
120 "       421.990   Starting water level    metre"
121 "             0   Keep Design Data: 1 = True; 0 = False"
122 "                   Level Discharge    Volume"
123 "                 421.990     0.000     0.000"
124 "                 422.200   0.00642  1.01E-05"
125 "                 422.600   0.01201    85.000"
126 "                 423.000   0.01572   170.000"
127 "                 423.500   0.01939   211.987"
128 "                 423.830   0.02147   221.426"
129 "                 423.930   0.02206   239.726"
130 "                 423.980   0.02235   270.251"
131 "                 424.030   0.06480   325.201"
132 "           1.   WEIRS"
133 "                   Crest      Weir     Crest      Left     Right"
134 "               elevation coefficie   breadth sideslope sideslope"
135 "                 423.980     0.900     0.600    50.000    50.000"
136 "           1.   ORIFICES"
```

```
137 "               Orifice   Orifice   Orifice Number of"
138 "                invert coefficie  diameter  orifices"
139 "               421.990     0.820    0.0750     1.000"
140 "             Peak outflow                  0.015    c.m/sec"
141 "             Maximum level               422.894    metre"
142 "             Maximum storage             147.562    c.m"
143 "             Centroidal lag                3.478   hours"
144 "                  0.226     0.226     0.015     0.000 c.m/sec"
145 " 40          HYDROGRAPH   Combine    1"
146 "            6   Combine "
147 "            1   Node #"
148 "                Total to Highway #6"
149 "             Maximum flow                  0.015    c.m/sec"
150 "             Hydrograph volume           254.889    c.m"
151 "                     0.226     0.226     0.015     0.015"
152 " 40          HYDROGRAPH Start - New Tributary"
153 "            2   Start - New Tributary"
154 "                     0.226     0.000     0.015     0.015"
155 " 81          ADD COMMENT================================================="
156 "           2  Lines of comment"
157 "              IA increased to 20mm to account for roof and landscape area "
158 "              runoff reduction due to amended topsoil"
159 " 33          CATCHMENT 203"
160 "             1   Triangular SCS"
161 "             1   Equal length"
162 "             1   SCS method"
163 "           203   Uncontrolled to Highway 6"
164 "        23.000   % Impervious"
165 "         0.304   Total Area"
166 "       120.000   Flow length"
167 "         2.000   Overland Slope"
168 "         0.234   Pervious Area"
169 "       120.000   Pervious length"
170 "         2.000   Pervious slope"
171 "         0.070   Impervious Area"
172 "       120.000   Impervious length"
173 "         2.000   Impervious slope"
174 "         0.250   Pervious Manning 'n'"
175 "        75.000   Pervious SCS Curve No."
176 "         0.109   Pervious Runoff coefficient"
177 "         0.236   Pervious Ia/S coefficient"
178 "        19.981   Pervious Initial abstraction"
179 "         0.015   Impervious Manning 'n'"
180 "        98.000   Impervious SCS Curve No."
181 "         0.424   Impervious Runoff coefficient"
182 "         3.858   Impervious Ia/S coefficient"
183 "        19.999   Impervious Initial abstraction"
184 "                     0.005     0.000     0.015     0.015 c.m/sec"
185 "              Catchment 203          Pervious   Impervious Total Area "
186 "              Surface Area           0.234      0.070      0.304      hectare"
187 "              Time of concentration  91.133     8.304      46.625     minutes"
188 "              Time to Centroid       205.843    118.191    158.743    minutes"
189 "              Rainfall depth         42.145     42.145     42.145     mm"
190 "              Rainfall volume        98.65      29.47      128.12     c.m"
191 "              Rainfall losses        37.547     24.268     34.493     mm"
192 "              Runoff depth           4.598      17.877     7.652      mm"
193 "              Runoff volume          10.76      12.50      23.26      c.m"
194 "              Runoff coefficient     0.109      0.424      0.182      "
195 "              Maximum flow           0.001      0.005      0.005      c.m/sec"
196 " 40          HYDROGRAPH Add Runoff "
197 "            4   Add Runoff "
198 "                     0.005     0.005     0.015     0.015"
199 " 40          HYDROGRAPH Copy to Outflow"
200 "            8   Copy to Outflow"
201 "                     0.005     0.005     0.005     0.015"
202 " 40          HYDROGRAPH   Combine    1"
203 "            6   Combine "
204 "            1   Node #"
```

```
205 "               Total to Highway #6"
206 "             Maximum flow                  0.019    c.m/sec"
207 "             Hydrograph volume           278.150    c.m"
208 "                     0.005     0.005     0.005     0.019"
209 " 38          START/RE-START TOTALS 203"
210 "            3   Runoff Totals on EXIT"
211 "             Total Catchment area                      1.266    hectare"
212 "             Total Impervious area                     0.743    hectare"
213 "             Total % impervious                       58.714"
214 " 19          EXIT"
```

```
 1 "                MIDUSS Output ------------------------------------------------>"
 2 "                MIDUSS version                            Version 2.25  rev. 473"
 3 "                MIDUSS created                          Sunday, February 7, 2010"
 4 "           10   Units used:                                              ie METRIC"
 5 "                Job folder:                                     Q:\48650\100\SWM"
 6 "                Output filename:                                10yr post r4.out"
 7 "                Licensee name:                                                A"
 8 "                Company                                                       "
 9 "                Date & Time last used:                 10/27/2023 at 3:59:18 PM"
10 " 31          TIME PARAMETERS"
11 "        5.000   Time Step"
12 "      180.000   Max. Storm length"
13 "     1500.000   Max. Hydrograph"
14 " 32          STORM Chicago storm"
15 "            1   Chicago storm"
16 "      595.000   Coefficient A"
17 "        0.360   Constant B"
18 "        0.691   Exponent C"
19 "        0.400   Fraction R"
20 "      180.000   Duration"
21 "        1.000   Time step multiplier"
22 "             Maximum intensity           186.431    mm/hr"
23 "             Total depth                  49.226    mm"
24 "            6   010hyd   Hydrograph extension used in this file"
25 " 81          ADD COMMENT================================================="
26 "          2  Lines of comment"
27 "             IA increased to 20mm to account for roof and landscape area "
28 "             runoff reduction due to amended topsoil"
29 " 33          CATCHMENT 201"
30 "            1   Triangular SCS"
31 "            1   Equal length"
32 "            1   SCS method"
33 "          201   Area to southwest property line, ultimately to Mun Drain #1"
34 "       46.000   % Impervious"
35 "        0.136   Total Area"
36 "       15.000   Flow length"
37 "        2.000   Overland Slope"
38 "        0.073   Pervious Area"
39 "       15.000   Pervious length"
40 "        2.000   Pervious slope"
41 "        0.063   Impervious Area"
42 "       15.000   Impervious length"
43 "        2.000   Impervious slope"
44 "        0.250   Pervious Manning 'n'"
45 "       75.000   Pervious SCS Curve No."
46 "        0.152   Pervious Runoff coefficient"
47 "        0.236   Pervious Ia/S coefficient"
48 "       19.981   Pervious Initial abstraction"
49 "        0.015   Impervious Manning 'n'"
50 "       98.000   Impervious SCS Curve No."
51 "        0.495   Impervious Runoff coefficient"
52 "        3.858   Impervious Ia/S coefficient"
53 "       19.999   Impervious Initial abstraction"
54 "                    0.009     0.000     0.000     0.000 c.m/sec"
55 "             Catchment 201          Pervious   Impervious Total Area "
56 "             Surface Area           0.073      0.063      0.136      hectare"
57 "             Time of concentration  19.542     1.701      6.436      minutes"
58 "             Time to Centroid       134.145    106.408    113.769    minutes"
59 "             Rainfall depth         49.226     49.226     49.226     mm"
60 "             Rainfall volume        36.15      30.80      66.95      c.m"
61 "             Rainfall losses        41.729     24.869     33.973     mm"
62 "             Runoff depth           7.497      24.357     15.253     mm"
63 "             Runoff volume          5.51       15.24      20.74      c.m"
64 "             Runoff coefficient     0.152      0.495      0.310      "
65 "             Maximum flow           0.001      0.008      0.009      c.m/sec"
66 " 40          HYDROGRAPH Start - New Tributary"
67 "            2   Start - New Tributary"
68 "                    0.009     0.000     0.000     0.000"
```

```
 69 " 81          ADD COMMENT================================================="
 70 "          2  Lines of comment"
 71 "             IA increased to 20mm to account for roof and landscape area "
 72 "             runoff reduction due to amended topsoil"
 73 " 33          CATCHMENT 202"
 74 "            1   Triangular SCS"
 75 "            1   Equal length"
 76 "            1   SCS method"
 77 "          202   Controlled area to Highway 6"
 78 "       70.000   % Impervious"
 79 "        0.962   Total Area"
 80 "       15.000   Flow length"
 81 "        2.000   Overland Slope"
 82 "        0.289   Pervious Area"
 83 "       15.000   Pervious length"
 84 "        2.000   Pervious slope"
 85 "        0.673   Impervious Area"
 86 "       15.000   Impervious length"
 87 "        2.000   Impervious slope"
 88 "        0.250   Pervious Manning 'n'"
 89 "       75.000   Pervious SCS Curve No."
 90 "        0.152   Pervious Runoff coefficient"
 91 "        0.236   Pervious Ia/S coefficient"
 92 "       19.981   Pervious Initial abstraction"
 93 "        0.015   Impervious Manning 'n'"
 94 "       98.000   Impervious SCS Curve No."
 95 "        0.867   Impervious Runoff coefficient"
 96 "        0.100   Impervious Ia/S coefficient"
 97 "        0.518   Impervious Initial abstraction"
 98 "                     0.270     0.000     0.000     0.000 c.m/sec"
 99 "             Catchment 202          Pervious   Impervious Total Area "
100 "             Surface Area           0.289      0.673      0.962      hectare"
101 "             Time of concentration  19.542     1.162      2.448      minutes"
102 "             Time to Centroid       134.145    90.250     93.321     minutes"
103 "             Rainfall depth         49.226     49.226     49.226     mm"
104 "             Rainfall volume        142.07     331.49     473.55     c.m"
105 "             Rainfall losses        41.729     6.525      17.086     mm"
106 "             Runoff depth           7.497      42.701     32.140     mm"
107 "             Runoff volume          21.64      287.55     309.18     c.m"
108 "             Runoff coefficient     0.152      0.867      0.653      "
109 "             Maximum flow           0.005      0.270      0.270      c.m/sec"
110 " 40          HYDROGRAPH Add Runoff "
111 "            4   Add Runoff "
112 "                     0.270     0.270     0.000     0.000"
113 " 54          POND DESIGN"
114 "        0.270   Current peak flow    c.m/sec"
115 "        0.207   Target outflow    c.m/sec"
116 "        309.2   Hydrograph volume    c.m"
117 "           9.   Number of stages"
118 "      421.990   Minimum water level    metre"
119 "      424.030   Maximum water level    metre"
120 "      421.990   Starting water level    metre"
121 "            0   Keep Design Data: 1 = True; 0 = False"
122 "                  Level Discharge    Volume"
123 "                421.990     0.000     0.000"
124 "                422.200   0.00642  1.01E-05"
125 "                422.600   0.01201    85.000"
126 "                423.000   0.01572   170.000"
127 "                423.500   0.01939   211.987"
128 "                423.830   0.02147   221.426"
129 "                423.930   0.02206   239.726"
130 "                423.980   0.02235   270.251"
131 "                424.030   0.06480   325.201"
132 "          1.   WEIRS"
133 "                  Crest      Weir     Crest      Left     Right"
134 "              elevation coefficie   breadth sideslope sideslope"
135 "                423.980     0.900     0.600    50.000    50.000"
136 "          1.   ORIFICES"
```

```
137 "               Orifice   Orifice   Orifice Number of"
138 "                invert coefficie  diameter  orifices"
139 "               421.990     0.820    0.0750     1.000"
140 "             Peak outflow                  0.017    c.m/sec"
141 "             Maximum level               423.185    metre"
142 "             Maximum storage             185.514    c.m"
143 "             Centroidal lag                3.733   hours"
144 "                  0.270     0.270     0.017     0.000 c.m/sec"
145 " 40          HYDROGRAPH   Combine    1"
146 "            6   Combine "
147 "            1   Node #"
148 "                Total to Highway #6"
149 "             Maximum flow                  0.017    c.m/sec"
150 "             Hydrograph volume           309.496    c.m"
151 "                     0.270     0.270     0.017     0.017"
152 " 40          HYDROGRAPH Start - New Tributary"
153 "            2   Start - New Tributary"
154 "                     0.270     0.000     0.017     0.017"
155 " 81          ADD COMMENT================================================="
156 "           2  Lines of comment"
157 "              IA increased to 20mm to account for roof and landscape area "
158 "              runoff reduction due to amended topsoil"
159 " 33          CATCHMENT 203"
160 "             1   Triangular SCS"
161 "             1   Equal length"
162 "             1   SCS method"
163 "           203   Uncontrolled to Highway 6"
164 "        23.000   % Impervious"
165 "         0.304   Total Area"
166 "       120.000   Flow length"
167 "         2.000   Overland Slope"
168 "         0.234   Pervious Area"
169 "       120.000   Pervious length"
170 "         2.000   Pervious slope"
171 "         0.070   Impervious Area"
172 "       120.000   Impervious length"
173 "         2.000   Impervious slope"
174 "         0.250   Pervious Manning 'n'"
175 "        75.000   Pervious SCS Curve No."
176 "         0.153   Pervious Runoff coefficient"
177 "         0.236   Pervious Ia/S coefficient"
178 "        19.981   Pervious Initial abstraction"
179 "         0.015   Impervious Manning 'n'"
180 "        98.000   Impervious SCS Curve No."
181 "         0.501   Impervious Runoff coefficient"
182 "         3.858   Impervious Ia/S coefficient"
183 "        19.999   Impervious Initial abstraction"
184 "                     0.008     0.000     0.017     0.017 c.m/sec"
185 "              Catchment 203          Pervious   Impervious Total Area "
186 "              Surface Area           0.234      0.070      0.304      hectare"
187 "              Time of concentration  68.049     5.923      37.281     minutes"
188 "              Time to Centroid       184.489    112.215    148.695    minutes"
189 "              Rainfall depth         49.226     49.226     49.226     mm"
190 "              Rainfall volume        115.23     34.42      149.65     c.m"
191 "              Rainfall losses        41.719     24.566     37.773     mm"
192 "              Runoff depth           7.507      24.660     11.453     mm"
193 "              Runoff volume          17.57      17.24      34.82      c.m"
194 "              Runoff coefficient     0.153      0.501      0.233      "
195 "              Maximum flow           0.002      0.008      0.008      c.m/sec"
196 " 40          HYDROGRAPH Add Runoff "
197 "            4   Add Runoff "
198 "                     0.008     0.008     0.017     0.017"
199 " 40          HYDROGRAPH Copy to Outflow"
200 "            8   Copy to Outflow"
201 "                     0.008     0.008     0.008     0.017"
202 " 40          HYDROGRAPH   Combine    1"
203 "            6   Combine "
204 "            1   Node #"
```

```
205 "               Total to Highway #6"
206 "             Maximum flow                  0.023    c.m/sec"
207 "             Hydrograph volume           344.312    c.m"
208 "                     0.008     0.008     0.008     0.023"
209 " 38          START/RE-START TOTALS 203"
210 "            3   Runoff Totals on EXIT"
211 "             Total Catchment area                     1.266    hectare"
212 "             Total Impervious area                    0.743    hectare"
213 "             Total % impervious                      58.714"
214 " 19          EXIT"
```

```
 1 "                MIDUSS Output ------------------------------------------------>"
 2 "                MIDUSS version                            Version 2.25  rev. 473"
 3 "                MIDUSS created                          Sunday, February 7, 2010"
 4 "           10   Units used:                                              ie METRIC"
 5 "                Job folder:                                      Q:\48650\100\SWM"
 6 "                Output filename:                                 25yr post r4.out"
 7 "                Licensee name:                                                 A"
 8 "                Company                                                        "
 9 "                Date & Time last used:                10/27/2023 at 3:58:24 PM"
10 " 31          TIME PARAMETERS"
11 "        5.000   Time Step"
12 "      180.000   Max. Storm length"
13 "     1500.000   Max. Hydrograph"
14 " 32          STORM Chicago storm"
15 "            1   Chicago storm"
16 "      702.000   Coefficient A"
17 "        0.350   Constant B"
18 "        0.690   Exponent C"
19 "        0.400   Fraction R"
20 "      180.000   Duration"
21 "        1.000   Time step multiplier"
22 "             Maximum intensity           220.574    mm/hr"
23 "             Total depth                  58.353    mm"
24 "            6   025hyd   Hydrograph extension used in this file"
25 " 81          ADD COMMENT================================================="
26 "          2  Lines of comment"
27 "             IA increased to 20mm to account for roof and landscape area "
28 "             runoff reduction due to amended topsoil"
29 " 33          CATCHMENT 201"
30 "            1   Triangular SCS"
31 "            1   Equal length"
32 "            1   SCS method"
33 "          201   Area to southwest property line, ultimately to Mun Drain #1"
34 "       46.000   % Impervious"
35 "        0.136   Total Area"
36 "       15.000   Flow length"
37 "        2.000   Overland Slope"
38 "        0.073   Pervious Area"
39 "       15.000   Pervious length"
40 "        2.000   Pervious slope"
41 "        0.063   Impervious Area"
42 "       15.000   Impervious length"
43 "        2.000   Impervious slope"
44 "        0.250   Pervious Manning 'n'"
45 "       75.000   Pervious SCS Curve No."
46 "        0.205   Pervious Runoff coefficient"
47 "        0.236   Pervious Ia/S coefficient"
48 "       19.981   Pervious Initial abstraction"
49 "        0.015   Impervious Manning 'n'"
50 "       98.000   Impervious SCS Curve No."
51 "        0.564   Impervious Runoff coefficient"
52 "        3.858   Impervious Ia/S coefficient"
53 "       19.999   Impervious Initial abstraction"
54 "                     0.016     0.000     0.000     0.000 c.m/sec"
55 "             Catchment 201          Pervious   Impervious Total Area "
56 "             Surface Area           0.073      0.063      0.136      hectare"
57 "             Time of concentration  13.765     1.331      5.044      minutes"
58 "             Time to Centroid       126.673    102.749    109.891    minutes"
59 "             Rainfall depth         58.353     58.353     58.353     mm"
60 "             Rainfall volume        42.85      36.51      79.36      c.m"
61 "             Rainfall losses        46.415     25.428     36.761     mm"
62 "             Runoff depth           11.938     32.924     21.592     mm"
63 "             Runoff volume          8.77       20.60      29.36      c.m"
64 "             Runoff coefficient     0.205      0.564      0.370      "
65 "             Maximum flow           0.002      0.015      0.016      c.m/sec"
66 " 40          HYDROGRAPH Start - New Tributary"
67 "            2   Start - New Tributary"
68 "                     0.016     0.000     0.000     0.000"
```

```
 69 " 81          ADD COMMENT================================================="
 70 "          2  Lines of comment"
 71 "             IA increased to 20mm to account for roof and landscape area "
 72 "             runoff reduction due to amended topsoil"
 73 " 33          CATCHMENT 202"
 74 "            1   Triangular SCS"
 75 "            1   Equal length"
 76 "            1   SCS method"
 77 "          202   Controlled area to Highway 6"
 78 "       70.000   % Impervious"
 79 "        0.962   Total Area"
 80 "       15.000   Flow length"
 81 "        2.000   Overland Slope"
 82 "        0.289   Pervious Area"
 83 "       15.000   Pervious length"
 84 "        2.000   Pervious slope"
 85 "        0.673   Impervious Area"
 86 "       15.000   Impervious length"
 87 "        2.000   Impervious slope"
 88 "        0.250   Pervious Manning 'n'"
 89 "       75.000   Pervious SCS Curve No."
 90 "        0.205   Pervious Runoff coefficient"
 91 "        0.236   Pervious Ia/S coefficient"
 92 "       19.981   Pervious Initial abstraction"
 93 "        0.015   Impervious Manning 'n'"
 94 "       98.000   Impervious SCS Curve No."
 95 "        0.879   Impervious Runoff coefficient"
 96 "        0.100   Impervious Ia/S coefficient"
 97 "        0.518   Impervious Initial abstraction"
 98 "                     0.328     0.000     0.000     0.000 c.m/sec"
 99 "             Catchment 202          Pervious   Impervious Total Area "
100 "             Surface Area           0.289      0.673      0.962      hectare"
101 "             Time of concentration  13.765     1.081      2.232      minutes"
102 "             Time to Centroid       126.673    89.548     92.917     minutes"
103 "             Rainfall depth         58.353     58.353     58.353     mm"
104 "             Rainfall volume        168.41     392.95     561.35     c.m"
105 "             Rainfall losses        46.415     7.077      18.879     mm"
106 "             Runoff depth           11.938     51.276     39.474     mm"
107 "             Runoff volume          34.45      345.29     379.74     c.m"
108 "             Runoff coefficient     0.205      0.879      0.676      "
109 "             Maximum flow           0.010      0.326      0.328      c.m/sec"
110 " 40          HYDROGRAPH Add Runoff "
111 "            4   Add Runoff "
112 "                     0.328     0.328     0.000     0.000"
113 " 54          POND DESIGN"
114 "        0.328   Current peak flow    c.m/sec"
115 "        0.207   Target outflow    c.m/sec"
116 "        379.7   Hydrograph volume    c.m"
117 "           9.   Number of stages"
118 "      421.990   Minimum water level    metre"
119 "      424.030   Maximum water level    metre"
120 "      421.990   Starting water level    metre"
121 "            0   Keep Design Data: 1 = True; 0 = False"
122 "                  Level Discharge    Volume"
123 "                421.990     0.000     0.000"
124 "                422.200   0.00642  1.01E-05"
125 "                422.600   0.01201    85.000"
126 "                423.000   0.01572   170.000"
127 "                423.500   0.01939   211.987"
128 "                423.830   0.02147   221.426"
129 "                423.930   0.02206   239.726"
130 "                423.980   0.02235   270.251"
131 "                424.030   0.06480   325.201"
132 "          1.   WEIRS"
133 "                  Crest      Weir     Crest      Left     Right"
134 "              elevation coefficie   breadth sideslope sideslope"
135 "                423.980     0.900     0.600    50.000    50.000"
136 "          1.   ORIFICES"
```

```
137 "               Orifice   Orifice   Orifice Number of"
138 "                invert coefficie  diameter  orifices"
139 "               421.990     0.820    0.0750     1.000"
140 "             Peak outflow                  0.022    c.m/sec"
141 "             Maximum level               423.882    metre"
142 "             Maximum storage             230.850    c.m"
143 "             Centroidal lag                3.849   hours"
144 "                  0.328     0.328     0.022     0.000 c.m/sec"
145 " 40          HYDROGRAPH   Combine    1"
146 "            6   Combine "
147 "            1   Node #"
148 "                Total to Highway #6"
149 "             Maximum flow                  0.022    c.m/sec"
150 "             Hydrograph volume           379.436    c.m"
151 "                     0.328     0.328     0.022     0.022"
152 " 40          HYDROGRAPH Start - New Tributary"
153 "            2   Start - New Tributary"
154 "                     0.328     0.000     0.022     0.022"
155 " 81          ADD COMMENT================================================="
156 "           2  Lines of comment"
157 "              IA increased to 20mm to account for roof and landscape area "
158 "              runoff reduction due to amended topsoil"
159 " 33          CATCHMENT 203"
160 "             1   Triangular SCS"
161 "             1   Equal length"
162 "             1   SCS method"
163 "           203   Uncontrolled to Highway 6"
164 "        23.000   % Impervious"
165 "         0.304   Total Area"
166 "       120.000   Flow length"
167 "         2.000   Overland Slope"
168 "         0.234   Pervious Area"
169 "       120.000   Pervious length"
170 "         2.000   Pervious slope"
171 "         0.070   Impervious Area"
172 "       120.000   Impervious length"
173 "         2.000   Impervious slope"
174 "         0.250   Pervious Manning 'n'"
175 "        75.000   Pervious SCS Curve No."
176 "         0.205   Pervious Runoff coefficient"
177 "         0.236   Pervious Ia/S coefficient"
178 "        19.981   Pervious Initial abstraction"
179 "         0.015   Impervious Manning 'n'"
180 "        98.000   Impervious SCS Curve No."
181 "         0.574   Impervious Runoff coefficient"
182 "         3.858   Impervious Ia/S coefficient"
183 "        19.999   Impervious Initial abstraction"
184 "                     0.015     0.000     0.022     0.022 c.m/sec"
185 "              Catchment 203          Pervious   Impervious Total Area "
186 "              Surface Area           0.234      0.070      0.304      hectare"
187 "              Time of concentration  47.934     4.636      28.216     minutes"
188 "              Time to Centroid       167.633    107.838    140.402    minutes"
189 "              Rainfall depth         58.353     58.353     58.353     mm"
190 "              Rainfall volume        136.59     40.80      177.39     c.m"
191 "              Rainfall losses        46.389     24.859     41.437     mm"
192 "              Runoff depth           11.964     33.494     16.916     mm"
193 "              Runoff volume          28.01      23.42      51.43      c.m"
194 "              Runoff coefficient     0.205      0.574      0.290      "
195 "              Maximum flow           0.004      0.015      0.015      c.m/sec"
196 " 40          HYDROGRAPH Add Runoff "
197 "            4   Add Runoff "
198 "                     0.015     0.015     0.022     0.022"
199 " 40          HYDROGRAPH Copy to Outflow"
200 "            8   Copy to Outflow"
201 "                     0.015     0.015     0.015     0.022"
202 " 40          HYDROGRAPH   Combine    1"
203 "            6   Combine "
204 "            1   Node #"
```

```
205 "               Total to Highway #6"
206 "             Maximum flow                  0.031    c.m/sec"
207 "             Hydrograph volume           430.861    c.m"
208 "                     0.015     0.015     0.015     0.031"
209 " 38          START/RE-START TOTALS 203"
210 "            3   Runoff Totals on EXIT"
211 "             Total Catchment area                      1.266    hectare"
212 "             Total Impervious area                     0.743    hectare"
213 "             Total % impervious                       58.714"
214 " 19          EXIT"
```

```
 1 "                MIDUSS Output ------------------------------------------------>"
 2 "                MIDUSS version                            Version 2.25  rev. 473"
 3 "                MIDUSS created                          Sunday, February 7, 2010"
 4 "           10   Units used:                                              ie METRIC"
 5 "                Job folder:                                      Q:\48650\100\SWM"
 6 "                Output filename:                                 50yr post r4.out"
 7 "                Licensee name:                                                 A"
 8 "                Company                                                        "
 9 "                Date & Time last used:                 10/27/2023 at 3:57:05 PM"
10 " 31          TIME PARAMETERS"
11 "        5.000   Time Step"
12 "      180.000   Max. Storm length"
13 "     1500.000   Max. Hydrograph"
14 " 32          STORM Chicago storm"
15 "            1   Chicago storm"
16 "      780.000   Coefficient A"
17 "        0.360   Constant B"
18 "        0.690   Exponent C"
19 "        0.400   Fraction R"
20 "      180.000   Duration"
21 "        1.000   Time step multiplier"
22 "             Maximum intensity           244.972    mm/hr"
23 "             Total depth                  65.003    mm"
24 "            6   050hyd   Hydrograph extension used in this file"
25 " 81          ADD COMMENT=================================================="
26 "          2  Lines of comment"
27 "             IA increased to 20mm to account for roof and landscape area "
28 "             runoff reduction due to amended topsoil"
29 " 33          CATCHMENT 201"
30 "            1   Triangular SCS"
31 "            1   Equal length"
32 "            1   SCS method"
33 "          201   Area to southwest property line, ultimately to Mun Drain #1"
34 "       46.000   % Impervious"
35 "        0.136   Total Area"
36 "       15.000   Flow length"
37 "        2.000   Overland Slope"
38 "        0.073   Pervious Area"
39 "       15.000   Pervious length"
40 "        2.000   Pervious slope"
41 "        0.063   Impervious Area"
42 "       15.000   Impervious length"
43 "        2.000   Impervious slope"
44 "        0.250   Pervious Manning 'n'"
45 "       75.000   Pervious SCS Curve No."
46 "        0.240   Pervious Runoff coefficient"
47 "        0.236   Pervious Ia/S coefficient"
48 "       19.981   Pervious Initial abstraction"
49 "        0.015   Impervious Manning 'n'"
50 "       98.000   Impervious SCS Curve No."
51 "        0.601   Impervious Runoff coefficient"
52 "        3.858   Impervious Ia/S coefficient"
53 "       19.999   Impervious Initial abstraction"
54 "                     0.022     0.000     0.000     0.000 c.m/sec"
55 "             Catchment 201          Pervious   Impervious Total Area "
56 "             Surface Area           0.073      0.063      0.136      hectare"
57 "             Time of concentration  11.548     1.182      4.491      minutes"
58 "             Time to Centroid       122.851    101.068    108.021    minutes"
59 "             Rainfall depth         65.003     65.003     65.003     mm"
60 "             Rainfall volume        47.74      40.67      88.40      c.m"
61 "             Rainfall losses        49.392     25.916     38.593     mm"
62 "             Runoff depth           15.610     39.086     26.409     mm"
63 "             Runoff volume          11.46      24.45      35.92      c.m"
64 "             Runoff coefficient     0.240      0.601      0.406      "
65 "             Maximum flow           0.004      0.021      0.022      c.m/sec"
66 " 40          HYDROGRAPH Start - New Tributary"
67 "            2   Start - New Tributary"
68 "                     0.022     0.000     0.000     0.000"
```

```
 69 " 81          ADD COMMENT================================================="
 70 "          2  Lines of comment"
 71 "             IA increased to 20mm to account for roof and landscape area "
 72 "             runoff reduction due to amended topsoil"
 73 " 33          CATCHMENT 202"
 74 "             1   Triangular SCS"
 75 "             1   Equal length"
 76 "             1   SCS method"
 77 "           202   Controlled area to Highway 6"
 78 "        70.000   % Impervious"
 79 "         0.962   Total Area"
 80 "        15.000   Flow length"
 81 "         2.000   Overland Slope"
 82 "         0.289   Pervious Area"
 83 "        15.000   Pervious length"
 84 "         2.000   Pervious slope"
 85 "         0.673   Impervious Area"
 86 "        15.000   Impervious length"
 87 "         2.000   Impervious slope"
 88 "         0.250   Pervious Manning 'n'"
 89 "        75.000   Pervious SCS Curve No."
 90 "         0.240   Pervious Runoff coefficient"
 91 "         0.236   Pervious Ia/S coefficient"
 92 "        19.981   Pervious Initial abstraction"
 93 "         0.015   Impervious Manning 'n'"
 94 "        98.000   Impervious SCS Curve No."
 95 "         0.885   Impervious Runoff coefficient"
 96 "         0.100   Impervious Ia/S coefficient"
 97 "         0.518   Impervious Initial abstraction"
 98 "                      0.370     0.000     0.000     0.000 c.m/sec"
 99 "             Catchment 202          Pervious   Impervious Total Area "
100 "             Surface Area           0.289      0.673      0.962      hectare"
101 "             Time of concentration  11.548     1.034      2.130      minutes"
102 "             Time to Centroid       122.851    89.143     92.655     minutes"
103 "             Rainfall depth         65.003     65.003     65.003     mm"
104 "             Rainfall volume        187.60     437.73     625.32     c.m"
105 "             Rainfall losses        49.392     7.474      20.050     mm"
106 "             Runoff depth           15.610     57.528     44.953     mm"
107 "             Runoff volume          45.05      387.39     432.45     c.m"
108 "             Runoff coefficient     0.240      0.885      0.692      "
109 "             Maximum flow           0.014      0.366      0.370      c.m/sec"
110 " 40          HYDROGRAPH Add Runoff "
111 "             4   Add Runoff "
112 "                      0.370     0.370     0.000     0.000"
113 " 54          POND DESIGN"
114 "         0.370   Current peak flow    c.m/sec"
115 "         0.207   Target outflow    c.m/sec"
116 "         432.4   Hydrograph volume    c.m"
117 "            9.   Number of stages"
118 "       421.990   Minimum water level    metre"
119 "       424.030   Maximum water level    metre"
120 "       421.990   Starting water level    metre"
121 "             0   Keep Design Data: 1 = True; 0 = False"
122 "                   Level Discharge    Volume"
123 "                 421.990     0.000     0.000"
124 "                 422.200   0.00642  1.01E-05"
125 "                 422.600   0.01201    85.000"
126 "                 423.000   0.01572   170.000"
127 "                 423.500   0.01939   211.987"
128 "                 423.830   0.02147   221.426"
129 "                 423.930   0.02206   239.726"
130 "                 423.980   0.02235   270.251"
131 "                 424.030   0.06480   325.201"
132 "           1.   WEIRS"
133 "                  Crest      Weir     Crest      Left     Right"
134 "              elevation coefficie   breadth sideslope sideslope"
135 "                 423.980     0.900     0.600    50.000    50.000"
136 "           1.   ORIFICES"
```

```
137 "               Orifice   Orifice   Orifice Number of"
138 "                invert coefficie  diameter  orifices"
139 "               421.990     0.820    0.0750     1.000"
140 "             Peak outflow                  0.022    c.m/sec"
141 "             Maximum level               423.980    metre"
142 "             Maximum storage             270.403    c.m"
143 "             Centroidal lag                4.044   hours"
144 "                  0.370     0.370     0.022     0.000 c.m/sec"
145 " 40          HYDROGRAPH   Combine    1"
146 "            6   Combine "
147 "            1   Node #"
148 "                Total to Highway #6"
149 "             Maximum flow                  0.022    c.m/sec"
150 "             Hydrograph volume           432.895    c.m"
151 "                     0.370     0.370     0.022     0.022"
152 " 40          HYDROGRAPH Start - New Tributary"
153 "            2   Start - New Tributary"
154 "                     0.370     0.000     0.022     0.022"
155 " 81          ADD COMMENT================================================="
156 "           2  Lines of comment"
157 "              IA increased to 20mm to account for roof and landscape area "
158 "              runoff reduction due to amended topsoil"
159 " 33          CATCHMENT 203"
160 "             1   Triangular SCS"
161 "             1   Equal length"
162 "             1   SCS method"
163 "           203   Uncontrolled to Highway 6"
164 "        23.000   % Impervious"
165 "         0.304   Total Area"
166 "       120.000   Flow length"
167 "         2.000   Overland Slope"
168 "         0.234   Pervious Area"
169 "       120.000   Pervious length"
170 "         2.000   Pervious slope"
171 "         0.070   Impervious Area"
172 "       120.000   Impervious length"
173 "         2.000   Impervious slope"
174 "         0.250   Pervious Manning 'n'"
175 "        75.000   Pervious SCS Curve No."
176 "         0.240   Pervious Runoff coefficient"
177 "         0.236   Pervious Ia/S coefficient"
178 "        19.981   Pervious Initial abstraction"
179 "         0.015   Impervious Manning 'n'"
180 "        98.000   Impervious SCS Curve No."
181 "         0.612   Impervious Runoff coefficient"
182 "         3.858   Impervious Ia/S coefficient"
183 "        19.999   Impervious Initial abstraction"
184 "                     0.021     0.000     0.022     0.022 c.m/sec"
185 "              Catchment 203          Pervious   Impervious Total Area "
186 "              Surface Area           0.234      0.070      0.304      hectare"
187 "              Time of concentration  40.214     4.116      24.626     minutes"
188 "              Time to Centroid       159.258    105.832    136.187    minutes"
189 "              Rainfall depth         65.003     65.003     65.003     mm"
190 "              Rainfall volume        152.16     45.45      197.61     c.m"
191 "              Rainfall losses        49.377     25.243     43.826     mm"
192 "              Runoff depth           15.626     39.760     21.177     mm"
193 "              Runoff volume          36.58      27.80      64.38      c.m"
194 "              Runoff coefficient     0.240      0.612      0.326      "
195 "              Maximum flow           0.005      0.020      0.021      c.m/sec"
196 " 40          HYDROGRAPH Add Runoff "
197 "            4   Add Runoff "
198 "                     0.021     0.021     0.022     0.022"
199 " 40          HYDROGRAPH Copy to Outflow"
200 "            8   Copy to Outflow"
201 "                     0.021     0.021     0.021     0.022"
202 " 40          HYDROGRAPH   Combine    1"
203 "            6   Combine "
204 "            1   Node #"
```

```
205 "               Total to Highway #6"
206 "             Maximum flow                  0.038    c.m/sec"
207 "             Hydrograph volume           497.272    c.m"
208 "                     0.021     0.021     0.021     0.038"
209 " 38          START/RE-START TOTALS 203"
210 "            3   Runoff Totals on EXIT"
211 "             Total Catchment area                      1.266    hectare"
212 "             Total Impervious area                     0.743    hectare"
213 "             Total % impervious                       58.714"
214 " 19          EXIT"
```

```
 1 "                MIDUSS Output ------------------------------------------------>"
 2 "                MIDUSS version                              Version 2.25  rev. 473"
 3 "                MIDUSS created                            Sunday, February 7, 2010"
 4 "           10   Units used:                                                ie METRIC"
 5 "                Job folder:                                      Q:\48650\100\SWM"
 6 "                Output filename:                                100yr post r4.out"
 7 "                Licensee name:                                                A"
 8 "                Company                                                       "
 9 "                Date & Time last used:                 10/27/2023 at 3:48:01 PM"
10 " 31          TIME PARAMETERS"
11 "        5.000   Time Step"
12 "      180.000   Max. Storm length"
13 "     1500.000   Max. Hydrograph"
14 " 32          STORM Chicago storm"
15 "            1   Chicago storm"
16 "      851.000   Coefficient A"
17 "        0.290   Constant B"
18 "        0.687   Exponent C"
19 "        0.400   Fraction R"
20 "      180.000   Duration"
21 "        1.000   Time step multiplier"
22 "             Maximum intensity           270.786    mm/hr"
23 "             Total depth                  71.828    mm"
24 "            6   100hyd   Hydrograph extension used in this file"
25 " 81          ADD COMMENT================================================="
26 "          2  Lines of comment"
27 "             IA increased to 20mm to account for roof and landscape area "
28 "             runoff reduction due to amended topsoil"
29 " 33          CATCHMENT 201"
30 "            1   Triangular SCS"
31 "            1   Equal length"
32 "            1   SCS method"
33 "          201   Area to southwest property line, ultimately to Mun Drain #1"
34 "       46.000   % Impervious"
35 "        0.136   Total Area"
36 "       15.000   Flow length"
37 "        2.000   Overland Slope"
38 "        0.073   Pervious Area"
39 "       15.000   Pervious length"
40 "        2.000   Pervious slope"
41 "        0.063   Impervious Area"
42 "       15.000   Impervious length"
43 "        2.000   Impervious slope"
44 "        0.250   Pervious Manning 'n'"
45 "       75.000   Pervious SCS Curve No."
46 "        0.272   Pervious Runoff coefficient"
47 "        0.236   Pervious Ia/S coefficient"
48 "       19.981   Pervious Initial abstraction"
49 "        0.015   Impervious Manning 'n'"
50 "       98.000   Impervious SCS Curve No."
51 "        0.631   Impervious Runoff coefficient"
52 "        3.858   Impervious Ia/S coefficient"
53 "       19.999   Impervious Initial abstraction"
54 "                     0.029     0.000     0.000     0.000 c.m/sec"
55 "             Catchment 201          Pervious   Impervious Total Area "
56 "             Surface Area           0.073      0.063      0.136      hectare"
57 "             Time of concentration  10.001     1.074      4.076      minutes"
58 "             Time to Centroid       120.070    99.883     106.671    minutes"
59 "             Rainfall depth         71.828     71.828     71.828     mm"
60 "             Rainfall volume        52.75      44.94      97.69      c.m"
61 "             Rainfall losses        52.256     26.477     40.398     mm"
62 "             Runoff depth           19.572     45.352     31.431     mm"
63 "             Runoff volume          14.37      28.37      42.75      c.m"
64 "             Runoff coefficient     0.272      0.631      0.438      "
65 "             Maximum flow           0.005      0.028      0.029      c.m/sec"
66 " 40          HYDROGRAPH Start - New Tributary"
67 "            2   Start - New Tributary"
68 "                     0.029     0.000     0.000     0.000"
```

```
 69 " 81          ADD COMMENT================================================="
 70 "          2  Lines of comment"
 71 "             IA increased to 20mm to account for roof and landscape area "
 72 "             runoff reduction due to amended topsoil"
 73 " 33          CATCHMENT 202"
 74 "            1   Triangular SCS"
 75 "            1   Equal length"
 76 "            1   SCS method"
 77 "          202   Controlled area to Highway 6"
 78 "       70.000   % Impervious"
 79 "        0.962   Total Area"
 80 "       15.000   Flow length"
 81 "        2.000   Overland Slope"
 82 "        0.289   Pervious Area"
 83 "       15.000   Pervious length"
 84 "        2.000   Pervious slope"
 85 "        0.673   Impervious Area"
 86 "       15.000   Impervious length"
 87 "        2.000   Impervious slope"
 88 "        0.250   Pervious Manning 'n'"
 89 "       75.000   Pervious SCS Curve No."
 90 "        0.272   Pervious Runoff coefficient"
 91 "        0.236   Pervious Ia/S coefficient"
 92 "       19.981   Pervious Initial abstraction"
 93 "        0.015   Impervious Manning 'n'"
 94 "       98.000   Impervious SCS Curve No."
 95 "        0.890   Impervious Runoff coefficient"
 96 "        0.100   Impervious Ia/S coefficient"
 97 "        0.518   Impervious Initial abstraction"
 98 "                     0.414     0.000     0.000     0.000 c.m/sec"
 99 "             Catchment 202          Pervious   Impervious Total Area "
100 "             Surface Area           0.289      0.673      0.962      hectare"
101 "             Time of concentration  10.001     0.992      2.037      minutes"
102 "             Time to Centroid       120.070    88.820     92.444     minutes"
103 "             Rainfall depth         71.828     71.828     71.828     mm"
104 "             Rainfall volume        207.30     483.69     690.99     c.m"
105 "             Rainfall losses        52.256     7.885      21.197     mm"
106 "             Runoff depth           19.572     63.943     50.632     mm"
107 "             Runoff volume          56.49      430.59     487.08     c.m"
108 "             Runoff coefficient     0.272      0.890      0.705      "
109 "             Maximum flow           0.020      0.409      0.414      c.m/sec"
110 " 40          HYDROGRAPH Add Runoff "
111 "            4   Add Runoff "
112 "                     0.414     0.414     0.000     0.000"
113 " 54          POND DESIGN"
114 "        0.414   Current peak flow    c.m/sec"
115 "        0.207   Target outflow    c.m/sec"
116 "        487.1   Hydrograph volume    c.m"
117 "           9.   Number of stages"
118 "      421.990   Minimum water level    metre"
119 "      424.030   Maximum water level    metre"
120 "      421.990   Starting water level    metre"
121 "            0   Keep Design Data: 1 = True; 0 = False"
122 "                  Level Discharge    Volume"
123 "                421.990     0.000     0.000"
124 "                422.200   0.00642  1.01E-05"
125 "                422.600   0.01201    85.000"
126 "                423.000   0.01572   170.000"
127 "                423.500   0.01939   211.987"
128 "                423.830   0.02147   221.426"
129 "                423.930   0.02206   239.726"
130 "                423.980   0.02235   270.251"
131 "                424.030   0.06480   325.201"
132 "          1.   WEIRS"
133 "                  Crest      Weir     Crest      Left     Right"
134 "              elevation coefficie   breadth sideslope sideslope"
135 "                423.980     0.900     0.600    50.000    50.000"
136 "          1.   ORIFICES"
```

```
137 "               Orifice   Orifice   Orifice Number of"
138 "                invert coefficie  diameter  orifices"
139 "               421.990     0.820    0.0750     1.000"
140 "             Peak outflow                  0.037    c.m/sec"
141 "             Maximum level               423.998    metre"
142 "             Maximum storage             289.708    c.m"
143 "             Centroidal lag                3.888   hours"
144 "                  0.414     0.414     0.037     0.000 c.m/sec"
145 " 40          HYDROGRAPH   Combine    1"
146 "            6   Combine "
147 "            1   Node #"
148 "                Total to Highway #6"
149 "             Maximum flow                  0.037    c.m/sec"
150 "             Hydrograph volume           486.912    c.m"
151 "                     0.414     0.414     0.037     0.037"
152 " 40          HYDROGRAPH Start - New Tributary"
153 "            2   Start - New Tributary"
154 "                     0.414     0.000     0.037     0.037"
155 " 81          ADD COMMENT================================================="
156 "           2  Lines of comment"
157 "              IA increased to 20mm to account for roof and landscape area "
158 "              runoff reduction due to amended topsoil"
159 " 33          CATCHMENT 203"
160 "             1   Triangular SCS"
161 "             1   Equal length"
162 "             1   SCS method"
163 "           203   Uncontrolled to Highway 6"
164 "        23.000   % Impervious"
165 "         0.304   Total Area"
166 "       120.000   Flow length"
167 "         2.000   Overland Slope"
168 "         0.234   Pervious Area"
169 "       120.000   Pervious length"
170 "         2.000   Pervious slope"
171 "         0.070   Impervious Area"
172 "       120.000   Impervious length"
173 "         2.000   Impervious slope"
174 "         0.250   Pervious Manning 'n'"
175 "        75.000   Pervious SCS Curve No."
176 "         0.274   Pervious Runoff coefficient"
177 "         0.236   Pervious Ia/S coefficient"
178 "        19.981   Pervious Initial abstraction"
179 "         0.015   Impervious Manning 'n'"
180 "        98.000   Impervious SCS Curve No."
181 "         0.639   Impervious Runoff coefficient"
182 "         3.858   Impervious Ia/S coefficient"
183 "        19.999   Impervious Initial abstraction"
184 "                     0.026     0.000     0.037     0.037 c.m/sec"
185 "              Catchment 203          Pervious   Impervious Total Area "
186 "              Surface Area           0.234      0.070      0.304      hectare"
187 "              Time of concentration  34.827     3.740      22.058     minutes"
188 "              Time to Centroid       152.796    104.435    132.933    minutes"
189 "              Rainfall depth         71.828     71.828     71.828     mm"
190 "              Rainfall volume        168.14     50.22      218.36     c.m"
191 "              Rainfall losses        52.152     25.915     46.118     mm"
192 "              Runoff depth           19.676     45.913     25.711     mm"
193 "              Runoff volume          46.06      32.10      78.16      c.m"
194 "              Runoff coefficient     0.274      0.639      0.358      "
195 "              Maximum flow           0.008      0.024      0.026      c.m/sec"
196 " 40          HYDROGRAPH Add Runoff "
197 "            4   Add Runoff "
198 "                     0.026     0.026     0.037     0.037"
199 " 40          HYDROGRAPH Copy to Outflow"
200 "            8   Copy to Outflow"
201 "                     0.026     0.026     0.026     0.037"
202 " 40          HYDROGRAPH   Combine    1"
203 "            6   Combine "
204 "            1   Node #"
```

```
205 "               Total to Highway #6"
206 "             Maximum flow                  0.048    c.m/sec"
207 "             Hydrograph volume           565.072    c.m"
208 "                     0.026     0.026     0.026     0.048"
209 " 38          START/RE-START TOTALS 203"
210 "            3   Runoff Totals on EXIT"
211 "             Total Catchment area                     1.266    hectare"
212 "             Total Impervious area                    0.743    hectare"
213 "             Total % impervious                      58.714"
214 " 19          EXIT"
```

Appendix C

Stormceptor Sizing

Stormceptor®

FORTERRA

Stormceptor® EF Sizing Report

STORMCEPTOR®
ESTIMATED NET ANNUAL SEDIMENT (TSS) LOAD REDUCTION

05/10/2022

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

Site Name:	961 St. David Street North

Drainage Area (ha):	0.77
% Imperviousness:	75.00

Runoff Coefficient 'c': 0.75

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

Required Water Quality Runoff Volume Capture (%):	90.00
Estimated Water Quality Flow Rate (L/s):	21.88
Oil / Fuel Spill Risk Site?	Yes
Upstream Flow Control?	Yes
Upstream Orifice Control Flow Rate to Stormceptor (L/s):	22.00
Peak Conveyance (maximum) Flow Rate (L/s):	
Site Sediment Transport Rate (kg/ha/yr):	

Project Name:	961 St. David Street North
Project Number:	48650-100
Designer Name:	Nathan Katerberg
Designer Company:	MTE Consultants Inc
Designer Email:	nkaterberg@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	80
EFO6	89
EFO8	95
EFO10	97
EFO12	99

Recommended Stormceptor EFO Model: EFO4

Estimated Net Annual Sediment (TSS) Load Reduction (%): 80

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

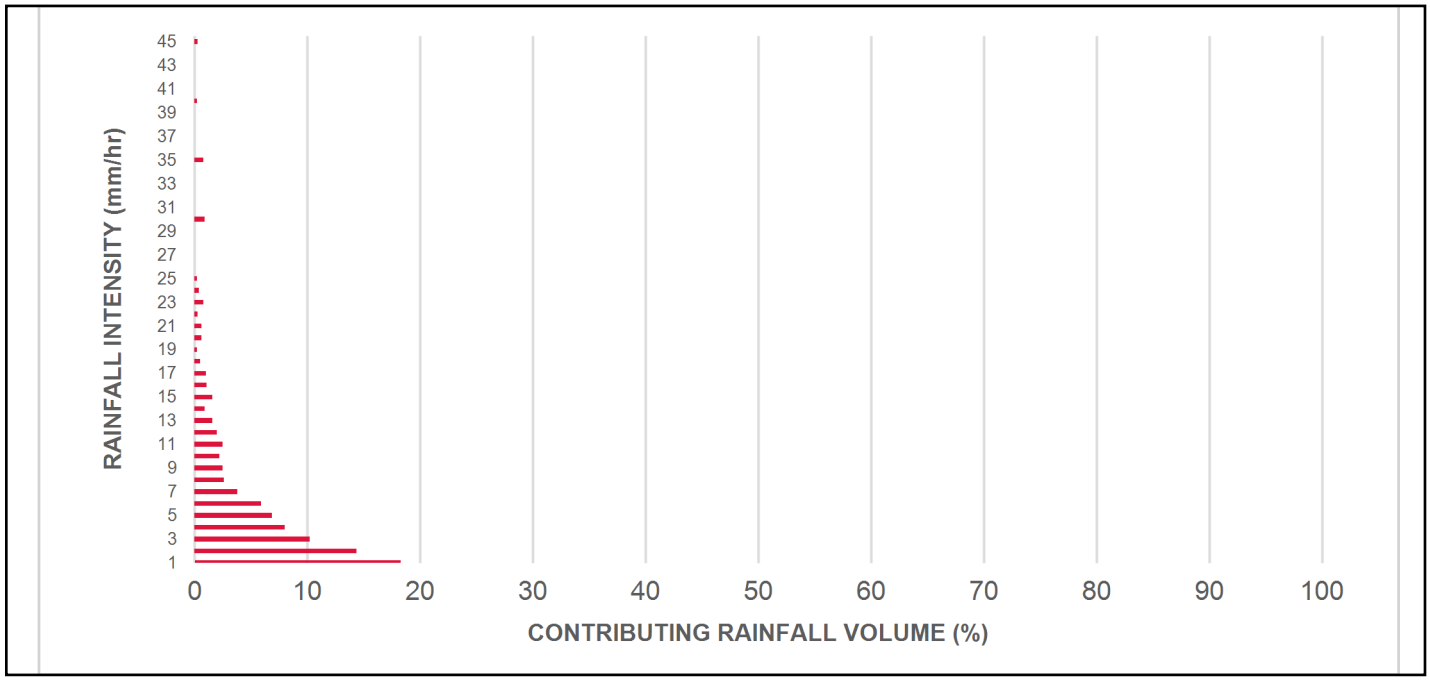
imbrium

Upstream Flow Controlled Results

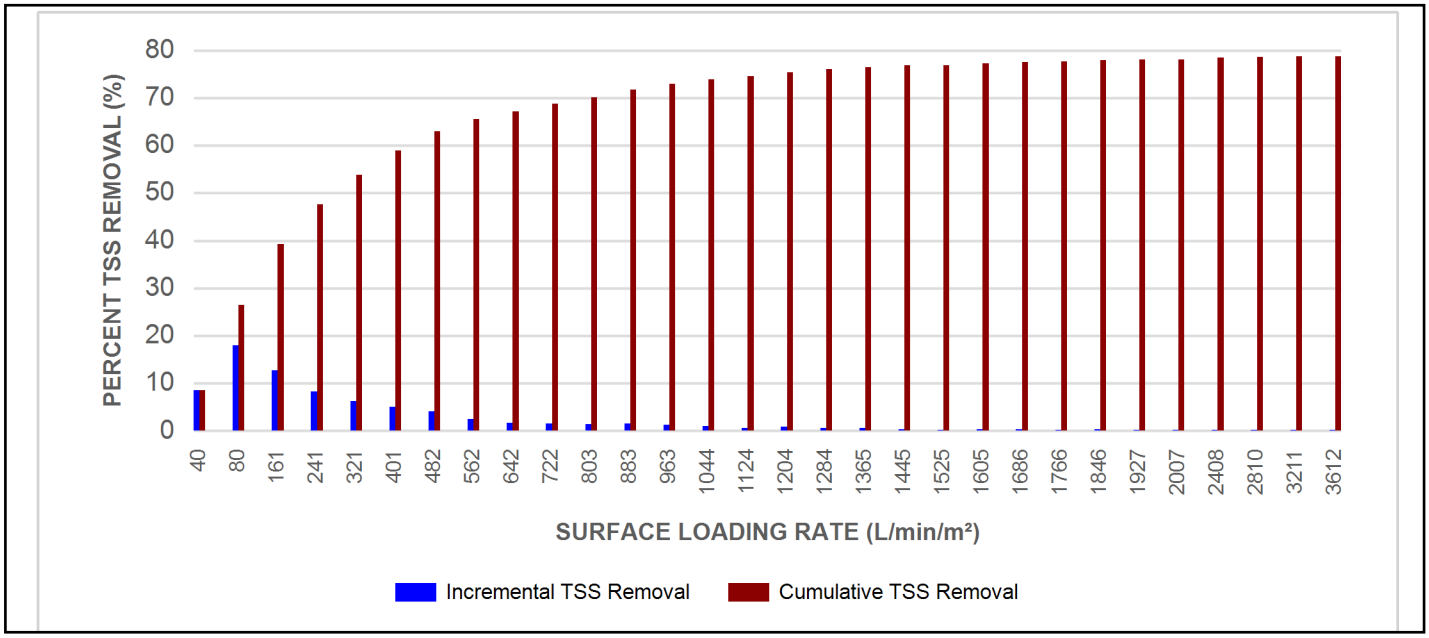
Rainfall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
0.5	8.5	8.5	0.80	48.0	40.0	100	8.5	8.5
1	18.3	26.8	1.61	96.0	80.0	98	18.0	26.5
2	14.4	41.3	3.21	193.0	161.0	88	12.7	39.3
3	10.2	51.5	4.82	289.0	241.0	81	8.3	47.6
4	8.0	59.5	6.42	385.0	321.0	78	6.2	53.8
5	6.9	66.4	8.03	482.0	401.0	74	5.1	58.9
6	5.9	72.3	9.63	578.0	482.0	70	4.1	63.0
7	3.8	76.1	11.24	674.0	562.0	66	2.5	65.5
8	2.6	78.7	12.84	771.0	642.0	64	1.7	67.2
9	2.5	81.1	14.45	867.0	722.0	64	1.6	68.8
10	2.2	83.3	16.05	963.0	803.0	63	1.4	70.1
11	2.5	85.8	17.66	1060.0	883.0	62	1.6	71.7
12	2.0	87.8	19.27	1156.0	963.0	62	1.2	72.9
13	12.2	100.0	20.87	1252.0	1044.0	61	7.4	80.3
14	0.0	100.0	22.00	1320.0	1100.0	59	0.0	80.3
15	0.0	100.0	22.00	1320.0	1100.0	59	0.0	80.3
16	0.0	100.0	22.00	1320.0	1100.0	59	0.0	80.3
17	0.0	100.0	22.00	1320.0	1100.0	59	0.0	80.3
18	0.0	100.0	22.00	1320.0	1100.0	59	0.0	80.3
19	0.0	100.0	22.00	1320.0	1100.0	59	0.0	80.3
20	0.0	100.0	22.00	1320.0	1100.0	59	0.0	80.3
21	0.0	100.0	22.00	1320.0	1100.0	59	0.0	80.3
22	0.0	100.0	22.00	1320.0	1100.0	59	0.0	80.3
23	0.0	100.0	22.00	1320.0	1100.0	59	0.0	80.3
24	0.0	100.0	22.00	1320.0	1100.0	59	0.0	80.3
25	0.0	100.0	22.00	1320.0	1100.0	59	0.0	80.3
30	0.0	100.0	22.00	1320.0	1100.0	59	0.0	80.3
35	0.0	100.0	22.00	1320.0	1100.0	59	0.0	80.3
40	0.0	100.0	22.00	1320.0	1100.0	59	0.0	80.3
45	0.0	100.0	22.00	1320.0	1100.0	59	0.0	80.3
						Estimated Net Annual Sediment (TSS) Load Reduction =		**80 %**

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



imbrium

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

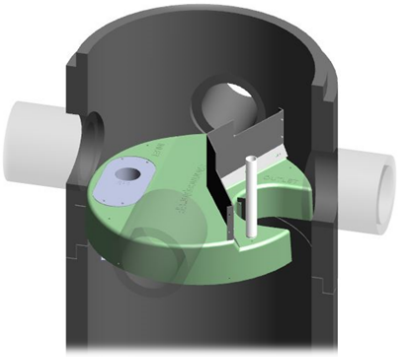
►**Stormceptor® EF and EFO** feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**, and the exceptional scour test 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.

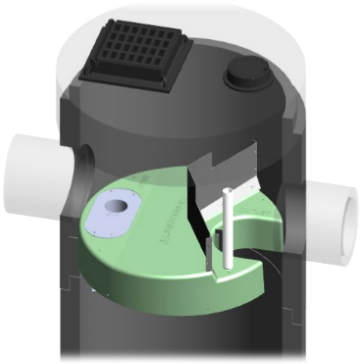
DESIGN FLEXIBILITY

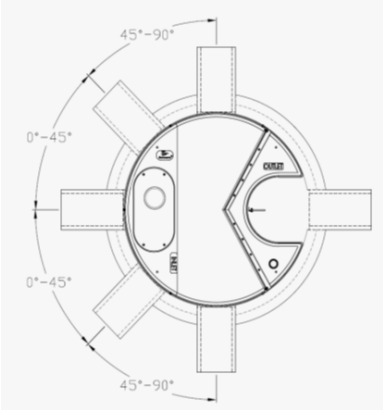
►**Stormceptor® EF** and **EFO** offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend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

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.

Appendix D

Water Balance

961 ST. DAVID STREET
WATER BALANCE (SURFACE RUNOFF AND INFILTRATION) ANALYSIS
Fergus, Ontario

Project No. 48650-100
Date: October 28, 2023
Design By: NGK
File: Q:\48650\100\SWM\Water Balance\2023-09-28_Yearly Water

Weather Station Fergus Shand Dam, 1981-2010 Canada Climate Normals
Total Precipitation 946 mm/year

Annual Water Balance Parameters & Hydrologic Cycle Components							
Condition	**Topography**	**Coverage**	**Soil Type**	**ET (mm/yr)**	**Runoff (mm/yr)**	**Infiltration (mm/yr)**	**Notes**
Pre-Development pervious areas	Flat Lands	Pasture/ Shrubs	A/B - Sand, Sandy Silt	588	71	287	
Impervious areas (Pre- and Post Development)				142	804	0	*Evapotranspiration rate of 15% assumed for impervious areas*
Post-Development pervious areas	Flat Lands	Urban Lawns	A/B - Sand, Sandy Silt	572	112	262	
Townhouse Lots with Amended Topsoil				288	363	295	*Based on GAWSER modelling completed for typical townhouse lot coverage and grading, with runoff from roof and rear-yard areas draining to an amended topsoil reservoir in the rear yards. These rates are representative of the entire lot area.*
Single Detached Lots with Amended Topsoil				341	85	520	*Based on GAWSER modelling completed for typical single detached lot coverage and split drainage grading, with runoff from roof and rear-yard areas draining to an amended topsoil reservoir in the side and rear yards. These rates are representative of the entire lot area.*

RUNOFF

Pre-Development Runoff										
Catchment[1]	**Area**	**% Impervious**	**Pervious Area**			**Impervious Area**			**Total Runoff Volume**	**Comments**
			Area	**Runoff Rate[2]**	**Runoff Volume**	**Area**	**Runoff Rate**	**Runoff Volume**		
	ha		*ha*	*mm/yr/m²*	*m³/yr*	*ha*	*mm/yr/m²*	*m³/yr*	*m³/yr*	
301	0.804	0	0.804	71	571				**571**	**To Wetland**
302	0.598	9	0.544	71	386	0.054	804	433	**819**	**To St. David Street North/Highway 6**
							Sum of Pre-Development Runoff		1,390	

Post-Development Runoff										
Catchment[1]	**Area**	**% Impervious**	**Pervious Area**			**Impervious Area**			**Total Runoff Volume**	**Comments**
			Area	**Runoff Rate[2]**	**Runoff Volume**	**Area**	**Runoff Rate[2]**	**Runoff Volume**		
	ha		*ha*	*mm/yr/m²*	*m³/yr*	*ha*	*mm/yr/m²*	*m³/yr*	*m³/yr*	
401	0.136	46	0.073	363	267	0.063	363	227	494	Townhouse Lots w/Amended Topsoil
							Post-Development Runoff, to Wetland		**494**	
402-1	0.485	69	0.150	112	168	0.335	804	2,691	2,859	Common element, front roofs and yards of Catchment 401 townhouse lots
402-2	0.399	60	0.160	363	580	0.239	363	870	1,449	Townhouse Lots w/Amended Topsoil
403	0.382	43	0.218	85	185	0.164	85	140	325	Single Detached Lots w/Amended Topsoil
							Post-Development Runoff, to St. David Street North/Highway 6		**5,621**	

INFILTRATION

Pre-Development Infiltration										
Catchment[1]	**Area**	**% Impervious**	**Pervious Area**			**Impervious Area**			**Total Infiltration Volume**	**Comments**
			Area	**Infiltration Rate**	**Infiltration Volume**	**Area**	**Infiltration Rate**	**Infiltration Volume**		
	ha		*ha*	*mm/yr/m²*	*m³/yr*	*ha*	*mm/yr/m²*	*m³/yr*	*m³/yr*	
301	0.804	0	0.804	287	2,307				2,307	To Wetland
302	0.598	9	0.544	287	1,562	0.054	0	0	1,562	To St. David Street North/Highway 6
								Sum of Pre-Development Infiltration	**3,869**	

Post-Development Infiltration										
Catchment[1]	**Area**	**% Impervious**	**Pervious Area**			**Impervious Area**			**Total Infiltration Volume**	**Comments**
			Area	**Infiltration Rate[2]**	**Infiltration Volume**	**Area**	**Infiltration Rate[2]**	**Infiltration Volume**		
	ha		*ha*	*mm/yr/m²*	*m³/yr*	*ha*	*mm/yr/m²*	*m³/yr*	*m³/yr*	
401	0.136	46	0.073	295	217	0.063	295	185	401	Townhouse Lots w/Amended Topsoil
402-1	0.485	69	0.150	262	394				394	Common element, front roofs and yards of Catchment 401 townhouse lots
402-2	0.399	60	0.160	295	471	0.239	295	707	1,178	Townhouse Lots w/Amended Topsoil
403	0.382	43	0.218	520	1,133	0.164	520	855	1,988	Single Detached Lots w/Amended Topsoil
							Sum of Post-Development Infiltration		**3,961**	

SUMMARY

		Pre-Development	Post-Development	Volume Change	Percentage Change
Runoff Volume (m^3/yr)	To Wetland	571	494	-77 m3 increase	-14%
	To St. David Street/Highway 6	819	5,621	4,802 m3 increase	-
Infiltration Volume (m^3/yr)		3,869	3,961	91 m3 increase	2%

NOTES

1 *Refer to Figures 2.0 and 4.0 for Pre- and Post-Development Water Balance Catchment Areas.*
2 *Infiltration and runoff rates for Catchments 402-2 and 403 are based on GAWSER modelling of typical lot coverages and grading design for both townhouse lots and single detached split drainage lots, with runoff from the roof and rear yard areas draining to an amended topsoil reservoir. The GAWSER modelling routed runoff from the impervious roof areas through the amended topsoil reservoir, and determined infiltration and runoff rates representative of the entire lot. Therefore in the Infiltration and Runoff tables, the whole-lot rate is applied to both the Impervious and Pervious portions of Catchments 402-2 and 403*