Functional Servicing and Stormwater Management Report
Alma Subdivision
Township of Mapleton

GMBP File: 120139

September 2024

GUELPH | OWEN SOUND | LISTOWEL | KITCHENER | LONDON | HAMILTON | GTA

650 WOODLAWN RD. W., BLOCK C, UNIT 2, GUELPH ON N1K 1B8 P: 519-824-8150
WWW.GMBLUEPLAN.CA

TABLE OF CONTENTS

LIST OF FIGURES

After Page

APPENDICES

FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT

ALMA SUBDIVISION

TOWNSHIP OF MAPLETON

SEPTEMBER 2024

GMBP FILE: 120139

1.0 INTRODUCTION

In support of the Draft Plan Approval of the subject property, GM BluePlan Engineering Limited have prepared this Functional Servicing and Stormwater Management Report to document the proposed site servicing and stormwater management design for the site.

The 8.01 ha site is located at 31 Church Street in the Hamlet of Alma, Township of Mapleton. The site is bound by existing residential properties and Church Street to the north, Peel Street (Wellington Road 17) and existing residential lands to the west, existing former Canadian Pacific Railway corridor and farmland to the south and existing woodlot and agricultural lands to the east. **Figure 1** illustrates the site location.

2.0 EXISTING CONDITIONS

2.1 Land Use

The site is currently a vacant agricultural field with treed areas located along the south, east and northeast portions of the site. The former railway corridor runs across the southerly portion of the site and is mainly covered in dense trees. The site is connected to Peel Street at the westerly portion of the property and existing Church Street at the north portion of the property.

The external lands to the north and west of the site have been developed for residential use consisting mostly of estate style single family housing.

2.2 Topography

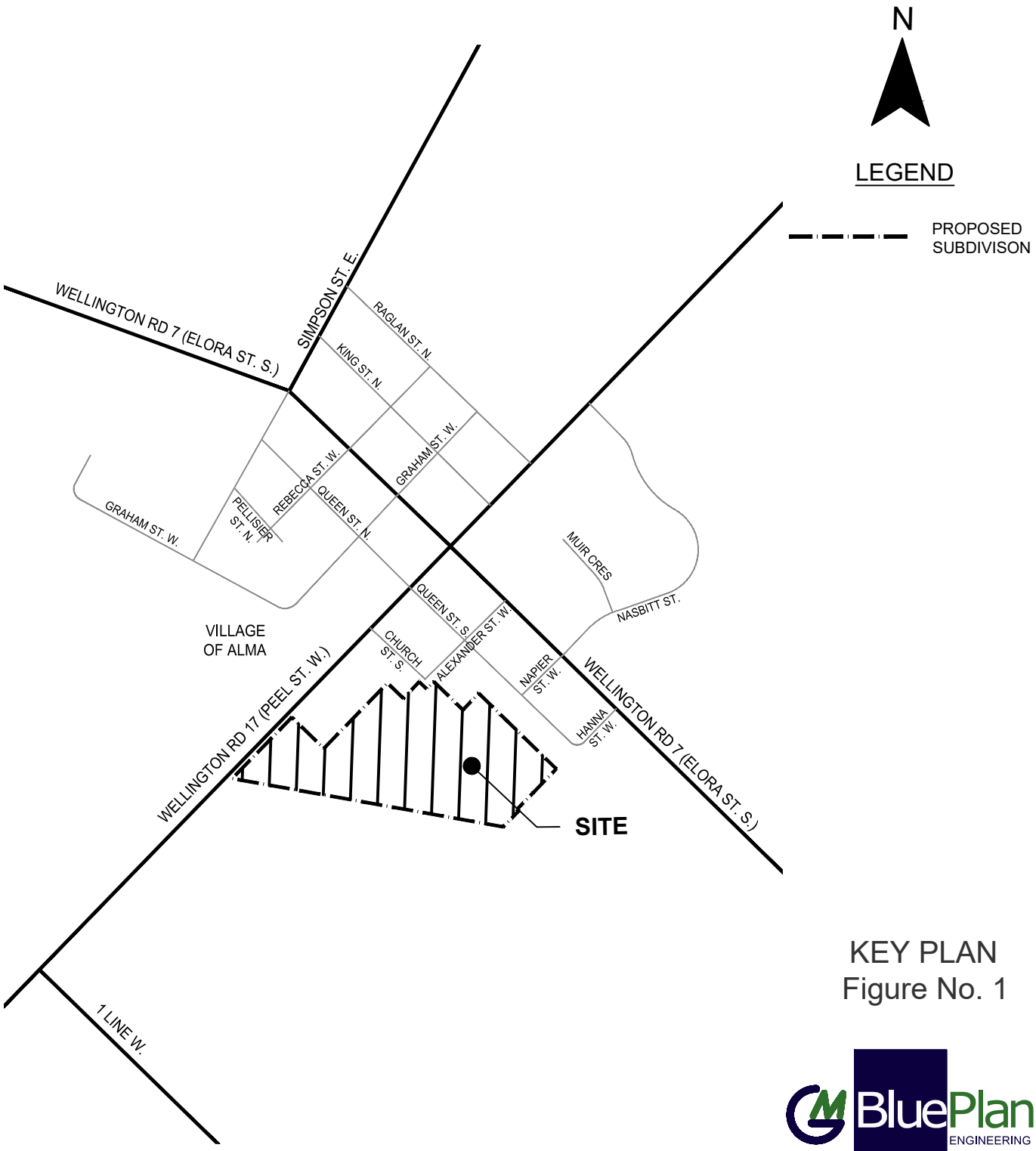
Existing ground elevations across the site range from approximately 447 metres above sea level at the northwesterly portion of the site, Peel Street, to approximately 437.50 metres at the north-easterly end of the site.

Runoff generated from the site currently sheetflows to the existing swale crossing the north-easterly portion of the site. The existing north-easterly drainage swale collects drainage from the majority of the Hamlet of Alma and surrounding farm fields and it continues in the southeasterly direction to the existing wooded area and wetland area located external of the site. The existing swale and external downstream wetland are regulated by the Grand River Conservation Authority (GRCA).

A rear yard swale crosses the property at the northerly portion of the site. This swale collects drainage from the existing lots fronting Peel Street and the part of the lots on Church Street, backing on to the subject site. The rear yard swale discharges to the existing culvert and roadside ditch system on Alexander Street.

The existing site features are shown on the Existing Conditions and Removals Plan prepared by GM BluePlan Engineering Limited.

120139
ALMA SUBDIVISION
TOWNSHIP OF MAPLETON



KEY PLAN
Figure No. 1

BluePlan ENGINEERING

120139
SEPTEMBER 2024
Scale: 1:10,000 | NAD 1983 UTM Zone 17N

2.3 Soils

CMT Engineering Inc. completed a Geotechnical Investigation of the site in 2020. Based on the CMT investigation, the topsoil depth on site ranges from 360 mm to 410 mm with an average depth of 377 mm. Subsurface soils are mainly composed of clayey silt in the upper 6 to 8 metre layers of the site. A confined sand layer is present directly below the clayey silt layer at a depth of 7.8 metres below the existing ground elevation at the easterly end of the site, Borehole 2, while silt is present directly below the clayey silt layer at a depth of 7.4 metres and 5.9 metres at the central and westerly portions of the site, Boreholes 1 and 3, respectively.

A copy of the CMT Geotechnical Investigation is included in **Appendix A.**

2.4 Groundwater

A Scoped Hydrogeological Assessment and Supplementary Groundwater Level Monitoring was completed by Hydrogeology Consulting Services (HCS) in 2022. Based on the HCS monitoring information, groundwater level measurements range from 0.05 to 2.48 metres below existing ground surface.

It is noted that the groundwater level measurement of 0.05 metre below the existing ground surface at Borehole 2 is interpreted to represent a perched groundwater table rather than a regional water table due to the location of the monitoring well filter screen in the confining sand layer. The existing sand layer which is located below the clayey silt layer at Borehole 2, approximately 7.8 metres below the existing ground elevation indicates a pressurized, artesian type of condition.

In addition, the HCS study mentions that Boreholes 1 and 3 are screened in a confined saturated silt deposit at a depth of 5.89 to 7.37 metres below the existing ground surface, respectively, and that the measured water levels do not indicate that a shallow groundwater table is encountered. The HCS Study concludes that “the near surface soils underlaying the subject property are low permeability clayey-silt deposits that do not contain significant groundwater and do not represent an aquifer”. Furthermore, the HCS study mentions that subsurface agricultural tiles may be installed to drain the perched groundwater layer.

Hydraulic conductivity rates range from 1×10^{-8} m/sec for the clayey silt soils to 1.9×10^{-4} m/sec for the deeper sandy soils found at Borehole 2. It is expected that low volumes of precipitation infiltrate through the clayey silt material on site to contribute to the deeper overburden groundwater regime.

A copy of the HCS Hydrogeological Assessment and Supplementary Groundwater Level Monitoring is included in **Appendix B.**

3.0 PROPOSED DEVELOPMENT

The proposed development generally consists of single-family estate style residential lots complete with a park block, internal roadways and a stormwater management block. **Figure 2**, illustrates the proposed Draft Plan of Subdivision prepared by Van Harten Surveying Inc.

Road connections to the existing municipal rights-of-ways will be provided by extending Church Street from its current terminus at Alexander Street in westerly direction to connect to Peel Street.

3.1 Site Grading

The preliminary site grading for the proposed residential lots, internal roads and stormwater management pond is shown on the Conceptual Grading Plans prepared by GM BluePlan Engineering Limited.

Existing road elevations are being maintained at the current Church Street terminus and Peel Street connections. The internal road network will form a low point at the entrance to the stormwater management pond which will provide for the major overland flow route from the development to be conveyed overland via the internal municipal right-of-way to the proposed stormwater management pond. The preliminary grading of the stormwater management pond has been designed to provide an outlet for the minor and major storm events to the existing swale which crosses the north-easterly portion of the property.

The proposed development will match into the existing property line elevations. The internal roadways are proposed to be graded with slopes ranging from 0.5% to 5%, while lots are generally proposed to be graded with slopes ranging from 2% to 6% per the per Township of Mapleton Development Standards. 3:1 transition slopes are proposed in rear yard areas to match into the existing property boundary elevations.

3.2 Streets

The internal roadways will be constructed as an urban cross section complete with concrete curb and gutter. The Township of Mapleton 20-metre-wide urban cross section will be used in the development of the site per Township of Mapleton Standard Drawing No. 101.

Concrete sidewalks, with a 1.5 metre width, will be constructed on both sides of each street.

3.3 Water Supply

The Hamlet of Alma does not have a municipal water supply system, as such, water supply to each of the proposed residential lots will be provided by individual drilled wells on each lot. An analysis of the local aquifer's ability to supply water at a sufficient rate was completed as part of the Hydrogeological Assessment prepared by HCS in May 2022, see **Appendix B**. Based on the analysis, there is ample supply available to meet the needs of the subdivision

The preliminary location of each well along with the 15m minimum setback radius from the septic system is shown on the Conceptual Servicing Plan prepared by GM BluePlan Engineering Limited.

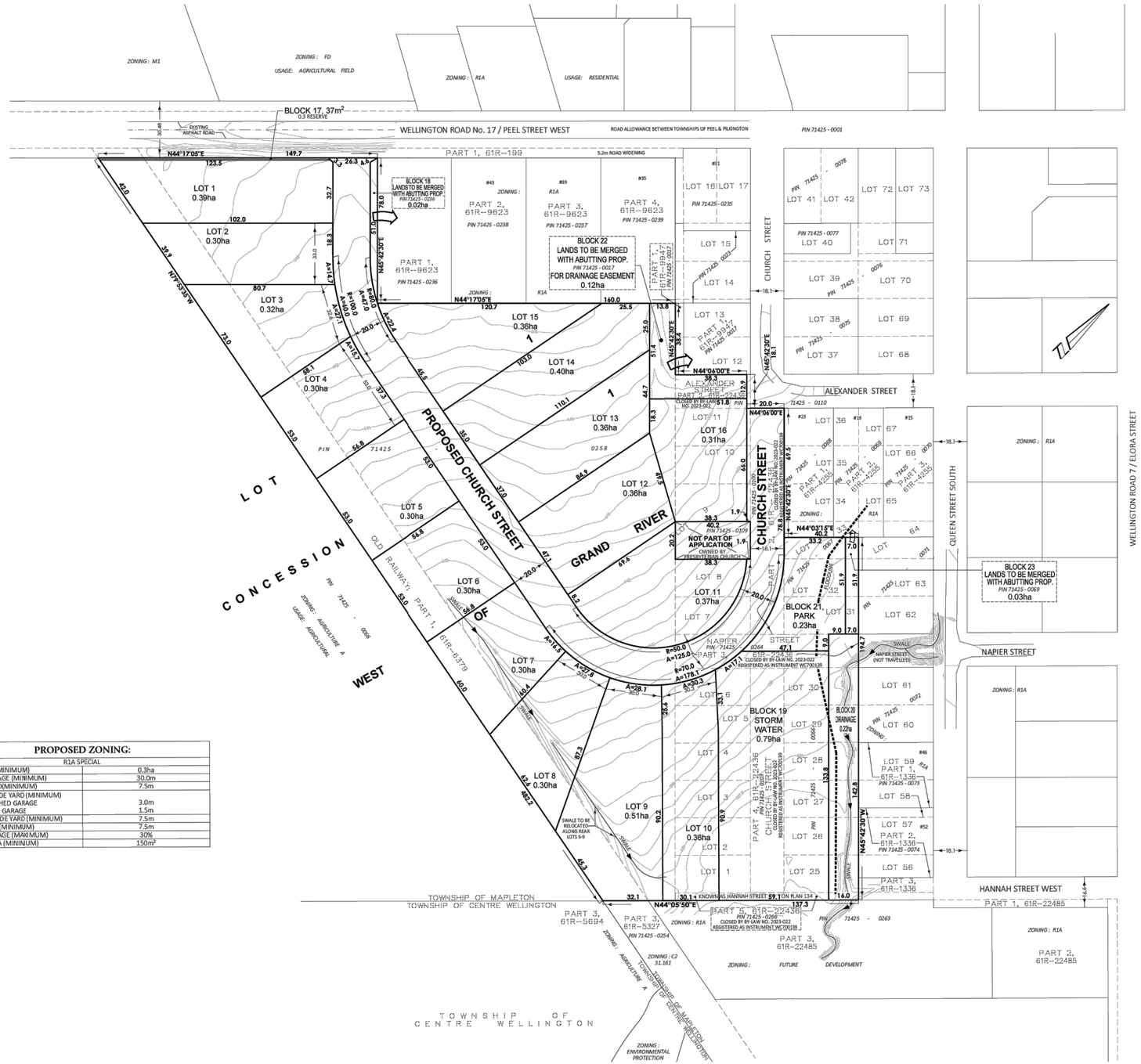
3.4 Sanitary Servicing

Sanitary servicing for the proposed development will be provided by a private septic system complete with enhanced tertiary treatment located in the front yard of each lot. The preliminary private sewage system design has been completed by Van Harten Surveying Inc. and has been included in **Appendix C** of this report.

The proposed location of the private septic system is illustrated on the Conceptual Servicing Plan prepared by GM BluePlan Engineering Limited.

120139
ALMA SUBDIVISION

TOWNSHIP OF
MAPLETON

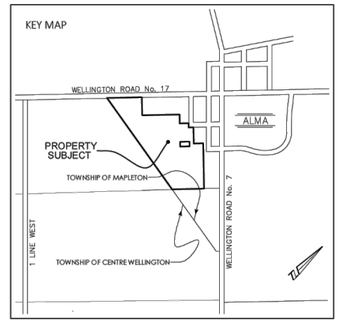


PROPOSED ZONING:	
R1A SPECIAL	
• LOT AREA (MINIMUM)	0.3ha
• LOT FRONTAGE (MINIMUM)	30.0m
• FRONT YARD(MINIMUM)	7.5m
• INTERIOR SIDE YARD (MINIMUM)	
- NO ATTACHED GARAGE	3.0m
- ATTACHED GARAGE	1.5m
• EXTERIOR SIDE YARD (MINIMUM)	7.5m
• REAR YARD (MINIMUM)	7.5m
• LOT COVERAGE (MAXIMUM)	30%
• FLOOR AREA (MINIMUM)	150m²

DRAFT PLAN OF SUBDIVISION OF
ALL OF LOTS 1-8,10,11,25-32 AND
PART OF LOTS 9 & 33
PART OF CHURCH STREET, ALEXANDER STREET, NAPIER STREET, AND HANNAH STREET
CLOSED BY BY-LAW NO. 2023-022 REGISTERED AS INSTRUMENT WC700139
VILLAGE OF ALMA
REGISTERED PLAN 134
AND
LOT 1, CONCESSION 1
WEST OF GRAND RIVER
GEOGRAPHIC MUNICIPALITY OF PILKINGTON
TOWNSHIP OF MAPLETON
COUNTY OF WELLINGTON

SCALE 1 : 1000
0 10 20 40 60 meters

VAN HARTEN SURVEYING INC.



LAND USE SCHEDULE

DESCRIPTION	LOTS	AREA (hectares)
LOTS	1-16	5.55
BLOCKS		
RESERVES	17	0.03
STORMWATER MANAGEMENT	19	0.79
DRAINAGE	20	0.22
PARK	21	0.23
LANDS TO BE MERGED WITH ABUTTING PROPERTY	18,22,23	0.16
ROADS		1.03
		8.01 TOTAL

ADDITIONAL INFORMATION
(UNDER SECTION 51(17) OF THE PLANNING ACT)
INFORMATION REQUIRED BY CLAUSES a,b,c,d,e,f,g,j and I ARE AS SHOWN ON THE DRAFT PLAN OF SUBDIVISION

h) municipal water supply
i) sand and gravel
k) individual septic and water

OWNER'S CERTIFICATE
I AUTHORIZE JEFFREY BUISMAN OF VAN HARTEN SURVEYING TO PREPARE AND SUBMIT THIS DRAFT PLAN OF SUBDIVISION.

DATE: AUGUST 22, 2024

KEVIN VANLEEUWEN
I HAVE AUTHORITY TO BIND THE CORPORATION
EXACT CONSTRUCTION LTD.

SURVEYOR'S CERTIFICATE
I CERTIFY THAT THE BOUNDARIES OF THE LAND TO BE SUBDIVIDED AND THEIR RELATIONSHIP TO THE ADJACENT LANDS ARE CORRECTLY SHOWN.

DATE: AUGUST 22, 2024

JEFFREY EDWARD BUISMAN
ONTARIO LAND SURVEYOR

PINS 71425-0066, 71425-0067, 71425-0100, 71425-0103, 71425-0258, 71425-0264, 71425-0266 PART OF PIN 71425-0102

OWNER: EXACT CONSTRUCTION LTD.

V.1	JANUARY 13/21
V.2	JANUARY 22/21
V.3	MARCH 29/21
V.4	APRIL 8/21
V.5	JANUARY 7/22
V.6	JANUARY 11/22
V.7	JANUARY 19/22
V.8	APRIL 28/23
V.9	OCTOBER 04/23
V.10	OCTOBER 11/23
V.11	JANUARY 23/24
V.12	AUGUST 14/24
V.13	AUGUST 22/24
V.14	SEPTEMBER 5/24

Van Harten SURVEYING INC.
LAND SURVEYORS and ENGINEERS

Kitchener/Waterloo	Guelph	Orangeville
Ph: 519-742-8371	Ph: 519-821-2763	Ph: 519-940-4110

www.vanharten.com info@vanharten.com

DRAWN BY: ARN | CHECKED BY: JEB | PROJECT No. 2908B-20

Sep 5, 2024-2:10:05 PM
G:\PILKINGTON\CON 1 WGR\EXACT ALMA SUBDIVISION\ACAD\EXACT DRAFT PLAN SUB (14) UTM.dwg

DRAFT PLAN OF
SUBDIVISION

Figure No. 2

BluePlan ENGINEERING

120139
SEPTEMBER 2024
Scale: N.T.S. | NAD 1983 UTM Zone 17N

FILE:\\geiconsultants.com\data\Data_Storage\Working\exact Construction\2401042 - 120139 Alma Subdivision\5 Work In Progress\Drafting\Sheets\Figures\120139 - Draft Plan.dwg LAYOUT:Draft Plan
LAST SAVED BY:Erianm3933, 9/16/2024 1:17:05 PM PLOTTED BY:Armstrong, Erin 9/16/2024 1:29:46 PM

3.5 Storm Sewer

The storm sewer system for the proposed development will be sized to convey the 5-year design storm to the proposed stormwater management facility. Preliminary storm sewer sizing has been completed to size the inlet pipe into the stormwater management pond and the first run of pipe branching away from the proposed low spot in the road at Church Street in support of determining the preliminary road elevations for the development. Preliminary storm sewer calculations are included in **Appendix D.**

Major storm events will be conveyed overland through the municipal right of ways to the stormwater management facility.

The stormwater management facility will outlet to the existing swale crossing the site. As part of the proposed development, the existing swale is to be re-graded with a flat bottom to increase capacity and mitigate the flooding depth during minor and major storm events. This will be discussed further in the upcoming sections of this report.

150mm diameter subdrains are proposed to be installed along the full length of the proposed curb line on both sides of the road per Township of Mapleton Development Standards Section B5.02.

Foundation drainage will be provided by sump-pump discharge to a 150mm diameter storm service lateral for each lot.

4.0 STORMWATER MANAGEMENT DESIGN

The studies, policies and guidelines used to develop the stormwater management plan are as follows:

1) The Stormwater Management Practices Planning and Design Manual, 1994
2) Stormwater Management Planning and Design Manual, 2003
3) The Interim Stormwater Quality Control Guidelines, 1991
4) The Stormwater Quality Best Management Practices Manual, 1991
5) The MTO Drainage Management Technical Guidelines, 1989
6) The Ontario Urban Drainage Design Guidelines, 1987

The stormwater management criteria for the proposed Alma Subdivision, are as follows:

1. Post-development flow rates for the site must be controlled to pre-development rates for the 2 to 100 year design storm events.
2. Provide enhanced level of quality control, 80% Total Suspended Solids (TSS) removal from all runoff leaving the site.
3. Major storm flows are to be routed overland to an appropriate outlet.

The method used to evaluate and design the stormwater management plan is as follows:

A three-hour duration rainfall event was used to generate the mass rainfall data required to model the 2, 5, 10, 25, 50 and 100-year design storms. The Mount Forest Intensity Duration Frequency (IDF) data was used per the Township of Mapleton Development Standards. The Mount Forest Intensity Duration Frequency data and MIDUSS Chicago Storm parameter calculation is included in **Appendix E.** The Chicago Storm parameters and the total depth of rainfall for each storm are shown below in **Table 1**.

Table 1: Mount Forest - Chicago Storm Parameters

	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
a =	758.485	876.909	997.497	1145.741	1273.113	1357.12
b =	7.538	7.781	8.438	9.035	9.492	9.595
c =	0.806	0.78	0.775	0.769	0.770	0.763
td =	1440	1440	1440	1440	1440	1440
Rainfall depth (mm)	51.605	72.080	85.001	101.960	112.445	126.124

The Regional Storm (Hurricane Hazel) was also modelled.

The Horton infiltration method was used in the runoff calculations. The parameters used in MIDUSS are as follows:

TABLE 2: Horton Infiltration Numbers

	IMPERVIOUS AREAS	PERVIOUS AREAS
Maximum Infiltration	0.0 mm/hr	75.0 mm/hr
Minimum Infiltration	0.0 mm/hr	12.5 mm/hr
Lag Constant	0.05 hr	0.25 hr
Depression Storage	1.5 mm	5.0 mm

The hydrologic model MIDUSS was used to create the runoff hydrographs and to route the flows through the storage structures.

4.1 Pre-Development Conditions

For pre-development conditions analysis purposes, the site was modelled as three (3) drainage catchments. The pre-development condition drainage catchments are shown on **Figure 3** and described below. The existing conditions MIDUSS computer modelling is attached in **Appendix F**.

Catchments external to the site discharging to the existing northerly and north-easterly swales crossing the property are discussed in Section 5.0 of this report.

Catchment 100 (7.88 hectares, 0% impervious) represents the bulk general developable area of the site. Runoff generated from Catchment 100 sheetflows overland in the easterly direction to the existing swale crossing the north-easterly property boundary of the site.

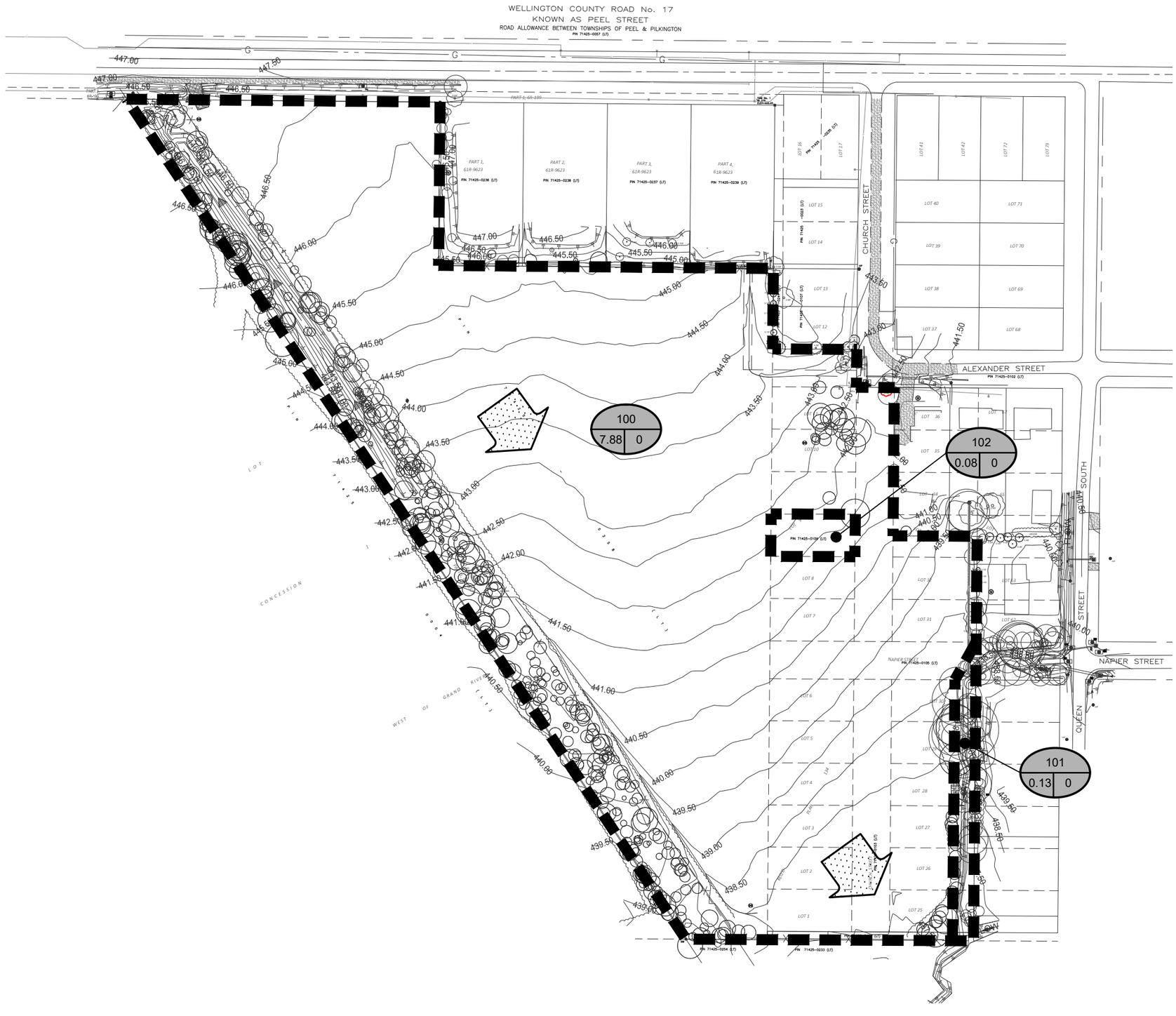
Catchment 101 (0.13 hectares, 0% impervious) represents the existing swale area crossing the north-easterly portion of the site. The existing swale continues downstream of the site in the easterly direction to the existing wooded and wetland area and is regulated by the Grand River Conservation Authority.

Catchment 102 (0.08 hectares, 0% impervious) represents the lands owned by the Presbyterian Church. Runoff generated from Catchment 102 sheetflows overland in the easterly direction to Catchment 100, ultimately discharging to the existing swale crossing the north-easterly property boundary of the site.

Table 3 lists the catchments under pre-development conditions.

Table 3: Pre-Development Condition Catchment

Catchment Number	Area (Ha)	Imperviousness (%)
100	7.88	0
101	0.13	0
102	0.08	0



ALMA SUBDIVISION TOWNSHIP OF MAPLETON

N

LEGEND

- EX. STORM SEWER
- DRAINAGE AREA BOUNDARY
- 101 / 0.11 | 80 — CATCHMENT NUMBER; % IMPERVIOUS; CATCHMENT AREA IN HECTARES
- MAJOR OVERLAND FLOW

30 0 20 40 80
1:2000 (m)

EXISTING CONDITIONS DRAINAGE AREA PLAN

Figure No. 3

BluePlan ENGINEERING

120139
SEPTEMBER 2024
Scale: 1:2000 | UTM CSRS 17 N

Table 4 lists the flow rates discharging from each catchment under pre-development conditions.

Table 4: Pre-Development Condition Flow Rates

	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	Regional Storm
Catchment 100	0.070 m^3/s	0.240 m^3/s	0.361 m^3/s	0.558 m^3/s	0.690 m^3/s	0.822 m^3/s	0.575 m^3/s
Catchment 101	0.005 m^3/s	0.018 m^3/s	0.025 m^3/s	0.031 m^3/s	0.035 m^3/s	0.040 m^3/s	0.012 m^3/s
Catchment 102	0.002 m^3/s	0.007 m^3/s	0.010 m^3/s	0.014 m^3/s	0.016 m^3/s	0.018 m^3/s	0.007 m^3/s
Total Flow Rate	**0.071 m^3/s**	**0.243 m^3/s**	**0.366 m^3/s**	**0.564 m^3/s**	**0.701 m^3/s**	**0.834 m^3/s**	**0.590 m^3/s**

4.2 Post-Development Conditions

For post-development analysis purposes, the site was modelled as six (6) drainage catchments. The post-development drainage catchments are shown on **Figure 4** and described below. The post-development MIDUSS computer modelling is attached in **Appendix G.**

Catchment 200 (6.33 hectares, 50% impervious) includes the proposed Church Street extension and the majority of the single-family estate type lots. Runoff generated from Catchment 200 will be directed to the proposed stormwater management pond.

Catchment 201 (0.66 hectares, 50% impervious) represents the proposed stormwater management pond block. The stormwater management pond will outlet to the existing swale crossing the north-easterly portion of the site.

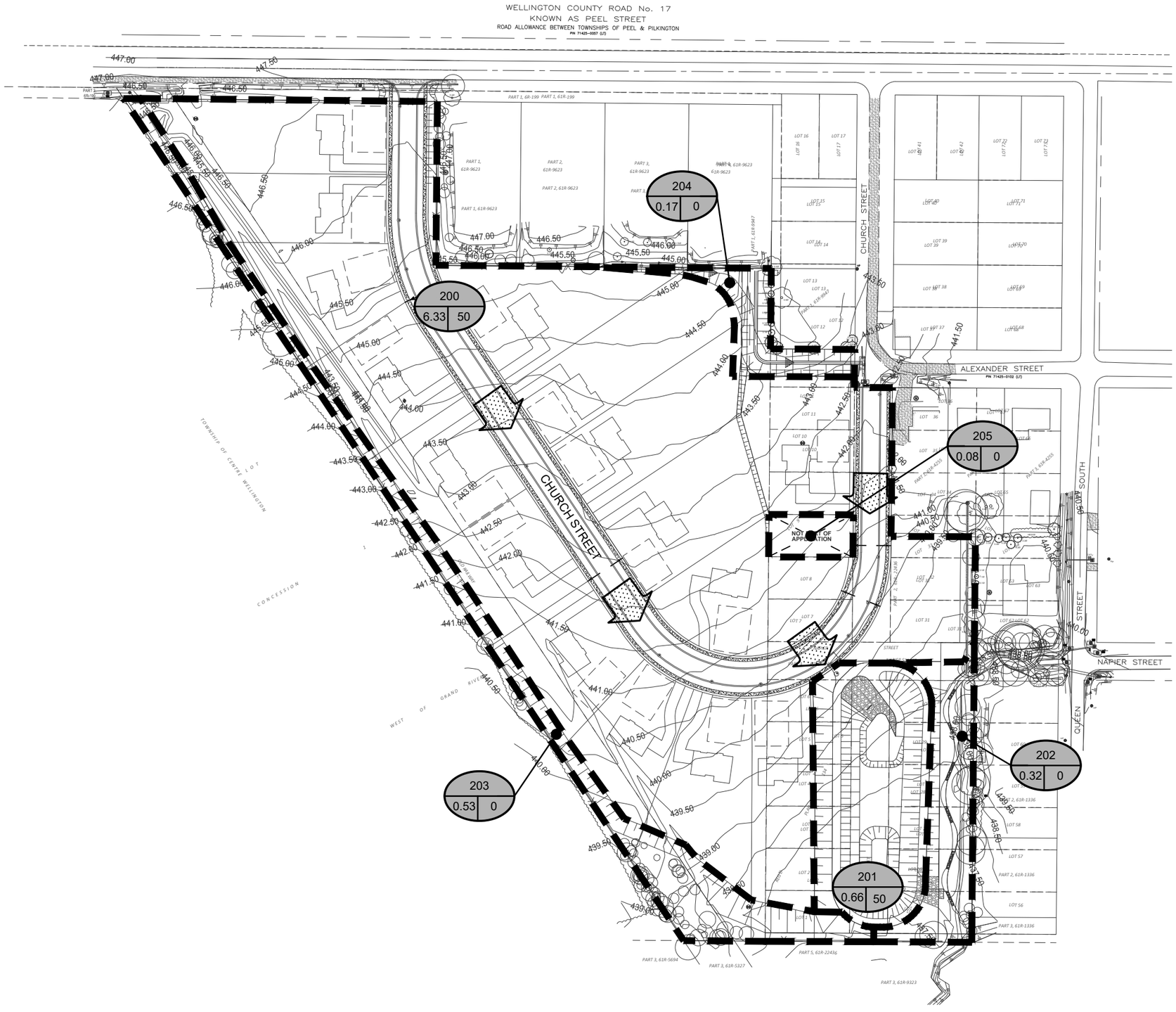
Catchment 202 (0.32 hectares, 0% impervious) represents the area required to accommodate the enhancements to the existing swale crossing the north-easterly portion of the site. The existing v-shaped swale is proposed to be regraded to a flat bottom cross section complete with low flow channel to increase capacity and mitigate flooding elevations. The swale will match the existing alignment at the limits of the subdivision and will continue downstream of the site in the easterly direction towards the existing wooded and wetland area. The existing swale, downstream wooded and wetland areas are regulated by the Grand River Conservation Authority.

Catchment 203 (0.53 hectares, 0% impervious) represents the proposed 3:1 transition slope to match existing elevations at the southerly property boundary for Lots 1 to 9. Runoff generated from the transition slope will sheetflow along the property line in the easterly direction and will discharge to the existing swale located downstream of the site.

Catchment 204 (0.17 hectares, 0% impervious) represent a portion of the 3:1 transition slope located at the rear of lots 13 to 15 as well as the existing northerly swale that collects runoff from the existing lots fronting Peel Street and Church Street. Runoff from Catchment 204 will continue to flow through the existing roadside ditches and culverts and will outlet to the existing swale crossing the property at the north-easterly end (Catchment 202).

Catchment 205 (0.08 hectares, 0% impervious) represents the lands owned by the Presbyterian Church. Runoff generated from Catchment 205 sheetflows overland in the easterly direction to Catchment 200, ultimately discharging to the proposed stormwater management pond.

ALMA SUBDIVISION
TOWNSHIP OF MAPLETON



LEGEND

- PROP. STORM SEWER
- DRAINAGE AREA BOUNDARY
- 201 / 0.11 | 80 — CATCHMENT NUMBER; % IMPERVIOUS; CATCHMENT AREA IN HECTARES
- MAJOR OVERLAND FLOW

30 0 20 40 80
1:2000 (m)

POST DEVELOPMENT DRAINAGE AREA PLAN

Figure No. 4

BluePlan ENGINEERING

120139
SEPTEMBER 2024
Scale: 1:2000 | UTM CSRS 17 N

FILE:\\geiconsultants.com\data\Data_Storage\Working\exact Construction\2401042 - 120139 Alma Subdivision\5 Work In Progress\Drafting\Sheets\Figures\120139 - SWM Figures.dwg LAYOUT:Post SWM
LAST SAVED BY:Eriarm3933, 9/16/2024 1:19:37 PM PLOTTED BY:Armstrong, Erin 9/16/2024 1:30:17 PM

Catchments external to the site discharging to the existing northerly and north-easterly swales crossing the property are discussed in Section 5.0 of this report.

The post-development conditions flow rates were calculated using MIDUSS software to route the hydrographs.

Table 5 summarizes the parameters utilized in the modelling under post-development conditions.

Table 5: Post-Development Condition Catchment Parameters

Catchment Number	Area (Ha)	Imperviousness (%)
200	6.33	50
201	0.66	50
202	0.32	0
203	0.53	0
204	0.17	0

Table 6 identifies the post-development uncontrolled flow rates generated from the site during the full range of design storm events.

Table 6: Post-Development Uncontrolled Flow Rates

	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	Regional Storm
Catchment 200	0.649 m^3/s	0.792 m^3/s	0.902 m^3/s	1.058 m^3/s	1.176 m^3/s	1.295 m^3/s	0.549 m^3/s
Catchment 201	0.074 m^3/s	0.099 m^3/s	0.118 m^3/s	0.150 m^3/s	0.174 m^3/s	0.189 m^3/s	0.070 m^3/s
Catchment 202	0.013 m^3/s	0.045 m^3/s	0.061 m^3/s	0.076 m^3/s	0.087 m^3/s	0.099 m^3/s	0.029 m^3/s
Catchment 203	0.021 m^3/s	0.074 m^3/s	0.101 m^3/s	0.127 m^3/s	0.145 m^3/s	0.164 m^3/s	0.047 m^3/s
Catchment 204	0.010 m^3/s	0.025 m^3/s	0.033 m^3/s	0.046 m^3/s	0.054 m^3/s	0.062 m^3/s	0.016 m^3/s
Catchment 205	0.002 m^3/s	0.007 m^3/s	0.010 m^3/s	0.014 m^3/s	0.016 m^3/s	0.018 m^3/s	0.007 m^3/s
Total Flow Rate	**0.746 m^3/s**	**1.027 m^3/s**	**1.212 m^3/s**	**1.448 m^3/s**	**1.623 m^3/s**	**1.807 m^3/s**	**0.717 m^3/s**

4.3 Stormwater Management Overview

In line with current practices and guidelines, the stormwater management approach for the Alma

Subdivision is designed as a “treatment train” to remove sediments and any absorbed contaminants prior to the discharge of runoff from the development to the receiving outlets. The “treatment train” approach will include a combination of lot level, conveyance and end-of-pipe best management practices and is proposed to filter and remove sediments from stormwater runoff prior to discharging to the existing swale located at the north-easterly portion of the site.

4.4 Lot Level Controls

Stormwater management practices recommended for providing lot level controls on this site are as follows:

a) Roof Drainage to Ground Surface

The lots will drain to the street. The roof runoff will be filtered across the grassed surface. The runoff for any event large enough to generate flow to the sewer system will be adequately filtered by the grass.

b) Rear Yard Swales

The grading of the lots will be to current Township of Mapleton Development Standards. Where practical, the length of the rear lot swales between catch basins will be increased to extend the contact time with the grassed surfaces.

To promote more infiltration on the lots and in the swales, it is recommended that the average depth of graded topsoil be 300 mm.

c) Foundation Drainage

Foundation drainage will be via sump pumps discharging to a proposed storm sewer lateral for each lot.

4.5 Conveyance Controls

Conveyance controls will be achieved through municipal maintenance of the storm sewer system. The regular cleanout of the manholes and catchbasin sumps will remove the heavier sediments deposited from the runoff during storm events.

4.6 End of Pipe Facilities

The end-of-pipe component consists of the proposed stormwater management pond located near the north-easterly edge of the property, adjacent to the existing swale. The proposed stormwater management facility will outlet to the existing swale and has been designed as a hybrid wet pond/wetland complete with a forebay, a 0.3m deep permanent pool in the wetland component and 2.25 m deep permanent pool in the wet pond component to provide the required water quality controls. The proposed stormwater management facility will have a reverse draw outlet for the 4-hour 25mm storm event (quality storm) to draw cooler water from the deeper parts of the pond, prior to outleting to the existing swale. The proposed outlet structure is designed to provide extended detention of the required water quality storage volumes as per the Ministry of Environment 2003 Stormwater Management Planning and Design Manual.

4.7 Proposed Stormwater Management Facility

Water Quality

The proposed stormwater management facility has been designed to function as a hybrid wet pond/wetland. From Table 3.2, Stormwater Management Planning and Design Manual, 2003, in order to provide enhanced water quality treatment, a hybrid wet pond/wetland facility requires 140 m^3/ha of storage volume for a

contributing drainage area that is 50% impervious. 40 m³/ha of the required storage volume is extended detention volume, while the remaining 100 m³/ha is permanent pool. Based on a contributing drainage area of 7.07 hectares and a requirement of 100 m³/ha of permanent pool, the required permanent pool storage is 707 m³.

The proposed stormwater management pond has been designed with a 0.3 metre deep permanent pool for the wetland portion and 2.25 metre deep permanent pool for the wet pond component, which provides a combined permanent pool volume of 582 m³. The remaining required permanent pool volume (approximately 360 m³) will be provided in the sediment forebay.

Extended Detention

Extended detention volume is calculated based on the runoff volume (721 m³) generated by the 4-hour 25 mm design storm event. The outlet structure has been designed to provide a 24-hour detention of the required extended detention volume, which corresponds to a release rate of 0.013 m³/s.

From the design of the stormwater management pond, a storage volume of 721 m³ corresponds to a ponding depth of approximately 0.32 metres. The outlet structure has been designed with a 110 mm diameter orifice, which will control the extended detention volume to the required release rate.

Table 7 provides a brief description of the stormwater management facility.

Table 7: Hybrid wet pond/wetland facility summary

Location	31 Church Street ,Alma, Township of Mapleton
Watershed/Subwatershed	Grand River
Receiver of Discharge	Grand River via Carroll Creek
Outlet Location	Latitude-43.727N longitude-80.501W
Catchment Area	7.07 Ha
Level of Treatment for Suspended Solids	Level 1 (80)
Treatment for other Contaminants, as Required	water temperature
Level of Volume Control	Regional Storm
Design Storm	2-Yr to Regional Storm event
Brief Description	N/A
Receive Emergency Sanitary Overflows	No
Notes / Additional Information	N/A

Table 8 compares the routing results through the stormwater management pond with the available stage/storage/ discharge capacities.

Table 8: Stormwater Management Pond – Stage/Storage/Discharge Comparison

Control	Available Capacity			Actual Capacity Used		
	Peak Flow m^3/s	Storage Volume m^3	Storage Elevation m	Peak Flow m^3/s	Storage Volume m^3	Storage Elevation m
Bottom of Pond	0	0	436.90	---	---	---
25 mm Storm	---	---	---	0.013	721	437.22
Orifice No 2	0.015	935	437.30	---	---	---
2 Year Storm	---	---	---	0.047	1,198	437.40
5 Year Storm	---	---	---	0.118	1,663	437.57
10 Year Storm	---	---	---	0.204	1,926	437.65
25 Year Storm	---	---	---	0.314	2,239	437.76
50 Year Storm	---	---	---	0.377	2,459	437.82
100 Year Storm	---	---	---	0.437	2,717	437.90
Regional Storm	---	---	---	0.494	3,073	438.01
Weir	0.558	3,407	438.10	---	---	---
Top of Pond	3.051	4,566	438.40	---	---	---
Overflow	4.123	4,903	438.48	---	---	---

Sediment Forebay Design

The proposed stormwater management facility has been designed with one sediment forebay located at the pond inlet. The sediment forebay is 1.0 m deep and has been designed per the Ministry of Environment Stormwater Management Planning and Design Manual guidelines. The full sediment forebay sizing information has been included in **Appendix G**.

Table No. 9 summarizes the required and provided parameters within the sediment forebay design.

Table No. 9: Sediment Forebay Design Details

Required	**Dispersion Length (m)**	14.1
	Settling Length (m)	9.3
	Flow Velocity (m/s)	0.15
	Length to Width Ratio	2:1
	Settling Velocity (m/s)	0.0003
Provided	**Forebay Length (m)**	30
	Flow Velocity (m/s)	0.05
	Length to Width Ratio	2:1

Therefore, the sediment forebay has been designed to provide the required dispersion and flow lengths.

Sediment Loading and Cleanout Frequency

Table No. 10 illustrates sediment loading to the sediment forebay as well as the subsequent cleanout frequency required to maintain this system.

Table No. 10: Sediment Loading and Cleanout Frequency – Sediment Forebays

Catchment Area	Imp. (%)	Annual Sediment Loading	TSS Removal	Annual TSS Reduction	Storage Volume	Cleanout Frequency
7.07 ha	50%	11.17 m^3 (based on 1.58 m^3/ha)	80%	8.94 m^3	120 m^3 (1/3 of forebay)	~ 13.4 years

Sediment loadings obtained from Table 6.3 of the MOE Stormwater Management Planning and Design Manual, 2003 and prorated based on catchment percent impervious.

Therefore, it is estimated that the sediment forebay will require cleaning every 13.4 years.

Thermal Mitigation

Thermal mitigation management practices have been implemented into the design of the proposed stormwater management facility prior to discharge to the existing swale located at the north-easterly portion of the site. The Stormwater Management Planning and Design Manual, Ministry of Environment 2003 and the Data Synthesis and Design Considerations for Stormwater Thermal Mitigations Measures, Sustainable Technologies Evaluation Program 2019 have been used to design the reverse draw outlet structure and deep pool to provide the required thermal mitigation measures for the pond. It is noted that pond outflow temperatures will decrease at elevations starting at 0.5m below the permanent pool level with more significant temperatures reductions at a depth of at least 1.2m below the permanent pool level. Deep draw outlets can reduce the inflow temperature by as much as 3 to 5 degrees Celsius with the most effective outlet depth being at least 2m below the permanent pool level. Due to the size of the stormwater management facility and possible groundwater implications for a deeper pool level, the proposed design uses an outlet depth of 1.2m to be obvert of the pipe.

The proposed stormwater management facility has been designed to function as a hybrid wet pond/wetland complete with a reverse draw from the wet pond (deep pool) portion of the facility. The reverse draw has been designed for the 4-hour 25mm storm event to allow cooler water to be discharged from the pond under the quality storm event per the Stormwater Management Planning and Design Manual guidelines. The reverse draw outlet consists of a 150mm diameter pipe with an obvert depth of 1.2m below the permanent pool elevation and a deep pool bottom depth of 0.9m below the reverse draw outlet to allow for 33% of permanent pool sediment build-up (1.2m x 0.33 = 0.4m) and 0.5m freeboard from the sediment level per the criteria set out in the Data Synthesis and Design Considerations for Stormwater Thermal Mitigations Measures.

Flows greater than the 25mm storm event will discharge through the proposed 2,400mm diameter perforated riser outlet structure to the existing swale.

In addition to the reverse draw from the deep pool portion of the proposed stormwater management facility, it is recommended that the landscape design of the pond includes plantings along the permanent pool, outlet structure and pond banks that help shade the pond and mitigate the thermal impacts of the development on the existing swale.

4.9 Comparison to Pre-Development Flows

Table 11 summarizes the comparison of pre and post-development flows from the site.

Table 11: Comparison of Pre and Post-Development Flows

	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	Regional Storm
Pre-Development Flow Rate	0.071 m^3/s	0.243 m^3/s	0.366 m^3/s	0.564 m^3/s	0.701 m^3/s	0.834 m^3/s	0.590 m^3/s
Post-Development Flow Rate	0.056 m^3/s	0.162 m^3/s	0.233 m^3/s	0.325 m^3/s	0.397 m^3/s	0.463 m^3/s	0.559 m^3/s

Therefore, the post-development flow rates discharging from the site during the 2 to 100-year design storm events and Regional Storm event are less than the pre-development flow rates from the site.

5.0 EXISTING NORTHERLY AND NORTH-EASTERLY SWALES

Northerly Swale

A rear yard swale crosses the site at the northerly portion of the property. This swale collects drainage from portions of the adjacent lots fronting Peel Street and Church Street for a total drainage area of 0.780 ha and discharges to the existing roadside ditch and culvert system on Alexander Street. The existing rear yard swale is proposed to be re-graded within the limits of the subdivision to accommodate the proposed lot layout and subdivision grading.

The proposed grading of the swale is shown on the Conceptual Grading Plans prepared by GM BluePlan Engineering Limited.

A preliminary MIDUSS model has been constructed illustrating the drainage catchments to the existing rear yard swale along with channel computations for the existing and proposed swale cross sections. The existing and proposed swale cross sections are shown on the Details and Section Plan prepared by GM BluePlan Engineering Limited. A copy of the MIDUSS model and swale catchment area plan is included in **Appendix H.**

The catchment area draining to the existing rear yard swale is described below:

Catchment 4000 (0.780 hectares, 50% impervious) represents the existing residential lots fronting Peel Street and Church Street adjacent to the site. Runoff from these lots is conveyed by the existing rear yard swale located at the northerly portion of the site. The existing swale discharges to the existing roadside ditch and culvert system on Alexander Street.

The existing and proposed condition flooding depths in the swale have been summarized in the table below for the 2 to 100 year design storms as well as the Regional Storm event.

Table 12: Comparison of Northerly Swale Flooding Depths Under Existing and Proposed Conditions

	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	Regional Storm
Existing Conditions Flooding Depth (m)	0.10 m	0.11 m	0.11 m	0.12 m	0.13 m	0.13 m	0.09 m
Proposed Conditions Flooding Depth (m)	0.07 m	0.08 m	0.08 m	0.09 m	0.10 m	0.10 m	0.06 m

Therefore, based on the preliminary MIDUSS analysis, the flooding depth in the existing rear yard swale located at the northerly portion of the site has been significantly reduced for the 2 to 100 year design storm events and Regional Storm event.

North-Easterly Swale

The existing swale crossing the north-easterly property boundary is proposed to be re-graded within the limits of the subdivision from a v-shaped to a flat bottom cross section to increase capacity and mitigate the flooding depth during major storm events. The majority of the easterly bank of the existing swale along with the existing trees are proposed to be left untouched with the limit of grading to start 6m west from the property boundary. The existing trees will provide visual screening from the existing lots on Queen Street which back on to the site and will help provide shading for the proposed swale improvements.

The proposed grading of the swale will incorporate a 10 metre wide flat bottom, matching the existing bottom of bank at the east portion of the swale and 3:1 side slopes matching into the proposed stormwater management facility access road. The slope and average depth of the swale will be generally maintained from existing to proposed conditions.

A low flow channel is proposed to be constructed along the flat bottom portion of the swale to allow for fish passage through the swale. The low flow channel will consist of a series of pools and riffles. The pool areas are 0.4m deep while the riffle areas are 0.3m deep.

The proposed grading of the flat bottom swale and low flow channel is shown on the Conceptual Grading Plans and Details prepared by GM BluePlan Engineering Limited.

It is anticipated that the proposed swale will be vegetated following construction to restore the natural habitat of the area.

A preliminary MIDUSS model has been constructed illustrating the drainage catchments to the existing swale along with channel computations for the existing v-shaped swale and proposed flat bottom swale cross sections. The existing and proposed swale cross sections are shown on the Details and Section Plan prepared by GM BluePlan Engineering Limited. A copy of the MIDUSS model and swale catchment area plan is included in **Appendix H.**

The catchment areas draining to the existing swale are described below:

Catchment 1000 (64.54 hectares, 5% impervious) represents the existing farmland area located northwest of Peel Street and Simpson Road intersection. Runoff generated from this catchment discharges overland to the existing culvert crossing Peel Street to the southern farm field, Catchment 2000.

Catchment 2000 (11.17 hectares, 2% impervious) represents the existing farm field located south of Peel Street, west of the Hamlet of Alma. Runoff from this catchment discharges overland to the existing network of roadside ditches and culverts in Alma, Catchment 3000.

Catchment 3000 (53.62 hectares, 50% impervious) represents the majority of the developed portion of the Hamlet of Alma. Runoff from this catchment is conveyed via the existing network of roadside ditches and culverts in Alma, ultimately discharging to the existing swale.

The existing and proposed condition flooding depths in the swale have been summarized in the table below for the 2 to 100 year design storms as well as the Regional Storm event.

Table 13: Comparison of North-Easterly Swale Flooding Depths Under Existing and Proposed Conditions

	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	Regional Storm
Existing Conditions Flooding Depth (m)	1.08	1.15	1.18	1.22	1.25	1.27	1.22
Proposed Conditions Flooding Depth (m)	0.49	0.58	0.64	0.71	0.76	0.81	0.71

Therefore, based on the preliminary MIDUSS analysis, the flooding depth in the existing north-easterly swale has been significantly reduced for the 2 to 100 year design storm events and Regional Storm event.

6.0 SEDIMENT AND EROSION CONTROL PLAN

Primary sediment control will be achieved with the installation of Type 2 sediment fence around the property boundary. The silt fence will eliminate the opportunity for water borne sediments to be transported from the site.

Temporary rock check dams will be installed in rear and side yard swales after the initial grading has been completed to slow the flow rates and promote the settlement of water borne sediments before they reach the silt fences and ponds.

Upon completion of the grading, any area not subject to active construction within 30 days will be topsoiled and seeded as per OPSS 572.

The stormwater management facility will be graded and shaped at the start of any construction or pre-grading activity. A silt fence will be placed around the outlet structures to restrict the movement of sediment.

Once catch basins have been installed, the grates will be wrapped in filter cloth. This will be maintained until all building and landscaping has been completed.

Inspection and maintenance of all silt fencing and the sediment pond will start after installation is complete. These features will be inspected on a weekly basis or after a rainfall event of 13 mm or greater. Maintenance will be carried out, within 48 hours, on any part of the facility found to need repair.

Monthly reports on the condition of the sediment and erosion control measures will be submitted to the Township of Mapleton and the Grand River Conservation Authority.

Once construction has been substantially completed, the silt fence will be removed from within the pond, any accumulated sediment will be removed and the landscaping and planting of the ponds will be completed.

After construction of the complete development, erosion will not occur and sediment transport will be minimal. The stormwater management facility will provide all sediment removal.

7.0 CONCLUSIONS

In summary, the features of the design for the proposed development are as follows:

1. Sanitary servicing will be provided by lot level private septic system complete with enhanced tertiary treatment.

2. Water servicing will be provided by a private well for each lot which is to be designed and constructed by others.

3. Storm sewers will be designed to convey the 5-year design storm event to the proposed stormwater management pond, while the major overland flows from the site will be directed overland towards the municipal rights-of-ways to the stormwater management pond.

4. The proposed stormwater management pond is designed to function as a hybrid wet pond/wetland complete with a permanent pool varying in depths from 0.3m to 2.25m and a 1.0m deep forebay to provide enhanced level of quality control (80% Total Suspended Solid removal).

5. Temperature mitigation measures have been implement in the design of the stormwater management facility to incorporate a reverse draw outlet for the 4-hour 25mm storm event to draw cooler water from the deeper portion of the pond prior to outleting to the existing swale located at the northeast portion of the site.

6. The post-development flow rates discharging from the site during the 2 to 100-year design storm events and Regional Storm event are less than the pre-development flow rates from the site.

7. The re-grading of the existing swales crossing the site at the northerly and north-easterly portions of the property will significantly reduce flooding depths during the 2 to 100 year design storm events and Regional Storm.

8. The stormwater management systems meet the current Provincial and Municipal guidelines.

9. The principles of “Stormwater Management Practices”, the Ministry of Environment Stormwater Management Planning and Design Manual 2003 have been used in the design of the stormwater management system.

Based on the above works, we trust that this is the information required to support the approval of the Draft Plan of Subdivision.

All of which is respectfully submitted.

GM Blue Plan Engineering LIMITED
Per:

Angela Kroetsch, P.Eng.
SZ/

APPENDIX A

Geotechnical Investigation, CMT Engineering Inc., 2020

GEOTECHNICAL INVESTIGATION

PROPOSED RESIDENTIAL SUBDIVISION
31 CHURCH STREET
ALMA, ONTARIO

CMT Project 20-732.R01

Prepared for:

Exact Construction

December 18, 2020

CMT Engineering Inc.
1011 Industrial Crescent, Unit 1
St. Clements, Ontario N0B 2M0
Tel: 519-699-5775
Fax: 519-699-4664
www.cmtinc.net

December 18, 2020 20-732.R01

Exact Construction
8262 Wellington Road 19
R. R. 3
Fergus, Ontario
N1M 2W4

Attention: Mr. Kevin Vanleeuwen

Dear Sir:

Re: Preliminary Geotechnical Investigation
Proposed Residential Subdivision
31 Church Street
Alma, Ontario

As requested, CMT Engineering Inc. conducted a geotechnical investigation at the above-referenced site, and we are pleased to present the enclosed report.

We trust that this information meets your present requirements, and we thank you for allowing us to undertake this project. Should you have any questions, please do not hesitate to contact our office.

Yours truly,

Brittany Brown

Brittany Brown, C.Tech., rcji

ks

TABLE OF CONTENTS

1.0 INTRODUCTION

The services of CMT Engineering Inc. (CMT Inc.) were retained by Mr. Kevin Vanleeuwen of Exact Construction to conduct a preliminary geotechnical and hydrogeological investigation for the proposed residential subdivision to be located at 31 Church Street, Alma, Ontario. The hydrogeological study was completed by Hydrogeology Consulting Services (HCS) and will be provided under separate cover. The location of the site is shown on Drawing 1.

It is understood that the project will comprise the construction of a residential subdivision, although no site plan has been provided at this time. It is assumed that the development will include the construction of new road(s) and approximately twenty (20) residential homes with associated driveways. Drilled water wells and septic systems will likely service the new residences.

The purpose of the geotechnical investigation was to assess the existing soil and groundwater conditions encountered in the boreholes/monitoring wells. Included in the assessment are the soil classification and groundwater observations, as well as comments and recommendations regarding geotechnical resistance (bearing capacity); serviceability limit states (anticipated settlement); dewatering considerations; site classification for seismic site response; recommendations for site grading, site servicing, excavations and backfilling; recommendations for slab-on-grade construction; pavement design/drainage; soil design properties; and a summary of the laboratory results.

The recommendations provided in this report are solely based on the information obtained in the boreholes advanced on the subject site.

2.0 EXISTING SITE CONDITIONS

The existing site currently comprises vacant agricultural land, previously used for crop production. The site is bounded by Peel Street West (Wellington Road 17) to the west, residential properties to the north and east, and a former CNR rail line to the south. The general site topography slopes gently towards the eastern extent of the site.

3.0 FIELD AND LABORATORY PROCEDURES

The field investigation was conducted on December 11, 2020 and comprised the advancement of three (3) boreholes with monitoring wells (referenced as Boreholes 1 to 3), using a Geoprobe 7822DT drillrig operated by employees of CMT Drilling Inc. Boreholes 1 and 2 were advanced to depths of approximately 9.14 m (30.0 ft) below the ground surface, while Borehole 3 was advanced to a depth of approximately 7.62 m (25.0 ft).

Standard penetration testing (SPT) and sampling was carried out in all boreholes using 38 mm inside diameter split spoon sampling equipment and an automatic hammer, in accordance with ASTM D 1586 "Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils". SPT soil sampling was generally conducted at 0.76 m (2.5 ft) to 1.52 m (5.0 ft) intervals to approximately 5.18 m (17.0 ft). Macro core (MC5) direct push sampling was conducted between the SPT samples conducted below 3.66 m (12.0 ft), and continuously below 5.18 m (17.0 ft) to borehole termination.

Technical staff from CMT Inc. observed the drilling operation and collected and logged the recovered soil samples. A small portion of each sample was placed in a sealed, marked jar for moisture content determinations. Representative samples from the boreholes at the following depths were submitted to the CMT Inc. laboratory in St. Clements, Ontario for grain size analyses:

- Borehole 1 - depth 1.52 m to 2.13 m (5.0 ft to 7.0 ft)
- Borehole 2 - depth 7.62 m to 9.14 (25.0 ft to 30.0 ft)
- Borehole 3 - depth 6.10 m to 7.62 m (20.0 ft to 25.0 ft)

The borehole logs are provided in Appendix A and the grain size analyses are provided in Appendix B.

The ground surface elevations at the borehole locations were surveyed by CMT Inc. personnel following the completion of drilling. The top of the existing water well (A299778) was used as a temporary benchmark, with an assumed elevation of 100.00 m. A geodetic benchmark elevation was not available at this time, although the geodetic elevations of the boreholes can be updated if that information becomes available. The ground surface elevations at the borehole locations ranged from approximately 101.75 m at the west extent of the site to approximately 92.78 m at the east extent. Although the site appears to be relatively flat, the overall topography differs by approximately 9.0 m from west to east. The locations of the boreholes are shown on Drawing 2.

4.0 SUBSOIL CONDITIONS

The soils encountered in the boreholes are described briefly below and a more detailed stratigraphic description is provided on the borehole logs in Appendix A. The following paragraphs have been simplified into terms of major soil strata. The soil boundaries indicated have been inferred from non-continuous samples and observations of sampling and drilling resistance and typically represent transitions from one soil type to another rather than exact planes of geological change. Further, the subsurface conditions are anticipated to vary between and beyond the borehole locations.

4.1. Topsoil

Loose, dark brown, silty topsoil was encountered at the surface of all three boreholes, ranging in thickness from approximately 360 mm to 410 mm (average 377 mm). The topsoil thickness is anticipated to vary throughout the site. Materials noted as topsoil in this report were classified based on visual and textural evidence. Testing of organic content or for other nutrients was not carried out.

4.2. Clayey Silt

Brown, grey, and grey-brown clayey silt, with some sand to sandy and trace to some gravel was encountered underlying the topsoil in all three boreholes and was considered to be the predominant soil type encountered on the site. Occasional seams of wet to saturated silty sand were noted throughout the clayey silt. The soils were considered to be soft to hard, with SPT N-values ranging from 3 to 45 blows per 0.3 m (average 20 blows per 0.3 m). The clayey silt was considered to be drier than the plastic limit to about the plastic limit, with moisture contents ranging from 11.1% to 17.8% (average 13.4%).

4.3. Sand

Compact, brown sand with trace silt and clay was encountered underlying the clayey silt in Borehole 2. The sand was considered wet, with a moisture content of about 12.2%.

4.4. Silt

Loose to compact, grey silt with trace sand and clay was encountered in the lower extents of Boreholes 1 and 3 underlying the clayey silt. The silt was considered moist to wet, with moisture contents ranging from about 14.8% to 22.0% (average 19.0%).

4.5. Groundwater

A total of three (3) monitoring wells were installed on December 11, 2020 as part of the hydrogeological study carried out by HCS. The water levels were measured by HCS on December 14, 2020.

The reported elevations of groundwater in the monitoring wells, as well as the ground surface and bottom of borehole elevations, are provided in the following table:

Borehole/ Monitoring Well No.	Ground Surface Elevation (m)	Approximate Elevation of Water in Monitoring Well (m) Dec. 14, 2020	Approximate Depth of Water in Monitoring Well (m) Dec. 14, 2020	Bottom of Monitoring Well Elevation (m)
BH 1	97.43	90.03	7.40	88.88
BH 2	92.78	92.72	0.06	83.70
BH 3	101.75	100.49	1.26	94.96

It should be noted that groundwater levels (particularly perched water) are generally dependent on the amount of precipitation, control of surface water, as well as the time of year, and can fluctuate significantly in elevation and volume.

The high groundwater levels and wet soil conditions encountered could make some excavations difficult. It should be expected that caving or sloughing of the excavation walls will occur. As such, it is recommended to keep foundations at least one footing width (0.5 m minimum) above the static water level, if applicable.

Recommendations with respect to dewatering conditions are provided in Section 5.8 of this report.

5.0 DISCUSSION AND RECOMMENDATIONS

It is understood that the project will comprise the construction of a residential subdivision. Although no site plan has been provided at this time, it is assumed that the development will include the construction of new road(s) and approximately twenty (20) residential homes with associated driveways. Drilled water wells and septic systems will likely service the new residences. Utilizing the information gathered during the preliminary geotechnical investigation and assuming that the borehole information is representative of the subsoil conditions throughout the site, the following comments and recommendations are provided.

This section of the report provides CMT Inc.'s interpretation of the factual geotechnical data obtained during the investigation and is intended for the guidance of the owner and design engineer. Where comments are made on construction, they are provided only to highlight those aspects which could affect the design of the project. Contractors bidding on or undertaking the

work should make their own independent interpretation of the factual subsurface information provided as it affects their proposed construction means and methods, equipment selection, scheduling, pricing, and the like.

5.1. Serviceability and Ultimate Limit Pressure

Based on the information obtained from the boreholes, the following table provides the estimated geotechnical reaction at the Serviceability Limit State (SLS) and the factored geotechnical resistance at the Ultimate Limit State (ULS) at the various elevations, including soil type:

Borehole No.	Ground Surface Elevation (m)	SLS kPa (psf)	ULS kPa (psf)	Estimated Highest Founding Elevation (m)	Depth to Highest Founding Elevation (m)	Soil Type
BH 1	97.43	75 (1,500)	112 (2,250)	97.02 to 95.60	0.41	Clayey Silt
		200 (4,000)	300 (6,000)	95.60 to 90.06	1.83	Clayey Silt
		75 (1,500)	112 (2,250)	90.06 to 88.29 (termination)	7.37	Silt
BH 2	92.78	150 (3,000)	225 (4,500)	91.71 to 83.64 termination	1.07	Clayey Silt/Sand
BH 3	101.75	100 (2,000)	150 (3,000)	100.99 to 100.23	0.76	Clayey Silt
		200 (4,000)	300 (6,000)	100.23 to 95.86	1.52	Clayey Silt
		75 (1,500)	112 (2,250)	95.86 to 94.13 (termination)	5.89	Silt

The proposed founding elevations and required bearing capacities were not available at the time of report preparation. Based on the data provided in the table above, suitable founding elevations for the proposed residences with conventional foundations designed with a bearing capacity of 75 kPa (1,500 psf) at SLS and 112 kPa (2,250 psf) at ULS range from depths of about 0.41 m to 1.07 m below the existing ground surface.

Should footings be designed to be constructed at elevations higher than the elevations indicated in the table above, then structural fill will be required in order to achieve the design grades for the proposed foundations. The serviceability limit pressure for good quality granular structural fill placed and compacted in accordance with Section 5.4.3 of this report is estimated to be at least 150 kPa (3,000 psf) at SLS and 225 kPa (4,500 psf) at ULS. Alternatively, lean mix concrete fill could be used. It is imperative that the

founding soils be assessed at the time of construction by qualified geotechnical personnel in order to confirm their founding suitability.

If wet to saturated soil conditions are encountered during excavation, it may be necessary to widen the footings or install a granular drainage layer to provide a suitable base for the foundations. This will depend on the bearing capacity required for the founding strata. If required, the granular drainage layer must conform to the requirements listed in Section 9.14.4 of the OBC 2012.

It is recommended that structural foundation drawings be cross-referenced with site servicing drawings to ensure that service pipes do not conflict with building foundations (including the zone of influence down and away from the footings).

With respect to the Serviceability Limit State (SLS), the total and differential footing settlements are not expected to exceed the generally acceptable limits of 25 mm (1") and 19 mm (3/4") respectively.

All exterior foundations must be provided with a minimum of 1.2 m of soil cover or equivalent thermal insulation (sufficient thermal insulation is required to protect all footings and slab-on-grades during construction until such a time that the structure is heated) in order to provide protection against frost action.

5.2. Seismic Site Classification

The site classification for seismic response in Table 4.1.8.4 of the 2012 Ontario Building Code relates to the average properties of the upper 30 m of strata. The information obtained in the geotechnical field investigation was gathered from the upper 7.62 m to 9.14 m of strata. Based on the information gathered in the geotechnical field investigation, the site classification for seismic site response would be considered Site Class D (stiff soils) for structures founded on the soils at the recommended founding elevations provided in Section 5.1 of this report as well as structures founded on structural fill placed in accordance with Section 5.4.3 of this report. The structural engineer responsible for the design of the structure should review the earthquake loads and effects.

5.3. Soil Design Parameters

The following table provides the estimated soil design parameters for imported granular fill, as well as the existing native soils encountered on-site. It should be noted that earth pressure coefficients (Ka, Kp, Ko) provided are for flat ground surface conditions and will differ for areas with slopes or embankments.

The estimated soil design parameters can be utilized for the design of perimeter shoring, foundations and retaining walls, lateral earth pressure calculations, as required:

Soil Type	Soil Density (kg/m^3)	Friction Angle (Degree)	Coefficient of Active Pressure (K_a)	Coefficient of Passive Pressure (K_p)	Coefficient of At-Rest Pressure (K_o)	Coefficient of Friction (μ)	Cohesion (Undrained) (kPa)
Imported Granular 'A'/ Granular 'B' (OPSS 1010)	2,100	34°	0.28	3.54	0.44	0.45	0
Clayey Silt	1,850	30°	0.33	3.00	0.50	0.38	10 - 20
Sand	1,850	33°	0.29	3.39	0.46	0.43	0
Silt	1,750	30°	0.33	3.00	0.50	0.38	0

5.4. Site Preparation

The site preparation for the proposed residential subdivision is anticipated to comprise the stripping of topsoil, removal or relocation of any existing services, and site grading to achieve the design grades.

5.4.1. Topsoil Stripping/Vegetation Removal

All existing topsoil and vegetation (including roots and all loose/disturbed soils associated with the roots) must be removed from within any proposed building envelopes, driveways and roads to expose approved competent subgrade soils. The topsoil may be used in landscaped areas where some settlement can be tolerated; otherwise, it should be properly disposed of off-site.

The volume of topsoil removed during the stripping process is also relative to the equipment utilized for the stripping process as well as the moisture conditions at the time of stripping. If an excavator with a smooth bucket is utilized for stripping, there would generally be less potential for topsoil to become intermixed with the underlying relatively loose subsoil and therefore less concern of over-excavation to remove all topsoil. If the topsoil is stripped with wheeled equipment or bulldozers, then there is an increased potential for the topsoil and subsoil to become intermixed, subsequently requiring additional excavation to remove all topsoil. This is further influenced by rutting which can occur during wet conditions.

5.4.2. Removal/Relocation of Existing Services

Any existing servicing that may be located within the proposed building envelopes must be removed/relocated. This includes any existing field tiles that are expected to be present. Any piping that is left in place that is no longer active must be completely sealed with watertight mechanical covers, concrete or grout at termination points to prevent the migration of soils into pipe voids, which may result in potential settlement. All existing trench backfill material associated with any existing buried pipes must be subexcavated and the subsequent excavation must be backfilled with approved soils placed in accordance with Section 5.4.3 of this report.

The monitoring wells that have been installed as part of the hydrogeological study must be decommissioned by a Ministry of the Environment, Conservation and Parks (MECP) licensed well contractor with a Class 1, Class 2 or Class 3 license in accordance with Reg. 903. CMT Drilling Inc. would be pleased to provide these services when required.

5.4.3. Site Grading/Structural Fill

Following the removal of topsoil and any unsuitable bearing soils, the exposed subgrade soils must be proof-rolled, and any soft or unstable areas must be subexcavated and replaced with approved fill materials.

Any fill materials required to achieve the design site grades should be placed according to the following procedures:

- Should the native subgrade soils at the design founding elevation in the proposed building envelopes comprise wet soils, then a granular drainage layer, constructed in accordance with Section 9.14.4 of the current Ontario Building Code (OBC) may be required. Alternatively, a lean mix concrete mud mat may be placed overlying the subgrade soils to provide a stable base;

- Prior to placement of any structural fill or bulk fill, the subgrade must be prepared large enough to accommodate a 1:1 slope commencing a distance of 1.0 m beyond the outside edge of the proposed foundations down to the approved competent founding soils;

- Soils approved for use as structural fill must be placed in loose lifts not exceeding 0.3 m (12") in depth for granular soils, such as the sand and gravel encountered on-site (recommended fill material) and 0.2 m (8") in depth for clayey silt (not recommended for this application), or the capacity of the compactor (whichever is less);

- Approved imported granular fill materials (OPSS 1010 Type III Granular 'B' recommended for this application) can be compacted utilizing adequate heavy vibratory smooth drum or padfoot compaction equipment;

- Fine-grained silt and clay soils (not recommended) must be compacted utilizing adequate heavy padfoot vibratory compaction equipment;

- Approved fill materials must be at suitable moisture contents (at or near to the optimum moisture content as determined by laboratory Proctor testing) to achieve the specified compaction. Soil moisture will also be dependent on weather conditions at the time of construction. Granular soils may require the addition of water in order to achieve the specified compaction;

- Approved structural fill materials that will support structures (including townhome foundations, retaining walls, interior slab-on-grades, sidewalks, large expansive exterior slabs and decks) must be compacted to a minimum of 100% standard Proctor maximum dry density (SPMDD). The native clayey silt soils are generally not recommended for use as structural fill as they can be subject to excess void space and potential settlement if not properly placed and compacted;

- Approved bulk fill (foundation wall backfill, bulk fill under slab-on-grades that will not support footings or heavy point loading, bulk fill for driveways and roads) must be compacted to a minimum 95% SPMDD. It would be expected that the existing on-site native soils, free of any deleterious materials, would be suitable for use as bulk fill; however, depending on the time of year and weather conditions when construction takes place, soils may require air-drying or the addition of water in order to achieve the specified density;

- Granular 'B' subbase and Granular 'A' base materials for any proposed new roads must be compacted to 100% SPMDD.

Due to the fine-grained nature of some of the native soils encountered throughout the boreholes, they will be easily disturbed and subject to strength losses, making travel on this material somewhat difficult with conventional rubber-tired construction equipment such as dump trucks and even smooth drum vibratory compactors. Conditions should be expected to worsen if the subgrade soils are in a wet condition. Therefore, it is recommended that construction traffic be minimized, where possible, from driving on the subgrade soils. Depending on the time of year, it may be required to construct a haul road utilizing a Granular 'B' base.

5.5. Foundation Subgrade Preparation

The fine-grained native soils encountered throughout the boreholes are sensitive to change in moisture content and can become loose/soft if the soils are subjected to additional water or precipitation, as well as severe drying conditions. The soils could also be easily disturbed if traveled on during construction. Once they become disturbed, they are no longer considered adequate for the support of foundations.

To ensure and protect the integrity of the founding soils during construction operations, the following is recommended:

- During construction, the subgrade should be sloped to a sump (as required) located outside the footprint of any foundations (if feasible) in the excavation to promote surface drainage of rainwater or seepage and the collected water should be pumped out of the excavation. It is critical that all water be controlled (not allowed to pond) and that the subgrade and foundation preparation commence in dry conditions;

- It is possible that some of the subgrade soils at the design founding elevation in the proposed building envelopes comprise wet soils, in which case a granular drainage layer, constructed in accordance with Section 9.14.4 of the current Ontario Building Code (OBC), may be required. Alternatively, a lean mix concrete mud mat may be poured over top of the subgrade soils to provide a stable base;

- Construction equipment travel and foot traffic on the founding soils should be minimized;

- If construction is to be undertaken during subzero weather conditions, the founding native soils and fill materials must be maintained above freezing;

- Prior to placing concrete for the footings, the founding soils must be cleaned of all disturbed or caved materials;

- The foundation formwork and concrete should be installed as soon as practical following the excavation, inspection and approval of the founding soils. The longer that the excavated soils remain open to weather conditions and groundwater seepage, the greater the potential for construction problems to occur;

- If it is expected that the founding soils will be left open to exposure for an extended period of time, it is recommended that a 75 mm concrete mud slab be poured in order to protect the structural integrity of the founding soils.

5.6. Slab-on-Grade/Modulus of Subgrade Reaction

Prior to the placement of the granular base for slab-on-grade construction, the subgrade soils should be proof-rolled. Any soft or weak zones in the subgrade should be subexcavated and backfilled with approved fill materials (see Sections 5.4.3 and 5.10 of this report).

The following table provides the estimated modulus of subgrade reaction (k) for imported granular fill, as well as the native soils encountered on-site:

Soil Type	Modulus of Subgrade Reaction (k)
Imported Granular 'A'/ Granular 'B' (OPSS 1010)	81,000 kN/m^3 (300 lb/in^3)
Clayey Silt	40,700 kN/m^3 (150 lb/in^3)
Sand	61,000 kN/m^3 (225 lb/in^3)
Silt	33,900 kN/m^3 (125 lb/in^3)

Floor slabs can be founded on a minimum thickness of 100 mm (4") of coarse, clean granular material containing not more than 10% of material that will pass a 4 mm sieve in accordance with the current OBC. The use of 19 mm clear crushed stone assists in creating a moisture barrier by reducing/preventing capillary rise of moisture from the subgrade. Compactive effort is required to consolidate the clear stone. The 19 mm clear crushed stone should meet the physical property and gradation requirements of OPSS 1004.

It is recommended that areas of extensive exterior slab-on-grade be constructed with a Granular 'B' subbase (450 mm) and a Granular 'A' base (150 mm), as well as incorporating subdrains, to promote rapid drainage and reduce the effects of frost heaving. This is particularly critical at barrier-free access points and at the location of out-swinging doors. Alternatively, structural frost slabs could be designed and constructed, or sufficient thermal insulation could be provided, at all door entrances and areas of barrier-free access.

5.7. Excavations

All excavations must be carried out in accordance with Ontario Regulation 213/91 (Reg 213/91) of the Occupational Health and Safety Act and Regulations for Construction Projects.

Type 2 Soils - In general, the native clayey silt encountered in the boreholes, in a drained state (not wet or saturated), would be classified as Type 2 soils under Reg 213/91. Type 2 soils must be sloped from within 1.2 m (4.0 ft) of the bottom of the excavation with a slope having a minimum gradient of 1 horizontal to 1 vertical. Soils underlain by Type 3 or Type 4 soils that are exposed in the excavation must be treated accordingly as Type 3 or Type 4 soils (see below). Soils in a saturated condition (if encountered) must be treated as Type 4 soils, addressed below.

Type 3 Soils - In general, the existing silt and sand encountered in the boreholes, as well as any fill soils which may be encountered in a drained state (not wet or saturated), would be classified as Type 3 soils under Reg 213/91. The Type 3 soils must be sloped from the bottom of the excavation at a minimum gradient of 1 horizontal to 1 vertical. All saturated soils encountered must be treated as Type 4 soils, as described below.

Type 4 Soils - In general, any wet to saturated soils (if encountered) would be classified as Type 4 soils under Reg 213/91. Type 4 soils must be sloped from the bottom of the excavation at a minimum gradient of 3 horizontal to 1 vertical.

If it is not practical to excavate according to the above requirements, then a trench support system (designed in accordance with the Ontario Health and Safety Act Regulations) may be utilized. When using a temporary trench support system consisting of trench boxes to reduce the lateral extent of the excavations, it should be noted that the support system is intended primarily to protect workers as opposed to controlling lateral soil movement. Any voids between the excavation walls and the support system should be immediately filled to reduce the potential for loss of ground and to provide support to existing adjacent utilities and structures, and it is recommended that the excavation be carried out in short sections, with the support system installed immediately upon excavation completion.

Sloughing of the excavation walls should be expected when excavating into non-cohesive or wet to saturated soils. As such, it may be necessary to increase the width of the excavation to accommodate sloughing soils.

5.8. Construction Dewatering Considerations

Wet to saturated soils were observed in the lower extent of the boreholes. Also, occasional wet seams were encountered. It should be noted that groundwater levels (particularly perched water) are generally dependent on the amount of precipitation, control of surface water, as well as the time of year, and can fluctuate significantly in elevation and volume. As such, provisions for site dewatering should be part of the site development and construction process.

Seepage control requirements during construction will depend upon the area of work on the site, the depth of the excavations, the time of year, the amount of precipitation and the control of surface water. As required, seepage should generally be adequately controlled

using conventional construction dewatering techniques such as pumping from sump pits. However, if heavy seepage occurs, it may be necessary to increase the number of pumps during construction.

Dewatering should be performed in accordance with OPSS 517 and the control of water must be in accordance with OPSS 518. It is the responsibility of the contractor to propose a suitable dewatering system based on the groundwater elevation at the time of construction. Collected water should discharge a sufficient distance away from the excavation to prevent re-entry. Sediment control measures must be installed at the discharge point of the dewatering system to avoid any potential adverse impacts on the environment.

5.9. Service Pipe Bedding

The existing native soils that are free of any organics or deleterious materials, are generally considered suitable for indirect support of the site service pipes. Relatively high groundwater levels were observed in several of the boreholes and should instability due to wet soil conditions be encountered, it may be necessary to increase the thickness of the granular base and utilize 19 mm clear stone to create an adequate supporting base for the service pipes and/or manholes. Pipe embedment, cover and backfill for both flexible and rigid pipes should be in accordance with all current and applicable OPSD, OPSS and OBC standards and guidelines and as follows.

Flexible Pipes – The pipe bedding should be shaped to receive the bottom of the pipe. If necessary, pipe culvert frost treatment should be undertaken in accordance with OPSD-803.030 and 803.031. The trench excavations should be symmetrical with respect to the centre-line of the pipe. The granular material placed under the haunches of the pipe must be compacted to 95% SPMDD prior to the continued placement and compaction of the embedment material. The homogeneous granular material used for embedment should be placed and compacted uniformly around the pipe. Should wet conditions be encountered at the base of the trench, then the pipe bedding should consist of 19 mm clear stone (meeting OPS Specifications) wrapped completely in a geotextile fabric such as Terrafix 270 or equivalent.

Rigid Pipes - In general, the pipe installation recommendations for rigid pipes are the same as those for flexible pipes, except that the minimum bedding depth below a rigid pipe should be 0.15*D* (where *D* is the pipe diameter). In no case should this dimension be less than 150 mm or greater than 300 mm.

Any service pipes that are not provided with sufficient frost coverage must be protected with the necessary equivalent thermal insulation. The general contractor is responsible to protect service piping from damage by heavy equipment.

5.10. Perimeter Building Drainage, Foundation Wall Backfill and Trench Backfill

Foundations constructed within wet soils as noted in the boreholes may be subject to flooding in the event of a power failure or equipment malfunction. Therefore, it would be recommended that foundations be constructed at least one footing width (minimum 0.5 m) above the static water level, if applicable. Groundwater elevations (perched and regional water tables) are generally dependent on the amount of precipitation, control of surface water, as well as the time of year and should be expected to fluctuate.

It is expected that the proposed residences will have basements, and as such, a perimeter drainage system will be required. The drainage system should be installed at the founding elevation and be constructed with positive drainage into a sump pit or other suitable outlet that provides positive drainage away from the structure. It is recommended that sump pumps be equipped with a battery backup (in the event if a power outage). It is also recommended that a capped cleanout port(s) be extended up to the ground surface elevation to provide future access (if required). Rainwater leaders must not be connected to the perimeter drainage system. Foundation wall and slab-on-grade dampproofing and/or waterproofing must conform to current OBC regulations (as required).

In order to assist in maintaining dry buildings with respect to surface water seepage, it is recommended that exterior grades around the buildings be sloped down and away at a 2% gradient or more, for a distance of at least 1.5 m. Any surface discharge rainwater leaders must be constructed with solid piping that discharges with positive drainage at least 1.5 m away from the building foundations and/or beyond external slab-on-grades such as sidewalks and accessibility ramps to a drainage swale or appropriate storm drainage system.

In order to reduce the effects of surficial frost heave in areas that will be hard surfaced, it is recommended that the exterior foundation backfill consist of free-draining granular material such as imported sand or Granular 'B' Type I or Type III (OPSS 1010), with a maximum aggregate size not exceeding 100 mm, and that it extends a minimum lateral distance of 600 mm out from the foundation walls and/or beyond perimeter sidewalks and entranceway slabs. It is critical that particles greater than 100 mm in diameter are not in contact with the foundation wall to prevent point loading and overstressing. The backfill material used against the foundation walls must be placed so that the allowable lateral capacities of the foundation walls are not exceeded. Where only one side of a foundation wall will be backfilled, and the height of the wall is such that lateral support is required, or where the concrete strength has not been achieved, the wall must be braced or laterally supported prior to backfilling. In situations where both sides of the wall are backfilled, the backfill should be placed in equal lifts, not exceeding 200 mm differential on each side during backfill operations and the backfill should be compacted to a minimum of 98% SPMDD.

It is recommended that frost tapers be constructed (refer to OPSD 3101.150 for typical details) in order to minimize differential frost action between the foundation wall backfill and the paved driveways. The frost taper must be constructed utilizing the OPSS 1010 granular material that is used for the foundation wall backfill.

The native soils, free of any organics or deleterious materials, are generally considered suitable for reuse as trench backfill and bulk fill in the driveways and roads; however, some of the soils may require air-drying or the addition of water in order to achieve the specified compaction. Air-drying cannot typically be achieved during winter construction; therefore, depending on the time of year that construction takes place, it may be more feasible to utilize an imported granular fill for this project (keeping in mind that frost tapers, as noted above, would be recommended to minimize differential frost heave).

Backfilling operations should be carried out with the following minimum requirements:

- Adequate heavy padfoot vibratory compaction equipment should be used for the compaction and to break down any large blocky pieces of soil;

- Loose lift thicknesses should not exceed 0.3 m (12") for granular soils or 0.2 m (8") for clayey silt soils or the capacity of the compactor (whichever is less);

- The soils must be at suitable moisture contents to achieve compaction to a minimum 95% SPMDD in non-structural bulk fill areas. Service trenches excavated within the zone of influence of footings for structures must be compacted to a minimum of 100% SPMDD;

- It is recommended that inspection and testing be carried out during construction to confirm backfill quality, thickness and to ensure that compaction requirements are achieved;

- Service trench backfill materials may consist of approved excavated soils with no particles greater than 100 mm and no topsoil or other deleterious materials;

- If construction operations are undertaken in the winter, strict consideration should be given to the condition of the backfill material to make certain that frozen material is not used.

5.11. Pavement Design/Drainage

Any soils containing organics or other deleterious material must be subexcavated from within the proposed driveways and roads. It is recommended to either subexcavate any existing loose subgrade materials or provide further consolidation with vibratory compaction equipment in order to prepare a proper, stable subgrade. Prior to placement of the granular base, the subgrade must be proof-rolled, and any soft or unstable areas

should be subexcavated and replaced with suitable drier materials. The subgrade should be graded smooth (free of depressions) and properly crowned to ensure positive drainage, with a minimum grade of 3% toward the drainage outlet or curb line. When service pipes are installed, pipe bedding and backfilling should be undertaken as indicated in Sections 5.9 and 5.10 of this report.

Rapid drainage of the pavement structure is critical to ensure long-term performance. As such, it is recommended to install subdrains for this project (provided gravity drainage to a suitable outlet can be provided). Subdrains should be designed and installed in accordance with OPSS 405 and OPSD 216.021. If Granular 'A' bedding (OPSS 1010) is utilized, the subdrains should be equipped with a factory installed filter sock. If 19 mm clear stone (OPSS 1004) is utilized as bedding for the subdrain (recommended for this application), then the bedding must be wrapped completely with geotextile filter fabric such as Terrafix 270R (or equivalent) and a factory installed filter sock is not required. Installation of rigid subdrains allows for better grade control and less potential for damage during installation or service. Positive drainage through grade control of subdrains is critical, as improperly installed subdrains can turn drainage systems into reservoirs, which can fuel frost action. The subdrains will hasten the removal of water, thereby reducing the risk and effects of frost heaving and load transfer in saturated conditions. It is suggested that subdrains be installed at regular intervals (to be designed based on layout of catch basins and storm sewers) through paved driveways and parking areas. It is also recommended to install subdrains through any areas that cannot tolerate differential frost heave such as accessibility ramps/sidewalks. The subdrains should be installed in a 0.3 m (1.0 ft) by 0.3 m (1.0 ft) trench in the subgrade and bedded approximately 50 mm (2") above the bottom of the trench. The subgrade must be prepared with positive drainage to the subdrains and the subdrains must be installed with positive drainage into a catch basin structure or other suitable outlet.

The native clayey silt subgrade soils are highly sensitive to change in moisture content and can become loose or soft if the soils are subject to inclement weather and seepage or severe drying. Furthermore, the subgrade soils could be easily disturbed if traveled on during construction. As such, where this material will be exposed, it is recommended that the granular subbase be placed immediately upon completion of the subgrade preparation to protect the integrity of the subgrade soils.

Should wet conditions be encountered during construction, site assessments may be required to determine what options can be undertaken to construct a modified pavement structure. These options may include subexcavation of loose/soft soils, increasing the thickness of the granular base, the use of reinforcing geotextiles or geogrids, or a combination of all.

It is expected that the new road(s) and driveways will experience mostly light traffic (personal vehicles) and some heavy traffic (moving trucks, delivery trucks, and maintenance vehicles).

Based on the anticipated vehicle loading and frost-susceptibility of the subgrade soils, the following pavement design is provided:

Material	Recommended Thickness for Light Traffic	Recommended Thickness for Heavy Traffic
Asphaltic Concrete	HL3 - 40 mm (1.5") HL4 or HL8 - 50 mm (2.0")	HL3 - 50 mm (2.0") HL4 or HL8 - 62.5 mm (2.5")
Granular 'A' Base (OPSS 1010)	150 mm (6.0")	150 mm (6.0")
Granular 'B' Subbase (OPSS 1010)	450 mm (18.0")	450 mm (18.0")

The granular base and subbase materials must conform to the physical property and gradation requirements of OPSS 1010 and must be compacted to 100% SPMDD. Asphaltic concrete should be supplied, placed and compacted to a minimum 92.0% Marshall maximum relative density, in accordance with OPSS 1150 and OPSS 310.

Construction joints in the surface and binder asphalt must be offset a minimum of 150 mm to 300 mm (6" to 12") from construction joints in the binder asphalt so that longitudinal joints do not coincide.

Should any new asphalt be joined into existing asphalt, it is recommended that the existing asphalt be sawcut in a straight line prior to being milled to a depth of 40 mm and a width of 150 mm as per OPSD 509.010. It is recommended that a tackcoat in conformance with OPSS 308 be applied to the edge and surface of all milled asphalt prior to placement of new asphalt.

The pavement should be designed to ensure that water will not pond on the pavement surface. If the surface asphalt is not placed within a reasonable time following placement of the binder asphalt, it is recommended that the catch basin lids are set at a lower elevation or apertures provided to allow surface water to drain into the catch basins and not accumulate around the catch basins. The strength of the pavement structure relies on all of the components to be in place in order to provide the design strength; therefore, it is strongly recommended that the surface asphalt be placed shortly after placement of the binder asphalt so as to avoid undue stress on the binder asphalt by not having the complete pavement structure in place.

It should be noted that, currently, asphalt mixes tend to be more flexible and, as such, there is a tendency for damage to occur from vehicles turning their steering wheels or applying excessive brake pressure. The condition is further intensified during hot weather. In high traffic areas or areas subjected to frequent turning of heavy vehicles, it is recommended that rigid Portland cement pavement be considered.

5.12. Septic System T-Time

A grain size analysis was performed on a representative sample of the native soil, as it is expected that new septic systems will be part of the proposed residential development. The following table provides the sample location, depth, corresponding estimated T-Time as well as soil type:

Borehole No.	Depth (m)	Estimated Percolation Rate (T) (min/cm)	Soil Type
1	1.52 – 2.13	50	Clayey, sandy silt, trace gravel (ML)

CMT Engineering Inc. would be pleased to provide septic system designs once information on the proposed residences is available.

5.13. Radon

According to information provided by Health Canada, radon is a radioactive gas that is naturally formed through the breakdown of uranium in soil, rock and water. When radon escapes the earth in the outdoors, it mixes with fresh air, resulting in concentrations that are too low to be of concern. However, when radon enters an enclosed space, such as a building, high concentration of radon can accumulate and become a health concern. Health Canada indicates that most buildings and homes have some level of radon in them. Unfortunately, it is not possible to predict before construction whether or not a new building will have high radon levels as radon can only be detected by radon measurement devices, which would be installed in a building, post construction. Section 9.13.4.1 Soil Gas Control of the current 2012 Ontario Building Code (OBC) states that *"Where methane or radon gases are known to be a problem, construction shall comply with the requirements for soil gas control in MMAH Supplementary Standard SB-9, Requirements for Soil Gas Control"*.

5.14 Excess Soil Management

Generally if surplus soils are to be exported off-site, it will be necessary to perform chemical analysis of the soils. Chemical analysis was **not** undertaken as part of this geotechnical investigation. Should chemical analysis tests be required, the required tests vary and will be dependent on the disposal site utilized by general contractor.

Most commonly, the soils are tested for the following:

- Sodium Absorption Ratio (SAR) as per O. Reg. 153/04 as amended by R511.
- Chemical analysis including:
  - F1 – F4, VOC's, BTEX as per O. Reg 153/04;
  - SVOC as per O. Reg 153/04 as amended by R511; and
  - Metals / inorganics as per O. Reg 153/04 amended by R511.

The chemical analysis results are then compared to Ontario Regulation 153/04 - as amended by O.Reg. 511 – April 15, 2011 Standards = [Suite] – ON-511-T1/T2-SOIL-RPI.

If soils are transported to a landfill facility, additional chemical testing in accordance with Ontario Regulation 347, Schedule 4, as amended to Ontario Regulation 558/00, dated March 2001, Toxicity Characteristic Leaching Procedure (TCLP) will be required.

When transporting soils off-site, the following is recommended:

- All chemical analyses and environmental assessment reports must be fully disclosed to the receiving site owners/authorities, whom must agree to receive the material;
- An environmental consultant must confirm the land use at the receiving site is compatible to receive the material;
- An environmental consultant must monitor the transportation and placement of the materials to ensure that the material is placed appropriately at the pre-approved site; and
- The excess materials may not be transported to a site that has previously had a Record of Site Condition (RSC) filed, unless the material meets the criteria outlined in the RSC.

It should be noted that landfill sites will generally only accept laboratory test results that have been completed within 30 days of exporting. Therefore, it is recommended that provisions for chemical analysis be included in the tender documents. It should also be noted that the laboratory testing generally takes five (5) working days to process with a regular turnaround time.

6.0 SITE INSPECTION

Qualified geotechnical personnel should supervise excavation inspections as well as compaction testing for structural filling, site grading and site servicing. This will ensure that footings are founded in the proper strata and that proper material and techniques are used and the specified

compaction is achieved. CMT Engineering Inc. would be pleased to review the design drawings and provide an inspection and testing program for the construction of the proposed subdivision.

7.0 LIMITATIONS OF THE INVESTIGATION

This report is intended for the Client named herein and for their Client. The report should be read in its entirety, and no portion of this report may be used as a separate entity. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties.

The recommendations made in this report are in accordance with our present understanding of the project. We request that we be permitted to review our recommendations when the drawings and specifications are complete, or if the proposed construction should differ from that mentioned in this report.

It is important to emphasize that a soil investigation is, in fact, a random sampling of a site and the comments are based on the results obtained at the test locations only. It is therefore assumed that these results are representative of the subsoil conditions across the site. Should any conditions at the site be encountered which differ from those found at the test locations, we request that we be notified immediately in order to permit a reassessment of our recommendations.

It should be noted that this report specifically addresses geotechnical aspects of the project and does not include any investigations or assessments relating to potential subsurface contamination. As such, there should be no assumptions or conclusions derived from this report with respect to potential soil or water contamination. Soil or water contamination is generally caused by the presence of xenobiotic (human-made) chemicals or other alteration processes in the natural soil and groundwater environment. If necessary, the investigation, assessment and rehabilitation of soil and water contaminants should be undertaken by qualified environmental specialists.

The samples obtained during the geotechnical investigation will be stored for a period of three months, after which time they will be disposed of unless alternative arrangements are made.

We trust that this report meets with your present requirements. Should you have any questions, please do not hesitate to contact our office.

Prepared by:

Brittany Brown

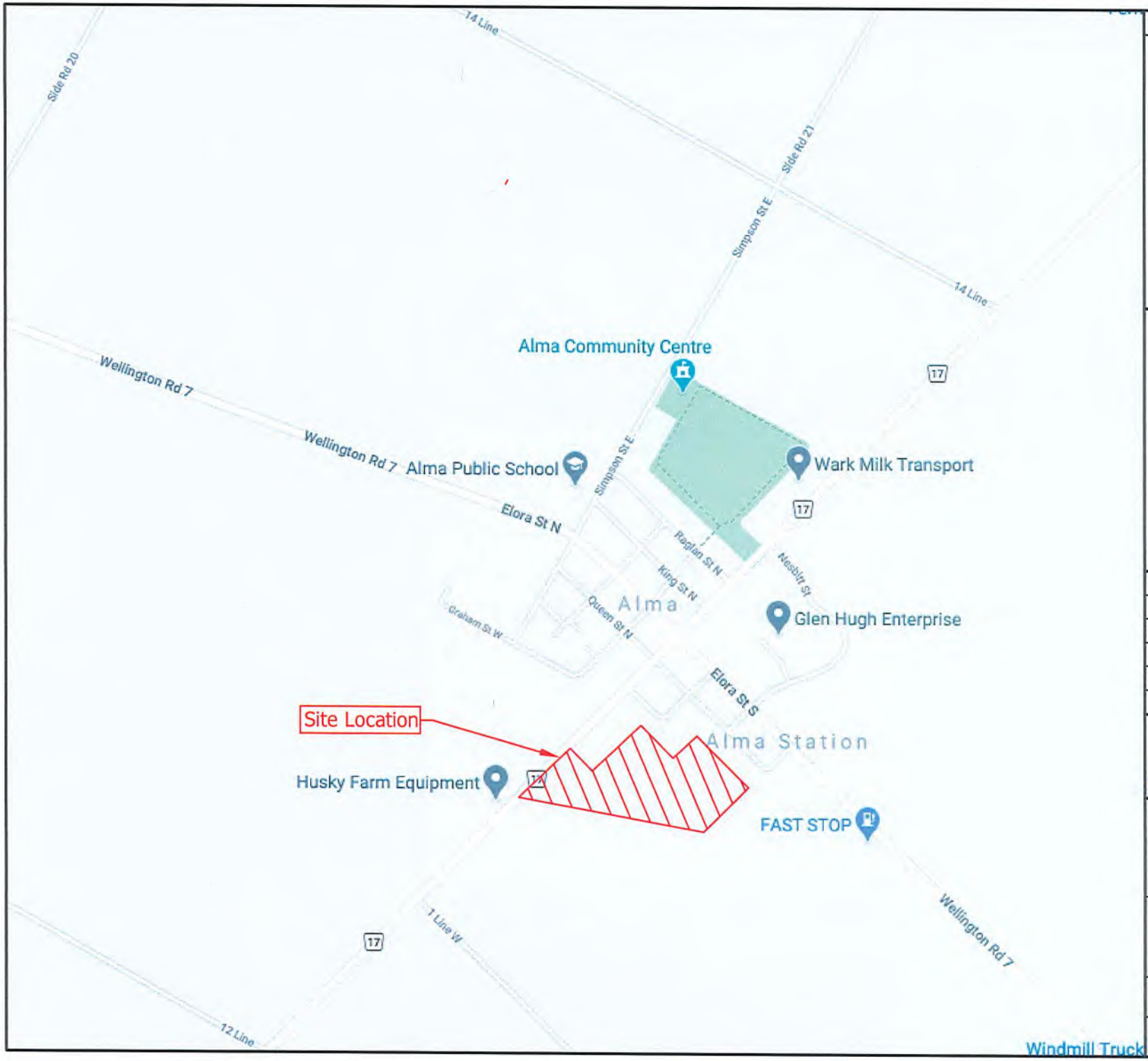
Brittany Brown, C. Tech., rcji

ks

Reviewed by:

Nathan Chortos, P.Eng.

Senior Geotechnical Engineer



NOTES:

Base map provided by Google.

N

NO.	DESCRIPTION	DATE

REVISIONS

CMT ENGINEERING INC.
1011 Industrial Crescent, Unit 1
St. Clements, Ontario N0B 2M0
Tel.: 519-699-5775
Fax: 519-699-4664
www.cmtinc.net

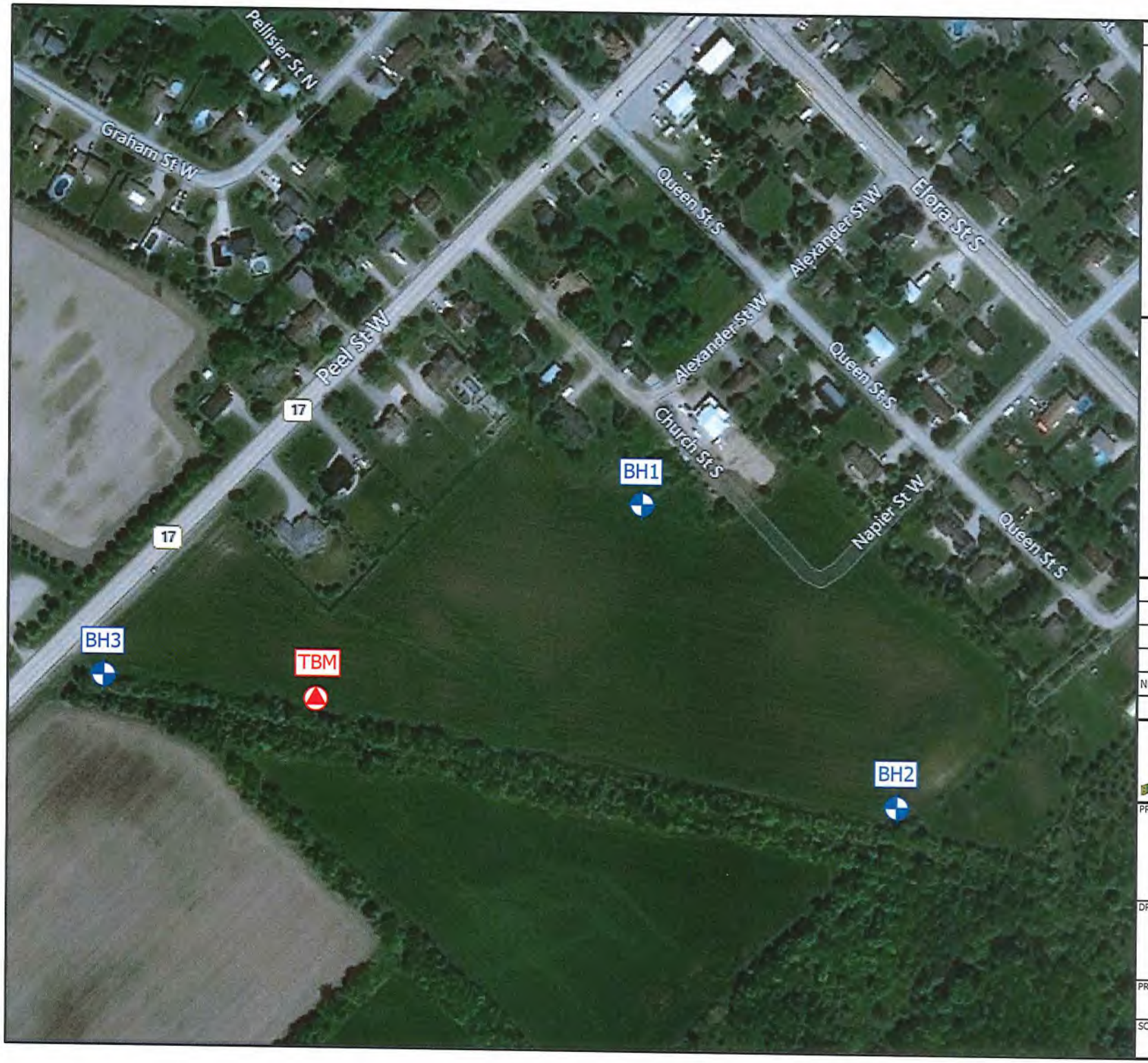
PROJECT:

Proposed Subdivision
31 Church Street
Alma, Ontario

DRAWING TITLE:

SITE LOCATION MAP

PROJECT NO.:	DATE:
20-732	December 18 2020
SCALE:	DRAWING NO.
N.T.S.	1



NOTES:

Base map provided by Bing.

Legend

CMT Borehole with Monitoring Well

Temporary Benchmark (TBM)
Top of Existing Water Well (A299778)
Assumed Elevation: 100.00 m

N

NO.	DESCRIPTION	DATE

REVISIONS

CMT ENGINEERING INC.
1011 Industrial Crescent, Unit 1
St. Clements, Ontario N0B 2M0
Tel.: 519-699-5775
Fax: 519-699-4664
www.cmtinc.net

PROJECT:

Proposed Subdivision
31 Church Street
Alma, Ontario

DRAWING TITLE:

AERIAL VIEW SHOWING
BOREHOLE LOCATIONS

PROJECT NO.:	DATE:
20-732	December 18, 2020
SCALE: N.T.S.	DRAWING NO. 2

APPENDIX A

BOREHOLE LOGS

CMT Engineering Inc.
1011 Industrial Crescent, Unit 1
St. Clements, Ontario N0B 2M0
Telephone: 519-699-5775
Fax: 519-699-4664

BOREHOLE NUMBER 1

PROJECT: Geotechnical Investigation for Proposed Subdivsion
PROJECT ADDRESS: 31 Church Street
PROJECT NUMBER: 20-732
PROJECT LOCATION: Alma, Ontario
DRILLING DATE: 20-12-11
GROUND ELEVATION: 97.43 m
DRILLING CONTRACTOR: CMT Drilling Inc.
LOGGED BY: BB
DRILLING EQUIPMENT: Geoprobe 7822DT
SAMPLING METHOD: SPT/MC5

DEPTH (m)	MATERIAL DESCRIPTION	Depth, Elevation (m)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	SPT N VALUE / POCKET PEN. (kPa) / MOISTURE CONTENT (%)
	TOPSOIL: Loose, dark brown silty topsoil, moist (410 mm)	0.00, 97.43	SS 1	67	2-3-3-3 (6)	6
	CLAYEY SILT: Firm, brown clayey silt, some sand to sandy, trace gravel, drier than the plastic limit	0.41, 97.02				
1			SS 2	100	2-3-4-4 (7)	7, 13.2
2	becoming stiff to hard, some sand	1.83, 95.60	SS 3	100	4-6-15-12 (21)	21, 12.9
3			SS 4	33	13-20-25-38 (45)	45, 14
			SS 5	100	12-11-14-13 (25)	25, 13.3
4			MC5 6	100		450, 14.1
5	becoming grey	4.65, 92.78	SS 7	100	12-14-16-21 (30)	30, 450, 12.5
6	occasional wet seams encountered	5.49, 91.94	MC5 8	100		1.1
7			MC5 9	100		17.8
	SILT: Compact, grey silt, trace clay and sand, moist	7.37, 90.06				
8	becoming loose, wet	7.92, 89.51	MC5 10	100		20.3
9	becoming compact, moist	8.69, 88.74				

WELL DIAGRAM: 38mm Riser; Bentonite Seal; Water level measured at 7.40m (El. 90.03m) on Dec. 14, 2020.; 38mm Screen; #2 Sand Pack

Bottom of borehole at 9.14 m, Elevation 88.29 m.
Groundwater measured at approximately 7.40 m below ground surface (elevation 90.03 m) on December 14, 2020.

BOREHOLE LOG WITH WELL2 20-732.GPJ CMT_TEMPLATE_2020-05-15.GDT 21-1-7

CMT Engineering Inc.
1011 Industrial Crescent, Unit 1
St. Clements, Ontario N0B 2M0
Telephone: 519-699-5775
Fax: 519-699-4664

BOREHOLE NUMBER 2

PROJECT: Geotechnical Investigation for Proposed Subdivsion
PROJECT ADDRESS: 31 Church Street
PROJECT LOCATION: Alma, Ontario
PROJECT NUMBER: 20-732
DRILLING DATE: 20-12-11
GROUND ELEVATION: 92.78 m
DRILLING CONTRACTOR: CMT Drilling Inc.
LOGGED BY: BB
DRILLING EQUIPMENT: Geoprobe 7822DT
SAMPLING METHOD: SPT/MC5

DEPTH (m)	MATERIAL DESCRIPTION	Depth, Elevation (m)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	SPT N VALUE / POCKET PEN. (kPa) / MOISTURE CONTENT (%)
0	**TOPSOIL:** Loose, dark brown silty topsoil, moist (360 mm)	0.00, 92.78	SS 1	50	1-1-2-2 (3)	3
	CLAYEY SILT: Soft, brown clayey silt, some sand, trace gravel, drier than the plastic limit	0.36, 92.42				
1	becoming stiff to very stiff	1.07, 91.71	SS 2	100	1-2-7-7 (9)	9 14.7
2			SS 3	100	6-8-11-12 (19)	19 13.8
3	becoming sandy, some gravel	2.67, 90.11	SS 4	100	9-10-12-15 (22)	22 14.1
	becoming stiff, more plastic (about the plastic limit)	3.30, 89.48	SS 5	100	8-7-6-8 (13)	13 13.3
4			MC5 6	100		175 13
5			SS 7	67	7-6-7-9 (13)	13 13.1
6			MC5 8	100		14.6
7			MC5 9	100		14.1
8	**SAND:** Compact, brown sand, trace silt and clay, wet	7.82, 84.96	MC5 10	100		12.2
9						

WELL DIAGRAM: Water level measured at 0.06m (El. 92.72m) on Dec. 14, 2020. / 38mm Riser / Bentonite Seal / #2 Sand Pack / 38mm Screen

Bottom of borehole at 9.14 m, Elevation 83.64 m.
Groundwater measured at approximately 0.06 m below ground surface (elevation 92.72 m) on December 14, 2020.

BOREHOLE LOG WITH WELL2 20-732.GPJ CMT_TEMPLATE_2020-05-15.GDT 21-1-7

CMT Engineering Inc.
1011 Industrial Crescent, Unit 1
St. Clements, Ontario N0B 2M0
Telephone: 519-699-5775
Fax: 519-699-4664

BOREHOLE NUMBER 3

PROJECT: Geotechnical Investigation for Proposed Subdivsion
PROJECT ADDRESS: 31 Church Street
PROJECT LOCATION: Alma, Ontario
PROJECT NUMBER: 20-732
DRILLING DATE: 20-12-11
GROUND ELEVATION: 101.75 m
DRILLING CONTRACTOR: CMT Drilling Inc.
LOGGED BY: BB
DRILLING EQUIPMENT: Geoprobe 7822DT
SAMPLING METHOD: SPT/MC5

DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	Depth, Elevation (m)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	SPT N VALUE / POCKET PEN. (kPa) / MOISTURE CONTENT (%)	WELL DIAGRAM
		TOPSOIL: Loose, dark brown silty topsoil, moist (360 mm)	0.00, 101.75	SS 1	67	1-2-2-4 (4)	4	
		CLAYEY SILT: Soft, mottled grey-brown clayey silt, some sand, trace gravel, drier than the plastic limit	0.36, 101.39					
1		becoming stiff	0.76, 100.99	SS 2	100	6-6-6-7 (12)	12 / 12.5	
		becoming very stiff, brown	1.52, 100.23	SS 3	100	5-9-12-12 (21)	21 / 12.2	
2				SS 4	100	13-15-16-20 (31)	31 / 450 / 12.9	Water level measured at 1.26m (El. 100.49m) on Dec. 14, 2020.
3				SS 5	100	9-12-18-20 (30)	30 / 450 / 13.1	Bentonite Seal
4				MC5 6	100		12.8	38mm Riser
		becoming hard, grey, about the plastic limit	4.22, 97.53					
5		(-5.03 m) wet silty sand seam encountered		SS 7	100	8-29-16-18 (45)	45 / 250 / 11.5	
		(-5.49 m) saturated silty sand seam encountered		MC5 8	100		17	
6		**SILT:** Loose, grey silt, trace clay and sand, wet	5.89, 95.86					#2 Sand Pack
				MC5 9	100		22	38mm Screen
7		becoming compact, moist	7.01, 94.74				14.8	

Bottom of borehole at 7.62 m, Elevation 94.13 m.

Groundwater measured at approximately 1.26 m below ground surface (elevation 100.49 m) on December 14, 2020.

BOREHOLE LOG WITH WELL2 20-732.GPJ CMT_TEMPLATE_2020-05-15.GDT 21-1-7

APPENDIX B

GRAIN SIZE ANALYSES

Particle Size Distribution Report

	% Cobbles	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	2.5	1.2	5.0	14.1	52.4	24.8

SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○	BH1	3	1.52-2.13m	clayey, sandy silt, trace gravel	ML
				Estimated Percolation Rate; T = 50 min/cm	
				Sampled by BB of CMT Engineering Inc., December 11, 2020	
				Tested by MS of CMT Engineering Inc., December 15, 2020	

CMT Engineering Inc.

St. Clements, ON

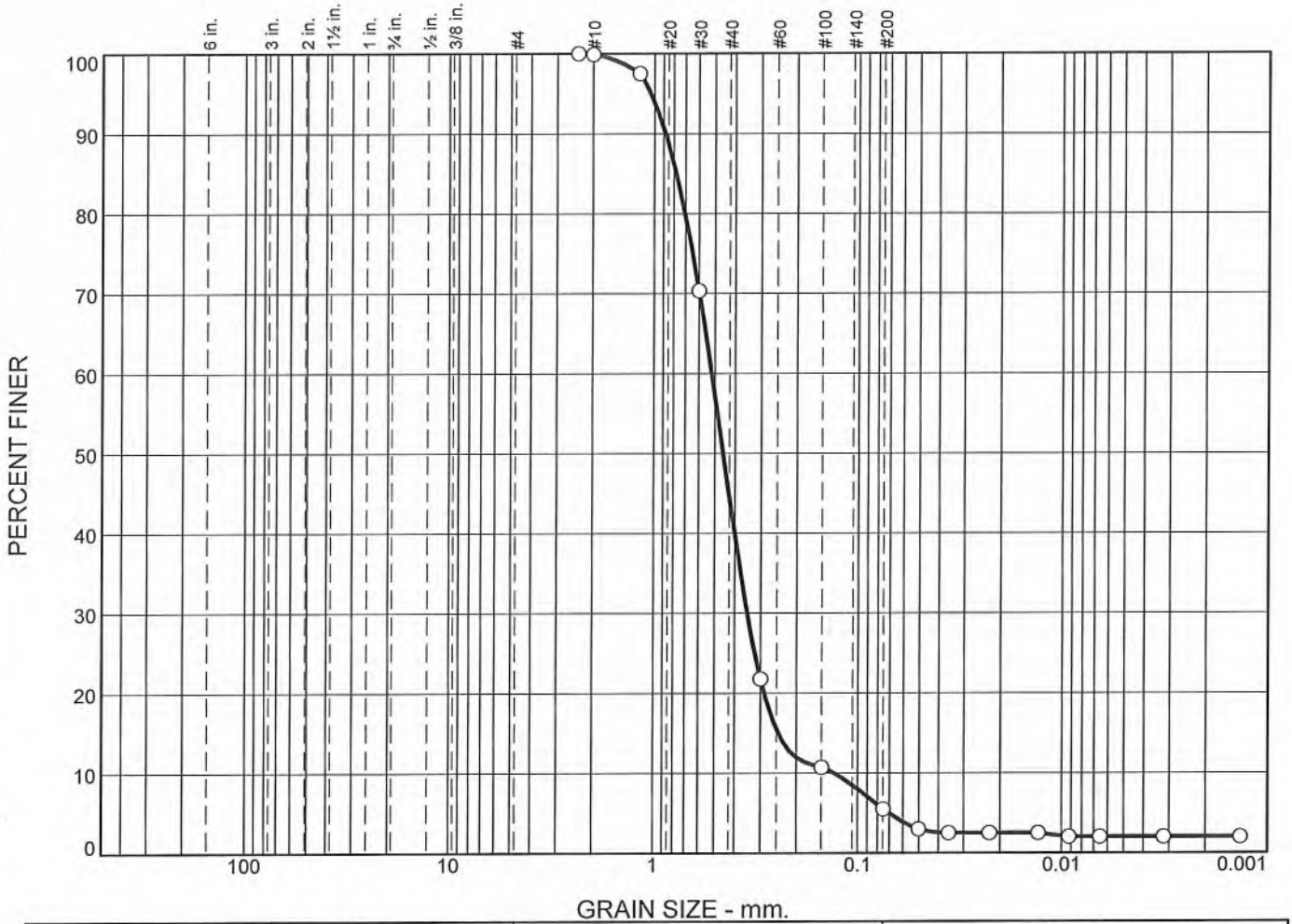
Client: Exact Construction

Project: Proposed Subdivision
31 Church Street, Alma, Ontario

Project No.: 20-732

Figure 1

Particle Size Distribution Report



	% Cobbles	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.1	55.4	39.0	3.5	2.0

SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○	BH2	10	7.62-9.14m	sand, trace silt and clay	SP-SM
				Sampled by BB of CMT Engineering Inc., December 11, 2020	
				Tested by MS of CMT Engineering Inc., December 15, 2020	

CMT Engineering Inc.

St. Clements, ON

Client: Exact Construction

Project: Proposed Subdivision
31 Church Street, Alma, Ontario

Project No.: 20-732

Figure 2

Particle Size Distribution Report

	% Cobbles	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.0	0.0	0.6	92.7	6.7

SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○	BH3	9	6.10-7.62m	silt, trace clay and sand	ML
				Sampled by BB of CMT Engineering Inc., December 11, 2020	
				Tested by MS of CMT Engineering Inc., December 15, 2020	

CMT Engineering Inc.

St. Clements, ON

Client: Exact Construction

Project: Proposed Subdivision
31 Church Street, Alma, Ontario

Project No.: 20-732

Figure 3

APPENDIX C

WELL RECORDS

Ontario

Ministry of the Environment, Conservation and Parks

Well Record - Regulation 903

Ontario Water Resources Act

Notice of Collection of Personal Information

Personal information contained on this form is collected pursuant to sections 35-50 and 75(2) of the *Ontario Water Resources Act* and section 16.3 of the Wells Regulation. This information will be used for the purpose of maintaining a public record of wells in Ontario. This form and the information contained on the form will be stored in the Ministry's well record database and made publicly available. Questions about this collection should be directed to the Water Well Customer Service Representative at the Wells Help Desk, 125 Resources Road, Toronto Ontario M9P 3V6, at 1-888-396-9355 or wellshelpdesk@ontario.ca.

Fields marked with an asterisk (*) are mandatory.

Well Tag Number *
A 313249

Type *

☑ Construction ☐ Abandonment

Measurement recorded in: *

☐ Metric ☑ Imperial

1. Well Owner's Information

Last Name and First Name, or Organization is mandatory. *

Last Name	First Name
VANLEEUWEN	KEVIN
Organization	**Email Address**
EXACT CONSTRUCTION	

Current Address

Unit Number	Street Number *	Street Name *	City/Town/Village
	8262	WELLINGTON RD 19 RR#3	FERGUS

Country	Province	Postal Code	Telephone Number
CAN	ON	N0B2M0	

2. Well Location

Address of Well Location

Unit Number	Street Number *	Street Name *	Township
	31	CHURCH	

Lot	Concession	County/District/Municipality

City/Town	Province	Postal Code
ALMA	Ontario	

UTM Coordinates	Zone *	Easting *	Northing *		Municipal Plan and Sublot Number
NAD 83	17	540060	4841716	Test UTM in Map	

Other

3. Overburden and Bedrock Material *

Well Depth * 30 (ft)

General Colour	Most Common Material	Other Materials	General Description	Depth From	Depth To

				(ft)	(ft)
Grey	Silt	Clay	Till	0	30

4. Annular Space *

Depth From (ft)	Depth To (ft)	Type of Sealant Used (Material and Type)	Volume Placed (cubic feet)
0	23	3/8 HOLEPLUG	0.5
23	30	#2 SAND	0.15

5. Method of Construction *

☐ Cable Tool ☐ Rotary (Conventional) ☐ Rotary (Reverse) ☐ Boring ☐ Air percussion ☐ Diamond
☐ Jetting ☐ Driving ☐ Digging ☐ Rotary (Air) ☐ Augering ☑ Direct Push
☐ Other (specify) _____

6. Well Use *

☐ Public ☐ Industrial ☐ Cooling & Air Conditioning
☐ Domestic ☐ Commercial ☐ Not Used
☐ Livestock ☐ Municipal ☑ Monitoring
☐ Irrigation ☐ Test Hole ☐ Dewatering
☐ Other (specify) _____

7. Status of Well *

☐ Water Supply ☐ Replacement Well ☐ Test Hole
☐ Recharge Well ☐ Dewatering Well ☑ Observation and/or Monitoring Hole
☐ Alteration (Construction) ☐ Abandoned, Insufficient Supply ☐ Abandoned, Poor Water Quality
☐ Abandoned, other (specify) _____
☐ Other (specify) _____

8. Construction Record - Casing * (use negative number(s) to indicate depth above ground surface)

Inside Diameter (in)	Open Hole **or** Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness	Depth From (ft)	Depth To (ft)
1.5	Plastic	0.06	-1	25

9. Construction Record - Screen

Outside Diameter (in)	Material (Plastic, Galvanized, Steel)	Slot Number	Depth From (ft)	Depth To (ft)
1.56	Plastic	10	25	30

10. Water Details

Water found at Depth (ft)	☐ Gas	Kind of water ☐ Fresh	☐ Untested	☐ Other

11. Hole Diameter

Depth From (ft)	Depth To (ft)	Diameter (in)
0	30	3.5

12. Results of Well Yield Testing

☐ Pumping Discontinued

Explain _____

If flowing give rate

☐ Flowing _____ (GPM)

Draw down

Time (min)	Static Level	1	2	3	4	5	10	15	20	25	30	40	50	60
Water Level (ft)														

Recovery

Time (min)	1	2	3	4	5	10	15	20	25	30	40	50	60
Water Level (ft)													

After test of well yield, water was

☐ Clear and sand free ☐ Other (specify)

Pump intake set at (ft)	Pumping rate (GPM)	Duration of pumping hrs + min	Final water level end of pumping (ft)	Disinfected? * ☐ Yes ☑ No

Recommended pump depth (ft)	Recommended pump rate (GPM)	Well production (GPM)

13. Map of Well Location *

Map 1. Please Click the map area below to import an image file to use as the map. ☐ Make map area bigger

14. Information

Well owner's information package delivered	Date Package Delivered (yyyy/mm/dd)	Date Work Completed (yyyy/mm/dd) *
☐ Yes ☐ No		2020/12/11

Comments

15. Well Contractor and Well Technician Information

Business Name of Well Contractor *	Well Contractor's License Number *
CMT DRILLING INC	7366

Business Address

Unit Number	Street Number	Street Name *
1	1011	INDUSTRIAL CRES

City/Town/Village *	Province	Postal Code *
ST CLEMENTS	ON	N0B 2M0

Business Telephone Number	Business Email Address
519-699-5775	info@cmtinc.net

Last Name of Well Technician *	First Name of Well Technician *	Well Technician's License Number *
BLACK	CHRIS	3711

16. Declaration *

☑ I hereby confirm that I am the person who constructed the well and I hereby confirm that the information on the form is correct and accurate.

Last Name	First Name	Email Address
BLACK	CHRIS	cblack@cmtinc.net

Signature		Date Submitted (yyyy/mm/dd)
Chris Black	Digitally signed by Chris Black Date: 2020.12.24 10:08:50 -05'00'	2020/12/24

17. Ministry Use Only

Audit Number

SXUO S4YK

Ontario

Ministry of the Environment, Conservation and Parks

Well Record - Regulation 903

Ontario Water Resources Act

Notice of Collection of Personal Information

Personal information contained on this form is collected pursuant to sections 35-50 and 75(2) of the *Ontario Water Resources Act* and section 16.3 of the Wells Regulation. This information will be used for the purpose of maintaining a public record of wells in Ontario. This form and the information contained on the form will be stored in the Ministry's well record database and made publicly available. Questions about this collection should be directed to the Water Well Customer Service Representative at the Wells Help Desk, 125 Resources Road, Toronto Ontario M9P 3V6, at 1-888-396-9355 or wellshelpdesk@ontario.ca.

Fields marked with an asterisk (*) are mandatory.

Well Tag Number *
A 313250

Type *

☑ Construction ☐ Abandonment

Measurement recorded in: *

☐ Metric ☑ Imperial

1. Well Owner's Information

Last Name and First Name, or Organization is mandatory. *

Last Name	First Name
VANLEEUWEN	KEVIN
Organization	**Email Address**
EXACT CONSTRUCTION	

Current Address

Unit Number	Street Number *	Street Name *	City/Town/Village
	8262	WELLINGTON RD 19 RR#3	FERGUS

Country	Province	Postal Code	Telephone Number
CAN	ON	N0B2M0	

2. Well Location

Address of Well Location

Unit Number	Street Number *	Street Name *	Township
	31	CHURCH	

Lot	Concession	County/District/Municipality

City/Town	Province	Postal Code
ALMA	Ontario	

UTM Coordinates	Zone *	Easting *	Northing *		Municipal Plan and Sublot Number
NAD 83	17	540190	4841566	Test UTM in Map	

Other

3. Overburden and Bedrock Material *

Well Depth * 30 (ft)

General Colour	Most Common Material	Other Materials	General Description	Depth From	Depth To

				(ft)	(ft)
Grey	Silt	Clay		0	25
Brown	Sand			25	30

4. Annular Space *

Depth From (ft)	Depth To (ft)	Type of Sealant Used (Material and Type)	Volume Placed (cubic feet)
0	20	3/8 HOLEPLUG	0.43
20	30	#2 SAND	0.21

5. Method of Construction *

☐ Cable Tool ☐ Rotary (Conventional) ☐ Rotary (Reverse) ☐ Boring ☐ Air percussion ☐ Diamond
☐ Jetting ☐ Driving ☐ Digging ☐ Rotary (Air) ☐ Augering ☑ Direct Push
☐ Other (specify) _____

6. Well Use *

☐ Public ☐ Industrial ☐ Cooling & Air Conditioning
☐ Domestic ☐ Commercial ☐ Not Used
☐ Livestock ☐ Municipal ☑ Monitoring
☐ Irrigation ☐ Test Hole ☐ Dewatering
☐ Other (specify) _____

7. Status of Well *

☐ Water Supply ☐ Replacement Well ☐ Test Hole
☐ Recharge Well ☐ Dewatering Well ☑ Observation and/or Monitoring Hole
☐ Alteration (Construction) ☐ Abandoned, Insufficient Supply ☐ Abandoned, Poor Water Quality
☐ Abandoned, other (specify) _____
☐ Other (specify) _____

8. Construction Record - Casing * (use negative number(s) to indicate depth above ground surface)

Inside Diameter (in)	Open Hole **or** Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness	Depth From (ft)	Depth To (ft)
1.5	Plastic	0.06	-1	25

9. Construction Record - Screen

Outside Diameter (in)	Material (Plastic, Galvanized, Steel)	Slot Number	Depth From (ft)	Depth To (ft)
1.56	Plastic	10	25	30

10. Water Details

Water found at Depth (ft)	☐ Gas	Kind of water ☐ Fresh	☐ Untested	☐ Other

11. Hole Diameter

Depth From (ft)	Depth To (ft)	Diameter (in)
0	30	3.5

12. Results of Well Yield Testing

☐ Pumping Discontinued

Explain _____

If flowing give rate

☐ Flowing _____ (GPM)

Draw down

Time (min)	Static Level	1	2	3	4	5	10	15	20	25	30	40	50	60
Water Level (ft)														

Recovery

Time (min)	1	2	3	4	5	10	15	20	25	30	40	50	60
Water Level (ft)													

After test of well yield, water was

☐ Clear and sand free ☐ Other (specify)

Pump intake set at (ft)	Pumping rate (GPM)	Duration of pumping hrs + min	Final water level end of pumping (ft)	Disinfected? * ☐ Yes ☑ No

Recommended pump depth (ft)	Recommended pump rate (GPM)	Well production (GPM)

13. Map of Well Location *

Map 1. Please Click the map area below to import an image file to use as the map. ☐ Make map area bigger

14. Information

Well owner's information package delivered	Date Package Delivered (yyyy/mm/dd)	Date Work Completed (yyyy/mm/dd) *
☐ Yes ☐ No		2020/12/11

Comments

15. Well Contractor and Well Technician Information

Business Name of Well Contractor *	Well Contractor's License Number *
CMT DRILLING INC	7366

Business Address

Unit Number	Street Number	Street Name *
1	1011	INDUSTRIAL CRES

City/Town/Village *	Province	Postal Code *
ST CLEMENTS	ON	N0B 2M0

Business Telephone Number	Business Email Address
519-699-5775	info@cmtinc.net

Last Name of Well Technician *	First Name of Well Technician *	Well Technician's License Number *
BLACK	CHRIS	3711

16. Declaration *

☑ I hereby confirm that I am the person who constructed the well and I hereby confirm that the information on the form is correct and accurate.

Last Name	First Name	Email Address
BLACK	CHRIS	cblack@cmtinc.net

Signature		Date Submitted (yyyy/mm/dd)
Chris Black	Digitally signed by Chris Black Date: 2020.12.24 10:17:17 -05'00'	2020/12/24

17. Ministry Use Only

Audit Number

J6QZ 3EYX

Ontario

Ministry of the Environment, Conservation and Parks

Well Record - Regulation 903

Ontario Water Resources Act

Notice of Collection of Personal Information

Personal information contained on this form is collected pursuant to sections 35-50 and 75(2) of the *Ontario Water Resources Act* and section 16.3 of the Wells Regulation. This information will be used for the purpose of maintaining a public record of wells in Ontario. This form and the information contained on the form will be stored in the Ministry's well record database and made publicly available. Questions about this collection should be directed to the Water Well Customer Service Representative at the Wells Help Desk, 125 Resources Road, Toronto Ontario M9P 3V6, at 1-888-396-9355 or wellshelpdesk@ontario.ca.

Fields marked with an asterisk (*) are mandatory.

Well Tag Number *
A313251

Type *

☑ Construction ☐ Abandonment

Measurement recorded in: *

☐ Metric ☑ Imperial

1. Well Owner's Information

Last Name and First Name, or Organization is mandatory. *

Last Name	First Name
VANLEEUWEN	KEVIN
Organization	**Email Address**
EXACT CONSTRUCTION	

Current Address

Unit Number	Street Number *	Street Name *	City/Town/Village
	8262	WELLINGTON RD 19 RR#3	FERGUS

Country	Province	Postal Code	Telephone Number
CAN	ON		

2. Well Location

Address of Well Location

Unit Number	Street Number *	Street Name *	Township
	31	CHURCH	

Lot	Concession	County/District/Municipality

City/Town	Province	Postal Code
ALAMA	Ontario	

UTM Coordinates	Zone *	Easting *	Northing *		Municipal Plan and Sublot Number
NAD 83	17	539734	4841635	Test UTM in Map	

Other

3. Overburden and Bedrock Material *

Well Depth * 23 (ft)

General Colour	Most Common Material	Other Materials	General Description	Depth From	Depth To

				(ft)	(ft)
Grey	Silt	Clay		0	15
Grey	Silt			15	23

4. Annular Space *

Depth From (ft)	Depth To (ft)	Type of Sealant Used (Material and Type)	Volume Placed (cubic feet)
0	16	3/8 HOLEPLUG	0.34
16	23	#2 SAND	0.15

5. Method of Construction *

☐ Cable Tool ☐ Rotary (Conventional) ☐ Rotary (Reverse) ☐ Boring ☐ Air percussion ☐ Diamond
☐ Jetting ☐ Driving ☐ Digging ☐ Rotary (Air) ☐ Augering ☑ Direct Push
☐ Other (specify) _____

6. Well Use *

☐ Public ☐ Industrial ☐ Cooling & Air Conditioning
☐ Domestic ☐ Commercial ☐ Not Used
☐ Livestock ☐ Municipal ☑ Monitoring
☐ Irrigation ☐ Test Hole ☐ Dewatering
☐ Other (specify) _____

7. Status of Well *

☐ Water Supply ☐ Replacement Well ☐ Test Hole
☐ Recharge Well ☐ Dewatering Well ☑ Observation and/or Monitoring Hole
☐ Alteration (Construction) ☐ Abandoned, Insufficient Supply ☐ Abandoned, Poor Water Quality
☐ Abandoned, other (specify) _____
☐ Other (specify) _____

8. Construction Record - Casing * (use negative number(s) to indicate depth above ground surface)

Inside Diameter (in)	Open Hole **or** Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness	Depth From (ft)	Depth To (ft)
1.5	Plastic	0.06	-1	18

9. Construction Record - Screen

Outside Diameter (in)	Material (Plastic, Galvanized, Steel)	Slot Number	Depth From (ft)	Depth To (ft)
1.56	Plastic	10	18	23

10. Water Details

Water found at Depth (ft)	☐ Gas	Kind of water ☐ Fresh ☐ Untested ☐ Other

11. Hole Diameter

Depth From (ft)	Depth To (ft)	Diameter (in)
0	23	3.5

12. Results of Well Yield Testing

☐ Pumping Discontinued

Explain _____

If flowing give rate

☐ Flowing _____ (GPM)

Draw down

Time (min)	Static Level	1	2	3	4	5	10	15	20	25	30	40	50	60
Water Level (ft)														

Recovery

Time (min)	1	2	3	4	5	10	15	20	25	30	40	50	60
Water Level (ft)													

After test of well yield, water was

☐ Clear and sand free ☐ Other (specify)

Pump intake set at (ft)	Pumping rate (GPM)	Duration of pumping hrs + min	Final water level end of pumping (ft)	Disinfected? * ☐ Yes ☑ No

Recommended pump depth (ft)	Recommended pump rate (GPM)	Well production (GPM)

13. Map of Well Location *

Map 1. Please Click the map area below to import an image file to use as the map. ☐ Make map area bigger

14. Information

Well owner's information package delivered	Date Package Delivered (yyyy/mm/dd)	Date Work Completed (yyyy/mm/dd) *
☐ Yes ☐ No		2020/12/11

Comments

15. Well Contractor and Well Technician Information

Business Name of Well Contractor *	Well Contractor's License Number *
CMT DRILLING INC	7366

Business Address

Unit Number	Street Number	Street Name *
1	1011	INDUSTRIAL CRES

City/Town/Village *	Province	Postal Code *
ST CLEMENTS	ON	N0B 2M0

Business Telephone Number	Business Email Address
519-699-5775	info@cmtinc.net

Last Name of Well Technician *	First Name of Well Technician *	Well Technician's License Number *
BLACK	CHRIS	3711

16. Declaration *

☑ I hereby confirm that I am the person who constructed the well and I hereby confirm that the information on the form is correct and accurate.

Last Name	First Name	Email Address
BLACK	CHRIS	cblack@cmtinc.net

Signature		Date Submitted (yyyy/mm/dd)
Chris Black	Digitally signed by Chris Black Date: 2020.12.24 10:45:08 -05'00'	2020/12/24

17. Ministry Use Only

Audit Number

4JQV AM7M

APPENDIX B

Scoped Hydrogeological Assessment and Supplementary Groundwater Level Monitoring, Hydrogeology Consulting Services (HCS), 2022

Scoped Hydrogeological Assessment

31 Church Street
Alma (Mapleton), Ontario

Project 10056

1. INTRODUCTION

Hydrogeology Consulting Services (HCS) was retained by Exact Construction Ltd. to conduct a scoped hydrogeological assessment for 31 Church Street in Alma, a community in the Township of Mapleton, Ontario. The location of the subject property is shown on Drawings 1 and 2 in Appendix A. Proposed development of the property includes a multiple residential lot subdivision with individual private water supplies and sewage effluent disposal systems.

The scope of work for this assessment was developed to respond to comments and guidelines provided by the Township of Mapleton, and to satisfy the Ontario Ministry of the Environment, Conservation, and Parks (MECP) Procedure D-5-4.

1.1 Concurrent Study of the Property

Concurrent study of the property includes a geotechnical investigation by CMT Engineering Inc. (December, 2020) comprising drilling and installation of boreholes and monitoring wells on the property, and the preparation of a geotechnical report. The geotechnical investigation report includes discussion of subsurface conditions, identification of major stratigraphic units encountered during drilling, borehole stratigraphic logs, and other pertinent information. The CMT Engineering Inc. geotechnical report should be reviewed in conjunction with this report.

1.2 Scope of Work

The three monitoring wells were installed on the property by CMT Engineering Inc. on December 11, 2020 and observed by HCS. These three wells were developed (purged) using Waterra inertial valves and tubing on December 14, 2020 to remove fine-grained material from the well screen sand pack and mitigate smearing on the borehole walls during drilling. Water chemistry samples were obtained from two wells for analysis of general chemistry parameters, and the three wells were assessed via slug tests to estimate saturated soil hydraulic conductivity. Stabilized groundwater elevations were measured using an electronic water level tape before and after testing, and the monitoring wells were instrumented with electronic pressure transducers (dataloggers) to allow continuous measurement of groundwater levels throughout the slug testing. Water level measurements are summarized in Table 1 in Appendix C.

Existing data for the subject property and surrounding area were compiled from multiple sources to gain an understanding of the subsurface stratigraphy, shallow groundwater flow regime, and downgradient receptors for on-site in-ground sewage effluent disposal systems. Local water users were identified through a review of Ministry of the Environment, Conservation and Parks (MECP) water well records surrounding the subject property.

1.2.1 Borehole Drilling and Monitoring Well Installation

On December 11, 2020, CMT Engineering Inc. conducted a geotechnical and environmental drilling program including the advancement of three boreholes to a maximum depth of 9.14 metres below ground surface (mBGS) using a direct push drillrig.

Continuous cores were advanced and soil samples were obtained. Selected soil samples were analyzed by CMT Engineering Inc. for particle size distribution (grain size) analysis.

The three boreholes were completed as 38-mm diameter monitoring wells using 1.52 m slotted Schedule 40 PVC well screen and PVC riser pipe, with well sand installed around the well screens and the borehole annular spaces sealed with bentonite. The wells were constructed with 10 cm square steel protective casings, and lockable vented protective caps were installed. Monitoring well construction followed Ontario Regulation 903 (as amended). Borehole logs are included in Appendix C for reference. The borehole ground surface elevations were surveyed by CMT Engineering Inc. to a local datum.

A manual electronic water level tape was used by HCS to measure the groundwater elevations on December 14, 2020. Water level comments are included on the borehole logs in Appendix C.

2. STUDY AREA PHYSIOGRAPHY AND GEOLOGY

2.1 Site Description

The subject property is a 6.8-hectare rural agricultural lot bordering the hamlet of Alma, within the Township of Mapleton. Currently an undeveloped agricultural lot, the proposed development of the subject property includes a residential subdivision with associated driveways, access road(s), and individual private on-site wells and septic systems. The subject property consists of an open field with a treeline bordering the southern property boundary, associated with a former rail line. Bordering the property to the west is a commercial development and agricultural field, with the hamlet of Alma to the north and northeast. East of the property is a small wooded/wetland area along with agricultural fields to the east and south.

This proposed usage of the subject property is in general accordance with the current zoning designation by the Township of Mapleton as “Future Development” (Township of Mapleton, 2020).

The ground surface topography of the subject property varies from a high point of approximately 446 metres above sea level (mASL) at the westernmost most portion of the lot (fronting on Peel Street West), gradually sloping downwards to a low point of approximately 437.5 mASL at the easternmost corner of the lot, as indicated by Grand River Conservation Authority (GRCA) mapping.

2.2 Physiography

The subject property is located within the undrumlinized Till Plains physiographic unit (Chapman and Putnam, 2007) which consists of glacially deposited fine-grained silty clay till soils, found more commonly to be in plain (or valley) formation rather than a drumlinized (hilly) formation. Neighbouring the property to the south and east is the Spillways physiographic unit, indicating an area of larger-grained soils from glacial river deposits. The property lies within the Stratford Till Plain physiographic region, consisting of a broad plain of relatively uniform silty clay (till) soils.

2.3 Geology

Quaternary Geology mapping of the Guelph area (Karrow, 1967) indicates the subject property is generally underlain by clayey sand till deposits.

As shown on the borehole logs included in Appendix C, near-surface soils on the subject property consist generally of topsoil underlain by clayey silt and silt deposits, with borehole BH 02-20 encountering an underlying sand deposit. The locations of the boreholes are indicated on Drawing 2 of the CMT Engineering Inc. geotechnical report (CMT Engineering Inc., 2020), included in Appendix A.

Geology from MECP Water Well Records (WWR) in Appendix D indicates overburden stratigraphy in the area typically consists of deposits of clay, sand, gravel, hardpan, and stones with clay being the most common near-surface deposit.

Paleozoic Geology mapping (Armstrong and Dodge, 2007) indicates underlying the overburden deposits is the Guelph Formation dolostone bedrock. MECP Well Records suggest overburden deposits in the area surrounding the subject property are approximately 75 m thick.

2.4 Local Hydrogeology and Groundwater

As shown on the appended Table 1, measured overburden groundwater elevations at the subject property range from 437.98 to 445.76 mASL, at depths between 0.05 to 2.48 mBGS, between December 14, 2020 and April 20, 2022. It is noted the groundwater measurement from BH 01-20 taken on December 14, 2020 is considered erroneous (and likely due to slow recovery of the well after drilling) as all subsequent measurements are significantly higher.

Groundwater encountered in the clayey silt and silt layers (as well as BH 02-20, which has a screened interval in a sand horizon) is interpreted to represent perched groundwater rather than a regional water-bearing aquifer deposit. Groundwater contour mapping shown on the appended Drawing 3 indicates the perched overburden groundwater beneath the subject property flows eastwards towards the origin of the surface drainage feature/headwaters of the tributary of Carroll Creek.

Locally, shallow overburden groundwater would be expected to flow generally eastwards as a subtle reflection of surface topography alongside and parallel to the drainage swale at the southwestern property boundary. Subsurface agricultural drainage tile may be installed at this property to manage and drain the perched groundwater, as ponded water was observed at ground surface near to both BH 01-20 and BH 02-20 on December 14, 2020. GRCA mapping indicates the property lies within the Upper Grand River subcatchment and tertiary watershed. This Upper Grand River subwatershed is a component of the larger more regional Northern Lake Erie watershed, ultimately draining into Lake Erie after passing through the Lower Grand River subcatchment.

The community of Alma is not municipally serviced for water supply, and drinking water is obtained by private water supply wells screened in the upper bedrock aquifer as well as the shallow overburden.

GRCA regional mapping indicates the subject property lies within a low average annual recharge area, with the majority of the property estimated at less than 50 mm of recharge per year, and portions of the property estimated at 50 – 100 mm of recharge per year. It is important to consider this regional mapping does not consider site-level soil stratigraphy. Based on the subsurface stratigraphy encountered in the on-site boreholes, it is expected that low volumes of precipitation infiltrate into the near-surface clayey silt material, and a larger proportion of this precipitation would be expected to join the evapotranspiration or stormwater runoff regimes. Relatively small and minor volumes of water are inferred to percolate vertically downwards over time, or flow laterally to areas with more vertically extensive granular deposits, to contribute small recharge volumes to the deeper overburden groundwater regime.

2.5 Surface Water Features

Surface water features on the property include a man-made stormwater drainage channel or swale running alongside the southwestern property boundary. Topographic contours of the subject property indicate that overall surface water drainage would be expected to flow to the southeast in the general direction of the constructed drainage swale. There are no wetland areas delineated on the subject property.

Surface water features surrounding the property consist of a GRCA regulated watercourse just beyond the southeastern property boundary, indicated by natural heritage mapping from the Ministry of Natural Resources and Forestry (MNRF) to be a non-evaluated wetland, approximately 70 m southeast of the subject property. The wetlands are associated with a drainage swale/tributary creek of Carroll Creek originating just beyond the northeastern property boundary, which generally flows south-westwards/southwards towards its eventual confluence with the Grand River.

Several small ponds and other GRCA-delineated wetland areas are located to the west and south within 1km of the subject property.

Due to the low hydraulic conductivity of the soils generally encountered on-site during drilling, water perched within the near-surface silty soils would not be expect to contribute significant baseflow to nearby creeks or wetland areas. Stormwater runoff as overland flow is inferred to generate a more significant contribution to the local surface water regime.

2.6 Soil Hydraulic Conductivity

Hydraulic conductivity estimates for the site soils were determined using single response hydraulic (slug) tests of the soil deposits screened by the monitoring wells. Estimates of hydraulic conductivity were also made using soil sample grain size analyses and the Kaubisch, Breyer, Kozeny-Carman, and Hazen formulae where appropriate.

2.6.1 Slug Test Results

Prior to conducting slug testing of the monitoring wells, each well was developed (purged) to remove fine-grained material from the sand pack around the well screen and the screened interval.

The slug test methodology followed the procedures developed by Hvorslev (1951), as described in Freeze and Cherry (1979). Three slug tests were conducted, two as a falling head tests by adding a known volume of water to the well, and one as a rising head test by purging the well dry and measuring the groundwater level recovery. The displacement and gradual re-equilibration of the water level in the well was recorded using an electronic pressure transducer (datalogger). Hvorslev's method is expressed by the following equation:

$$K = \frac{r^2 \ln (L/R)}{2LT_{0.37}}$$

where:

- K = hydraulic conductivity of the tested material (m/sec)
- r = inner radius of the well riser pipe (m)
- R = outer radius of the well riser pipe (m)
- L = length of screen and sand pack (m)
- $T_{0.37}$ = time lag (sec), where $(H-h)/(H-H_0) = 0.37$
- h = water level at each time of measurement (m)
- H_0 = initial water level (m, start of test)
- H = stabilized water level prior to slug testing (m)

The time lag, $T_{0.37}$, represents the time required for the water level to recover to the stabilized level if the initial flow rate from the surrounding aquifer into the well is maintained. This time lag is determined graphically as the time where $(H-h)$ divided by $(H-H_0)$ is equal to 0.37.

Graphical analysis of the slug tests are included in Appendix E, and the hydraulic conductivity estimate is listed in Table 2 in Appendix B.

The hydraulic conductivity estimate of <1 x 10^{-8} m/sec for borehole BH 01-20 is due to the very slow recovery time of the slug test (i.e. not achieving $T_{0.37}$), and indicates a very low permeability for the deeper silt and clay soils. The hydraulic conductivity estimate for BH 03-20 was also low, at 6.6 x 10^{-7} m/sec, providing further evidence for low permeability of the clayey silt stratigraphy. BH 02-20 is installed in sandier soils with a relatively higher estimated hydraulic conductivity of 4.7 x 10^{-6} m/sec. Further discussion related to the permeability of the subsurface environment is included in Section 2.6.2, below.

2.6.2 Grain Size Analysis Results

Soil samples collected from boreholes BH01-20, BH02-20 and BH03-20 during drilling were submitted to the CMT Engineering Inc. laboratory facility in St. Clements, Ontario for analysis of particle size distribution (grain size). As shown on the grain size analysis graphs included in Appendix F, the analyzed soils consist primarily of silts and clays, with the sample from BH 02-20 consisting of predominantly sand. The grain size analysis results were used to estimate soil hydraulic conductivity (K) values by applying the Kaubisch, Breyer, Hazen, and Kozeny-Carman formulae were appropriate based on the limitations of each formula. For BH 01-20, the D_{10} value was estimated resulting in an estimated hydraulic conductivity value using the Kaubisch formula. The calculated hydraulic conductivity values as summarized in the appended Table 2 range from 3.3 x 10^{-9} to 1.3 x 10^{-8} m/sec for the silty soil from BH 01-20 and 03-20, to 1.9 x 10^{-4} m/sec for the sandy soil from BH 02-20. The calculated values indicate very low permeability for the silt and clay soils, and a more moderate to high permeability for the sandy soil.

The hydraulic conductivity estimates from both the slug tests and the grain size analyses correlate reasonably well with published ranges for the major soil types (Freeze and Cherry, 1979).

2.7 Groundwater Chemistry

On December 14, 2020 water chemistry samples were obtained from the monitoring wells at BH 03-20 and BH 01-20. Samples were collected in the appropriate containers, stored in a cooler, and delivered to ALS Environmental Laboratories in Waterloo, Ontario for analysis of general chemistry parameters. The laboratory Certificate of Analysis is included in Appendix G for reference, and the appended Table 3 summarizes parameters of interest.

Please Note: It is important to consider that while the sample results are compared to the Ontario Drinking Water Quality Standards (ODWQS) for reference purposes, the ODWQS are only applicable to potable water. Perched groundwater extracted from a monitoring well is not considered potable water.

Additionally, it is important to consider the water chemistry samples were obtained using inertial valve pumps (Waterra tubing and foot valves). The method of water collection inherently results in the inclusion of sediments into the water sample, thereby increasing concentrations of

parameters such as colour, turbidity, total suspended solids, total dissolved solids, and total metals where metals are adsorbed onto soil particles.

As shown on the appended Table 3 the samples exhibited low and non-detectable concentrations of Nitrate and Nitrite (all less than 1 mg/L) and a Total Ammonia (as N) concentration of 0.164 mg/L in BH 01-20 and 0.048 in BH 03-20.

One or both samples exhibited exceedances of the ODWQS for aesthetic/operational parameters including Total Dissolved Solids, Turbidity, Colour, Hardness, and a variety of metals. Additionally, one or both samples exceeded the ODWQS Maximum Acceptable Criteria (MAC) for Aluminum, Arsenic, Barium, Chromium, Manganese, and Lead. These elevated concentrations are expected to be a result of the sampling methodology.

The near surface silt and clay soils are expected to function as an aquitard, inhibiting the vertical migration of contaminants (e.g. agricultural fertilizers, sewage effluent, etc.) from the ground surface to deeper overburden and/or bedrock aquifers beneath the subject property and adjacent areas. Although the subject property is bordered by properties serviced by on-site sewage (septic) systems, the Nitrate, Nitrite and Total Ammonia concentrations observed in the shallow perched groundwater were less than 1 mg/L.

3. WATER USERS

Well Records from the MECP Water Well Record (WWR) Database were reviewed to determine the number of private water supply wells present. As shown on the well records in Appendix D, one hundred and thirty-one wells are located within an approximate radius of 500 m from the subject property according to the MECP WWR Database. Of these wells, three are identified as monitoring wells not used for water supply, two are identified as not in use, eight are abandonment records, seven wells have no completion details, and nine wells have a diameter of 50 mm and are concluded to be geotechnical investigative wells not used for water supply. These twenty-nine wells have been excluded from further consideration.

Of the remaining one hundred and two wells, one hundred and one wells are completed in overburden at depths ranging from 7.6 mBGS to 78.3 mBGS, and one well is completed in bedrock at a total depth of 78.3 mBGS (bedrock encountered at 75.6 mBGS).

The overburden wells consist of seventeen dug wells (with diameters of 0.4 to 0.8 m) completed at depths of less than 15 m; four drilled wells completed at depths of 24 to 31 m; and eighty wells completed at depths of more than 47 m.

Three of the one hundred and two wells are identified as commercial wells, two wells are identified as institutional use, one is identified as a public supply well, one identified as livestock supply, and the remainder are domestic wells. These wells are plotted on Drawing 3 in

Appendix A. As indicated on Drawing 3, there are only five wells with depths of less than 31 m plotted within 100 m of the subject property. These wells are as follows:

Table I: Shallow Water Supply Wells Within 100 m of the Subject Property

Well Name	Completed Depth (mBGS)
6702085	27.4
6709097	10.7
6710987	31.1
6705957	9.1
6706635	8.2

Of the five wells identified as shallow wells within 100 m of the subject property, only three are completed at depths of less than 25 m.

It is noted that some wells plotted on the appended Drawing 3 are located in areas where the actual existence of a well is unlikely (they may be associated with nearby properties), and that some properties shown on the aerial imagery do not have a well associated with them; however, the MECP WWR coordinate data has been used in the absence of more reliable information. As the community of Alma is not serviced municipally for water supply, residences within town limits would are expected to have private water supply wells. The locations and completion depths of private water supply wells adjacent to/downgradient of the subject property could be investigated further by HCS through a door-to-door well survey.

3.1 Municipal Wellhead Protection Areas and Vulnerability Mapping

Grand River Conservation Authority Mapping (2019) shown on the appended Drawing 1 indicates the closest nearby Wellhead Protection Area (WHPA) to the subject property is located approximately 3.77 km from the southeast property boundary. This WHPA–B represents a 5 to 25-year time of travel to municipal wells supplying water to the Towns of Salem and Elora within the Township of Centre-Wellington. The property is not located within a surface water Intake Protection Zone (IPZ).

WHPA vulnerability mapping indicates the property is not located in an area of vulnerability, that the intrinsic vulnerability for the area is low, and that the property is not located within a Significant Groundwater Recharge Area (SGRA). The subject property is located within a Wellhead Water Quantity Protection Area (WHPA-Q). As described in the Centre Wellington Tier 3 Water Budget Study, the WHPA-Q suggests future groundwater takings that consume water, and land use changes which limit the ability of water to soak into the ground (groundwater recharge), could potentially affect the availability of water for municipal supply

wells within the Township of Centre Wellington. While groundwater takings located within the WHPA-Q would not necessarily be expected to impact groundwater levels at the municipal wells, additional study may be necessary for new water takers within the WHPA-Q.

Additionally, the study concluded that cumulative effects of unserviced domestic water well pumping on bedrock water supply aquifers utilized by municipal wells is minimal.

3.2 Sensitive Features

Ontario Source Protection Information Atlas (OSPIA) mapping (2020) indicates that the subject property does not fall within a highly vulnerable aquifer zone, or a significant groundwater recharge area.

4. PREDICTIVE NITRATE IMPACT ASSESSMENT

The subject property is proposed to be developed with individual lots and associated residential dwellings, including private servicing for water supply and sewage disposal. These single-family residential sewage systems will discharge effluent to the local subsurface via individual leaching beds. The leaching beds will load residential waste nutrients to the subsurface, and eventually the shallow perched groundwater system(s). The principal components of the sewage effluent will be nitrate (as nitrogen), ammonia, and phosphorus (total). As ammonia is normally aerobically converted to nitrate in the unsaturated zone, and phosphorus typically reacts with and attaches to soil particles, nitrate is the primary nutrient parameter that percolates downwards to the water table and can impact groundwater. Nitrate can persist in groundwater; however, under anaerobic conditions it is typically converted to nitrogen gas by bacteria in the process of denitrification.

Assessment of the potential impact of a subsurface sewage disposal systems is performed based on nitrate loading of the shallow groundwater aquifer, as excessive amounts of nitrate can impact both drinking water (particularly for infants) and surface water (due to eutrophication and plant growth).

The Ontario Drinking Water Quality Standard (ODWQS) for nitrate-N is 10 mg/L, and this is the criteria applied to the predictive nitrate impact assessment.

For the purposes of this assessment, the Ontario Ministry of the Environment and Climate Change (MOECC, now MECP) Technical Guideline for Individual On-Site Sewage Systems Procedure D-5-4 (1996) is applied as follows:

$$C_{PB} = \frac{(SEF \times C_{SEF}) + (GR \times C_{GR}) + (GUF \times C_{GUF})}{(SEF + GR + GUF)}$$

Variables:

C_{PB} = Nitrate concentration in groundwater at the down-gradient property boundary (mg/L as nitrate-N)

SEF = Sewage effluent flow (m^3/yr)

For the purposes of this assessment, the daily design sewage flow for a 3-bedroom home as provided by Table 8.1.2.3. from the Ontario Building Code (2012, as amended) is applied assuming the smallest proposed lot size for all lots.

= 1,600 L/day x 19 lots x 365 days
= 11,096,000 L/yr

C_{SEF} = Nitrate concentration of sewage effluent (mg/L)

Sewage effluent nitrate concentration of 40 mg/L for a conventional treatment system, 20 mg/L for a tertiary treatment system, and 12 mg/L for an enhanced tertiary treatment system.

GR = Groundwater recharge from infiltrating precipitation (m^3/yr)

Groundwater Recharge = Infiltration Rate[1] x Site Area[2]

= 0.125 m/yr x 55,100 m^2
= 6,887.5 m^3/yr
= 6,887,500 L/yr

C_{GR} = Nitrate concentration of groundwater recharge (mg/L)

0.1 mg/L Nitrate concentration assumed for infiltrating precipitation.

It is noted that the groundwater recharge calculations above have assumed a minimum lot area of 0.29 hectares for each of the 19 proposed lots. Lot sizes are expected to vary from 0.29-0.55 hectares; therefore, the calculations provided are considered conservative and provide an additional factor of safety.

Based on the variables described above, predictive nitrate impact calculation results are summarized in Table II below.

[1] Infiltration rate from MOEE Hydrogeological Technical Information Requirements for Land Development Applications (1995).

[2] Site Area is taken as the total property area assigned to residential building lots, based on methodology outlined in MOECC (now MECP) Procedure D-5-4: Technical Guideline for Individual On-Site Sewage Systems: Water Quality Impact Risk Assessment.

Table II: Nitrate Impact Assessment Calculated Results

	Sewage Effluent Concentration (mg/L)	Total Annual Sewage volume (L/yr)	Nitrate-N Concentration at Downgradient Property Boundary (mg/L)
31 Church Street – 19 Lots with minimum size of 0.29 hectares	40	11,096,000	**24.72**
	20	11,096,000	**12.38**
	12	11,096,000	**7.44**

The nitrate impact assessment calculations show using a conventional or tertiary treatment system for each lot would result in nitrate-N concentrations at the downgradient lot boundaries exceeding the ODWQS criteria limit of 10 mg/L. Using an enhanced tertiary treatment sewage system for each lot would result in groundwater nitrate-N concentrations at the downgradient lot boundaries below the 10 mg/L ODWQS criteria limit.

To minimize the potential for impacts to the shallow overburden soils and overburden aquifers, enhanced tertiary treatment of sewage effluent with a design effluent concentration of 12 mg/L or less for nitrate-N should be considered for the sewage effluent disposal systems for the proposed lots.

As an example, empirical test results provided by Waterloo Biofilter for CAN-BNQ 3680-600 testing of their Water NOx system demonstrated a six month average total nitrogen effluent concentration of 11.9 mg/L, an average nitrate + nitrite concentration of 3.4 mg/L, and an average total nitrogen reduction rate of 80.3%. It is reasonable to conclude enhanced tertiary treatment systems can achieve the required nitrate reduction.

It is important to note that these calculations have conservatively assumed no dilution effects from groundwater underflow, and a conservatively small lot size for each of the 19 proposed lots.

4.1 Sewage Effluent Impact Assessment

The theoretical calculations presented in Section 4.0 show enhanced tertiary treatment will meet the MECP's Procedure D-5-4 Nitrate Impact Assessment criteria. As discussed previously in Section 3 within a 500 m radius of the proposed lot the MECP WWR database suggests one hundred and two overburden wells may exist, including shallow wells completed at depths of less than 10 mBGS. As discussed previously in Section 3, of the five wells identified as shallow wells within 100 m of the subject property, only three are completed at depths of less than 25 m. As shown on the appended Drawing 3 shallow perched groundwater is flowing eastwards, generally cross-gradient of the residential properties to the north of the subject property. If necessary, a door-to-door well survey could determine whether any shallow water supply wells are in fact located in proximity to and downgradient of the proposed development.

5. PATHOGEN MIGRATION ASSESSMENT

The possibility exists for pathogens entering the effluent leaching bed to be transported by the infiltrating precipitation to the groundwater table, and then flow towards downgradient receptors (e.g. private water supply wells, surface water features, etc.).

While MECP Procedure D-5-4 for residential lots does not contemplate pathogen assessment, Chapter 22 (Large Subsurface Sewage Disposal Systems) of the Design Guidelines for Sewage Works (MECP, 2008) does discuss pathogen movement and its potential impact on groundwater and surface water. An evaluation of the potential for pathogen migration is provided below.

Pathogens can travel relatively quickly through granular material; however, appropriate vertical separation between an effluent leaching bed and the shallow groundwater table can remove most effluent-borne pathogens.

Based on the perched groundwater contour mapping provided on the appended Drawing 3 it is reasonable to consider the drainage swale/tributary headwaters along the eastern/northeastern property boundary as the shallow groundwater outflow boundary (or closest downgradient receptor) for the purposes of a pathogen migration assessment.

Subsurface stratigraphy observed in the on-site monitoring wells generally consists of topsoil underlain by varying deposits of clayey silt and silt, and isolated deposits of sand, with perched groundwater encountered at depths of ranging from 0.06 mBGS to 7.40 mBGS. As the typical required vertical separation from a leaching bed to the water table is 0.9 m, it is concluded the opportunity exists within portions of the subject property for extended unsaturated percolation of effluent to allow for filtration of pathogens from the effluent and pathogen decay. A geotechnical test-pitting program could confirm shallow perched groundwater and near-surface soil conditions to evaluate on-site sewage system design constraints based on the site-specific soils and groundwater presence.

As a conservative measure and a factor of safety, it is recommended that raised leaching beds (i.e. raised filter beds) be constructed with fine sands to achieve a longer travel time for percolating sewage effluent and increase the opportunity for pathogen filtration and decay. A septic design engineer should be retained to design appropriate leaching beds, incorporating raised filter beds constructed from fine sand to maximize the potential for pathogen attenuation.

It is reasonable to conclude there is a sufficient separation between the leaching beds and surface water to minimize the possibility of pathogen migration to surface water features. Adherence to required setback distances from surface water features should be incorporated during the detailed design of the on-site sewage systems.

6. WATER SUPPLY POTENTIAL ASSESSMENT

The proposed residential lots will be serviced by private water supply wells. The attached Drawing 2 shows a GRCA delineated wetland area just beyond the southeast property border; however, as discussed in Section 2.4 the low permeability near-surface soils and perched groundwater conditions are not expected to contribute significant baseflow to the surface water feature.

According to the GRCA, the closest municipal wellhead protection area (WHPA) is approximately 3.7 km from the subject property.

Well Records from the Ministry of the Environment, Conservation, and Parks (MECP) Water Well Record (WWR) Database indicate one hundred and two wells within 500 m of the subject property, with one hundred and one wells completed in overburden at depths ranging from 7.6 mBGS to 78.3 mBGS, and one well completed in bedrock at a total depth of 78.3 mBGS (bedrock encountered at 75.6 mBGS).

The overburden wells consist of seventeen dug wells (with diameters of 0.4 to 0.8 m) completed at depths of less than 15 m; four drilled wells completed at depths of 24 to 31 m; and eighty wells completed at depths of more than 47 m.

Pumping test results were recorded for one well completed in overburden at a depth of less than 15 m, with a pumping test rates of 113 litres per minute (L/min) during a pump test that lasted 1 hour. Shallow dug wells are not considered suitable for the proposed subdivision due to increased risk of impacts from surficial contaminants.

Pumping test results were recorded for four wells completed in overburden at depths of 24-31 m, with pumping test rates ranging from 19 to 113 litres per minute, averaging 54 L/min during pump tests that lasted 1 to 4 hours.

Pumping test results were recorded for seventy-seven wells completed in overburden at depths of more than 47 m, with pumping test rates ranging from 11 to 302 litres per minute, averaging 83 L/min during pump tests that lasted 1 to 72 hours.

The on-site supply well (MECP Well Tag #A299778) is completed in overburden gravel and sand deposits at a depth of 54.3 m. The logged soil stratigraphy of this well indicates a clay till aquitard from 21.6 to 51.5 m overlying the granular aquifer deposit from 51.5 to 54.3 m. This deep overburden granular aquifer was pumped at 68 L/min for one hour with zero drawdown observed.

Quaternary geology mapping indicates the subject property is underlain by silty clay till deposits. MECP Well Records from the area indicate overburden thickness of 33-88 m. Beneath overburden soils is the Salina Formation dolostone, shale, and gypsum bedrock.

Within the scope of this desktop study, the information available indicates that a sufficient supply of groundwater should be available to provide for the needs of 19 single-family residential dwellings from the deep overburden aquifer beneath the property. While a high yield of good quality groundwater would be expected to be available from the Guelph Formation bedrock aquifer, the Salina Formation bedrock contact is mapped in close proximity to the subject property. The Salina Formation is known to produce water of a lesser quality with aesthetic issues such as Sulphur, Manganese, and Iron; therefore, while bedrock wells may yield high quantities of water the aesthetic quality of the water could be impaired and require treatment to make it acceptable for potability. It is suggested that private water supply wells for the proposed severances be completed in the deep overburden aquifer at depths below 47 m to minimize the potential for water quality issues unless a test well can be drilled to the bedrock aquifer for water chemistry assessment.

If bedrock water of acceptable quality can be identified beneath the property, a mix of overburden and bedrock wells would serve to minimize cumulative impacts to a single aquifer resource.

Please be advised that this assessment is based on a desktop review of publicly available information. Verification of available water supply and/or water quality, and/or empirical investigation of the potential cumulative impact of groundwater extraction, would require a pumping test to be conducted.

7. CLOSURE

This scoped hydrogeological assessment compiled data for the subject property from existing sources and on-site investigation to gain an understanding of the subsurface statigraphy and shallow groundwater flow regime.

The subject property is underlain by predominantly clayey silt and silt soils, with some sand deposits, as determined through a shallow hydrogeological investigation to a depth of at least 9.14 m. These generally fine-grained soils provide aquitard-type conditions that inhibits the infiltration and vertical percolation of precipitation downwards, creating shallow perched groundwater conditions and limiting recharge of underlying overburden/bedrock aquifers.

Subsurface stratigraphy beneath the subject property consists of silt, clayey silt, and sand deposits to a depth of at least 9.14 m, underlain at depths of more than 78 m by the Guelph Formation dolostone bedrock. Groundwater was observed in the near-surface soils, exhibiting perched and in some cases confined conditions. Shallow perched groundwater is flowing eastwards across the subject property towards the tributary headwater of Carrol Creek.

Soil hydraulic conductivity estimates from grain size analyses indicate the overburden silt and clay deposits have a low hydraulic conductivity of 3.3×10^{-9} m/sec to 6.6×10^{-7} m/sec, with sandy conditions observed at BH 02-20 having a higher hydraulic conductivity.

A drainage swale/tributary headwater of Carroll Creek originates beyond the northeast property boundary, flowing to a GRCA-delineated wetland area approximately 67 m southeast of the southeastern property boundary. The subject property is not identified as an area of significant groundwater recharge, and it is anticipated only small volumes of precipitation infiltrate on site and percolate vertically downwards through the low permeability aquitard-type conditions, contributing little if any recharge to deeper overburden/bedrock aquifers. Surface water runoff follows ground surface topography through drainage swales.

The subject property is approximately 3.7 km from the closest WHPA boundary surrounding the Salem and Elora municipal wells.

Water chemistry analysis of perched groundwater beneath the subject property encountered very low concentrations of nitrate, nitrite, and ammonia, suggesting that the perched groundwater is not locally impacted by nitrogen pollution from agricultural or residential activities.

According to the MECP WWR database one hundred and two private water supply wells in the area are screened in the overburden aquifer at depths between 7.6 and 78.3 mBGS. Groundwater contouring for the overburden aquifer shows that perched groundwater is flowing north-eastwards.

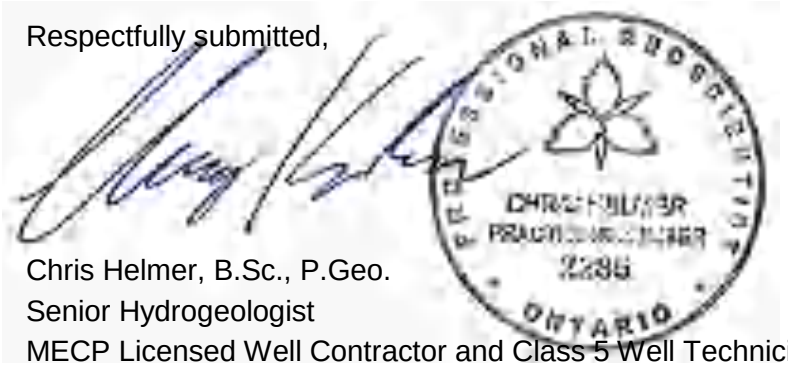
Nitrate impact assessment calculations using conservatively assessed lot sizes demonstrate that the use of enhanced tertiary treatment for the sewage effluent disposal systems will result in a nitrate-N concentration at the downgradient property boundary below the ODWQS criteria limit of 10 mg/L. The use of enhanced tertiary treatment systems with a maximum effluent nitrate-N concentration of 12 mg/L will be required to support the proposed 19 lot development.

To minimize the potential for pathogen mitigation from effluent discharge, raised filter beds should be constructed of fine sands to increase the percolation time for leachate.

Should the lot severance proposal or sewage system design parameters change, an updated nitrate impact assessment would be required.

We trust that this report satisfies your present requirements, and we thank you for this opportunity to be of service. If you have any questions, or require further hydrogeological consulting services, please feel free to contact the undersigned.

Respectfully submitted,



Chris Helmer, B.Sc., P.Geo.
Senior Hydrogeologist
MECP Licensed Well Contractor and Class 5 Well Technician
www.hydrog.ca

8. LIMITATIONS AND USE

This report has been prepared for the exclusive use of the Client indicated in Section 1. Chris F Helmer hereby disclaims any liability or responsibility to any person or party, other than the Client, for any loss, damage, expense, fines, or penalties which may arise from the use of any information or recommendations contained in this report by anyone other than the Client.

The conclusions and recommendations provided in this report are not intended as specifications or instructions to contractors. Any use contractors may make of this report, or decisions made based on it, are the responsibility of the contractors. Contractors must accept responsibility for means and methods of construction they select, seek additional information if required, and draw their own conclusions as to how the subsurface conditions may affect them.

In preparing this report Chris F Helmer has relied in good faith on information provided by individuals and companies noted in this report, and assumes that the information provided is factual and accurate. No responsibility is accepted for any deficiencies, misstatements, or inaccuracies contained in this report as a result of errors, omissions, misinterpretations, or fraudulent acts in the resources referenced, or of persons interviewed or consulted during the preparation of this report.

The report and its complete contents are based on data and information collected during investigations conducted by Chris F Helmer, and pertains solely to the conditions of the site at the time of the investigation, supplemented by historical information and data as described in this report. It is important to note that the investigation involves sampling of the site at specific locations, and the conclusions in this report are based on the information gathered. Limitations of the data and information include the fact that conditions between and beyond the sampling locations may vary; that the assessment is dependent upon the accuracy of the analytical data generated through sample analysis; and that conditions or contaminants may exist for which no analyses have been conducted. Furthermore, no assurance is made regarding potential changes in site conditions and/or the regulatory regime (standards, guidelines, etc.), subsequent to the time of investigation.

The professional services provided for this project include only the hydrogeological aspects of the subsurface conditions at the site, unless otherwise stated specifically in the report. No other warranty or representation is either expressed or implied, as to the accuracy of the information or recommendations included or intended in this report.

9. REFERENCES

Armstrong, D.K. and Dodge, J.E.P. 2007. *Paleozoic Geology Map of Southern Ontario*. Ontario Geological Survey.

Chapman, L.J. and Putnam, D.F. 2007. *Physiography of Southern Ontario*. Ontario Geological Survey.

CMT Engineering Inc. 2020. *Geotechnical Investigation, Proposed Residential Subdivision. 31 Church Street, Alma Ontario.*
County of Wellington Planning and Development Department. 2020. *Township of Mapleton Schedule A-4 Alma Detail.* Ministry of Natural Resources.

Freeze, R.A. and J.A. Cherry. 1979. *Groundwater.* Englewood Cliffs, New Jersey: Prentice-Hall. 614pp.

Karrow, P.F. 1967. *Pleistocene Geology of the Guelph Area, Southern Ontario*. Geological Survey of Canada.

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

Ontario Ministry of the Environment. 1995. *Hydrogeological Technical Information Requirements for Land Development Applications.*

APPENDIX A: DRAWINGS

Drawing 1 – Location Plan
Drawing 2 – Site Plan (CMT Engineering Inc., 2020)
Drawing 3 – Groundwater Contours
Drawing 3 – MECP Water Well Records

LEGEND

Subject Property

GRCAWetland Area

imagery from Grand River Conservation Authority © 2021

Drawing 1 - Location Plan
31 Church Street, Alma

HCS HYDROGEOLOGY CONSULTING SERVICES

Drawn:	CFH
Date:	02-Jan-21

NOTES:

Base map provided by Bing.

Legend

CMT Borehole with Monitoring Well

Temporary Benchmark (TBM)
Top of Existing Water Well (A299778)
Assumed Elevation: 100.00 m

N

NO.	DESCRIPTION	DATE

REVISIONS

CMT ENGINEERING INC.
1011 Industrial Crescent, Unit 1
St. Clements, Ontario N0B 2M0
Tel.: 519-699-5775
Fax: 519-699-4664
www.cmtinc.net

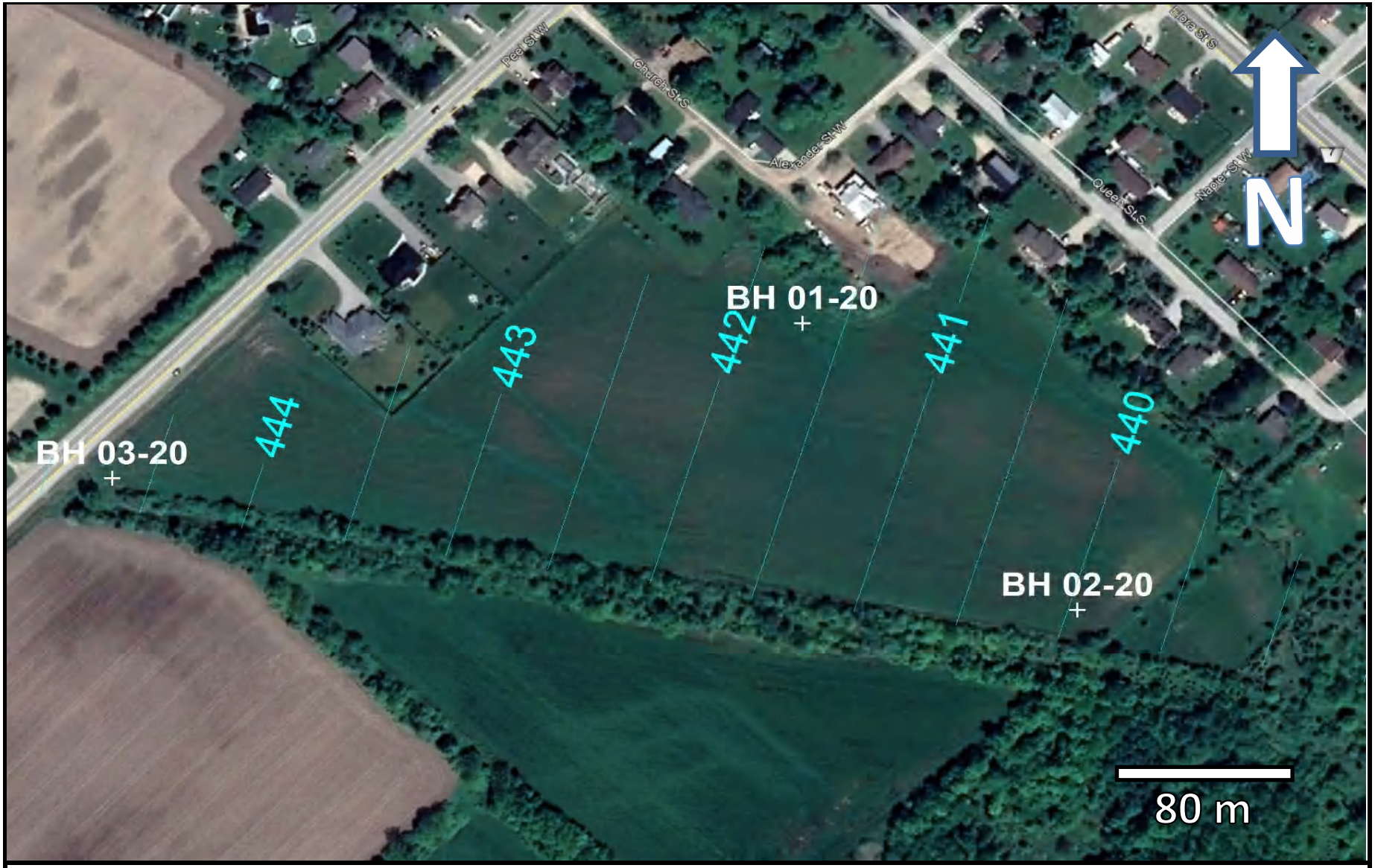
PROJECT:

Proposed Subdivision
31 Church Street
Alma, Ontario

DRAWING TITLE:

AERIAL VIEW SHOWING
BOREHOLE LOCATIONS

PROJECT NO.:	DATE:
20-732	December 18, 2020
SCALE:	DRAWING NO.
N.T.S.	2



imagery from Google Earth © 2022

LEGEND

- Monitoring Well
- Groundwater Contour (mASL)

Drawing 3 - Groundwater Contour Mapping (20-Apr-2022)
31 Church Street, Alma

HCS HYDROGEOLOGY CONSULTING SERVICES

Drawn:	CFH
Date:	01-May-22

LEGEND

- Subject Property
- Supply Well (<31 m deep)
- Supply Well (>47 m deep)

imagery from Google Earth © 2021

Drawing 4 - MECP WWRs
31 Church Street, Alma

HCS HYDROGEOLOGY CONSULTING SERVICES

Drawn:	CFH
Date:	02-Jan-21

APPENDIX B: TABLES

Table 1 – Groundwater Level Measurements

Table 2 – Hydraulic Conductivity Estimates

Table 3 – Water Chemistry Analysis Results

31 Church Street, Alma, Ontario
Table 1 - Groundwater Level Measurements

Name	Ground Surface Elevation (mASL)	Stickup (m)	14-Dec-20			22-Apr-21			2021-15-Jul			29-Oct-21		
			WL (mBTOP)	WL (mBGS)	WL (mASL)	WL (mBTOP)	WL (mBGS)	WL (mASL)	WL (mBTOP)	WL (mBGS)	WL (mASL)	WL (mBTOP)	WL (mBGS)	WL (mASL)
BH 01-20	442.63	1.01	8.41	7.40	435.23	1.95	0.94	441.69	3.49	2.48	440.15	2.32	1.31	441.32
BH 02-20	438.21	0.97	1.03	0.06	438.15	1.02	0.05	438.16	1.35	0.38	437.83	1.15	0.18	438.03
BH 03-20	447.02	0.98	2.24	1.26	445.76	2.39	1.41	445.61	3.01	2.03	444.99	2.39	1.41	445.61

Name	Ground Surface Elevation (mASL)	Stickup (m)	10-Jan-22			20-Apr-22		
			WL (mBTOP)	WL (mBGS)	WL (mASL)	WL (mBTOP)	WL (mBGS)	WL (mASL)
BH 01-20	442.63	1.01	2.46	1.45	441.18	2.47	1.46	441.17
BH 02-20	438.21	0.97	1.20	0.23	437.98	1.06	0.09	438.12
BH 03-20	447.02	0.98	2.54	1.56	445.46	2.44	1.46	445.56

Measurement is considered erroneous
mASL - metres Above Sea Level
mBGS - metres Below Ground Surface

31 Church Street, Alma, Ontario
Table 2 - Hydraulic Conductivity Estimates

Name	Soil Sample Depth or Screened Interval (mBGS)	Soil Type	Analysis Method	Hydraulic Conductivity (m/sec)
BH 01-20	1.52 - 2.13	Clayey, sandy silt, trace gravel	Kaubisch	5.2×10^{-7}
BH 01-20	7.62 - 9.14	Silt, trace clay and sand	Hvorslev	#VALUE!
BH 02-20	7.62 - 9.14	Sand, trace silt and clay	Breyer	2.5×10^{-4}
BH 02-20	7.62 - 9.14	Sand, trace silt and clay	Hvorslev	4.7×10^{-6}
BH 03-20	6.10 - 7.62	Silt, trace clay and sand	Kozeny Carman	1.1×10^{-7}
BH 03-20	6.10 - 7.62	Silt, trace clay and sand	Hvorslev	$<1 \times 10^{-8}$

mBGS - metres Below Ground Surface
m/sec - metres per second

Measurement is considered erroneous

31 Church Street, Alma, ON
Table 3 - December Water Chemistry Analysis Results
14-Dec-20

Parameter	Units[i]	ODWQS [ii]	ODWQS Operational & Aesthetic [iii]	BH 01-20	BH 03-20
				0	
Physical Tests					
Colour, Apparent	CU		**5**	**24.7**	**9.7**
Conductivity	umhos/cm			906	1480
pH	pH units		**6.5-8.5**	8.12	7.74
Total Dissolved Solids	mg/L		**500**	**646**	**1150**
Turbidity	NTU		**5**	**>4000**	**>4000**
Anions and Nutrients					
Alkalinity, Total (as $CaCO_3$)	mg/L		**30-500**	253	324
Ammonia, Total (as N)	mg/L			0.164	0.048
Chloride (Cl)	mg/L		**250**	156	**278**
Fluoride	Measurement	*1.5*		0.267	0.15
Nitrite (as N)	mg/L		**80-100**	**22000**	**17500**
Orthophosphate, Dissolved (as P)	mg/L	*10*		0.471	<0.10
	mg/L	*1*		<0.010	<0.050
	mg/L			<0.0030	<0.0030
Sulfate (SO_4)	mg/L		**500**	23.0	86.8
Total Metals					
Aluminum (Al)-Total	mg/L		**0.1**	**38.4**	**62.4**
Antimony (Sb)-Total	mg/L	*0.006*		<0.010	<0.010
Arsenic (As)-Total	mg/L	*0.0100*		*0.022*	*0.050*
Barium (Ba)-Total	mg/L	*1*		*1.33*	*1.26*
Boron (B)-Total	mg/L	*5*		<1.0	<1.0
Cadmium (Cd)-Total	mg/L	*0.005*		0.00458	0.00305
Calcium (Ca)-Total	mg/L			6040	5000
Chromium (Cr)-Total	mg/L	*0.05*		*0.125*	*0.192*
Copper (Cu)-Total	mg/L		**1**	0.338	0.318
Iron (Fe)-Total	mg/L		**0.3**	**16.8**	153
Lead (Pb)-Total	mg/L	*0.01*		*0.290*	*0.267*
Magnesium (Mg)-Total	mg/L			1670	1230
Manganese (Mn)-Total	mg/L		**0.05**	**16.4**	**14.9**
Nickel (Ni)-Total	mg/L			0.140	0.165
Phosphorus (P)-Total	mg/L			<5.0	14.6
Selenium (Se)-Total	mg/L	*0.05*		<0.0050	<0.0050
Silicon (Si)-Total	mg/L			56	83
Silver (Ag)-Total	mg/L			<0.0050	<0.0050
Sodium (Na)-Total	mg/L	*20*	**200**	*59.0*	*62.3*
Sulfur (S)-Total	mg/L			<50	58
Uranium (U)-Total	mg/L	*0.02*		0.0174	0.0235
Zinc (Zn)-Total	mg/L		**5**	0.91	0.91

i - All measured concentrations are in units indicated. CU = Colour Unit. NTU = Napthalene Turbidity Unit

ii - Concentrations in *underlined and italicized text* exceed the Ontario Drinking Water Quality Standards (ODWQS) - Tables 1 & 2; Safety Standards.

iii - Concentrations in **bold text** exceed the ODWQS - Aesthetic and Operational parameters.

iv - Parameters that are not listed in this table were reported to be below the detection limit and are included on the Certificate of Analysis in Appendix D.

APPENDIX C: BOREHOLE LOGS

BH 01-20 through BH 03-20 (CMT Engineering Inc., 2020)

CMT Engineering Inc.
1011 Industrial Crescent, Unit 1
St. Clements, Ontario N0B 2M0
Telephone: 519-699-5775
Fax: 519-699-4664

BOREHOLE NUMBER 1

PROJECT: Geotechnical Investigation for Proposed Subdivsion
PROJECT ADDRESS: 31 Church Street
PROJECT NUMBER: 20-732
PROJECT LOCATION: Alma, Ontario
DRILLING DATE: 20-12-11
GROUND ELEVATION: 97.43 m
DRILLING CONTRACTOR: CMT Drilling Inc.
LOGGED BY: BB
DRILLING EQUIPMENT: Geoprobe 7822DT
SAMPLING METHOD: SPT/MC5

DEPTH (m)	MATERIAL DESCRIPTION	Depth, Elevation (m)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	SPT N VALUE / POCKET PEN. (kPa) / MOISTURE CONTENT (%)	WELL DIAGRAM
0	**TOPSOIL:** Loose, dark brown silty topsoil, moist (410 mm)	0.00, 97.43	SS 1	67	2-3-3-3 (6)	6	
	CLAYEY SILT: Firm, brown clayey silt, some sand, trace gravel, drier than the plastic limit	0.41, 97.02					
1			SS 2	100	2-3-4-4 (7)	7 13.2	
	becoming stiff to very stiff, some sand	1.83, 95.60	SS 3	100	4-6-15-12 (21)	21 12.9	38mm Riser
2			SS 4	33	13-20-25-38 (45)	45 14	
3			SS 5	100	12-11-14-13 (25)	25 13.3	
			MC5 6	100		450 14.1	Bentonite Seal
4							
	becoming grey	4.65, 92.78	SS 7	100	12-14-16-21 (30)	30 450 12.5	
5							
	occasional wet seams encountered	5.49, 91.94	MC5 8	100		11.1	
6			MC5 9	100		17.8	
	SILT: Compact, grey silt, trace clay and sand, moist	7.37, 90.06					Water level measured at 7.40m (El. 90.03m) on Dec. 14, 2020.
7							
	becoming loose, wet	7.92, 89.51	MC5 10	100		20.3	38mm Screen
8							
	becoming compact, moist	8.69, 88.74					#2 Sand Pack
9							

Bottom of borehole at 9.14 m, Elevation 88.29 m.
Groundwater measured at approximately 7.40 m below ground surface (elevation 90.03 m) on December 14, 2020.

CMT Engineering Inc.
1011 Industrial Crescent, Unit 1
St. Clements, Ontario N0B 2M0
Telephone: 519-699-5775
Fax: 519-699-4664

BOREHOLE NUMBER 2

PROJECT: Geotechnical Investigation for Proposed Subdivsion
PROJECT ADDRESS: 31 Church Street
PROJECT NUMBER: 20-732
PROJECT LOCATION: Alma, Ontario
DRILLING DATE: 20-12-11
GROUND ELEVATION: 92.78 m
DRILLING CONTRACTOR: CMT Drilling Inc.
LOGGED BY: BB
DRILLING EQUIPMENT: Geoprobe 7822DT
SAMPLING METHOD: SPT/MC5

DEPTH (m)	MATERIAL DESCRIPTION	Depth, Elevation (m)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	SPT N VALUE / POCKET PEN. (kPa) / MOISTURE CONTENT (%)	WELL DIAGRAM
0	**TOPSOIL:** Loose, dark brown silty topsoil, moist (360 mm)	0.00, 92.78	SS 1	50	1-1-2-2 (3)	3	Water level measured at 0.06m (El. 92.72m) on Dec. 14, 2020.
	CLAYEY SILT: Soft, brown clayey silt, some sand, trace gravel, drier than the plastic limit	0.36, 92.42					
1	becoming stiff to very stiff	1.07, 91.71	SS 2	100	1-2-7-7 (9)	9 14.7	
2			SS 3	100	6-8-11-12 (19)	19 13.8	38mm Riser
			SS 4	100	9-10-12-15 (22)	22 14.1	
3	becoming sandy, some gravel	2.67, 90.11					
	becoming stiff, more plastic (about the plastic limit)	3.30, 89.48	SS 5	100	8-7-6-8 (13)	13 13.3	Bentonite Seal
4			MC5 6	100		175 13	
5			SS 7	67	7-6-7-9 (13)	13 13.1	
6			MC5 8	100		14.6	
7			MC5 9	100		14.1	
8	**SAND:** Compact, brown sand, trace silt and clay, wet	7.82, 84.96	MC5 10	100			#2 Sand Pack
9						12.2	38mm Screen

Bottom of borehole at 9.14 m, Elevation 83.64 m.
Groundwater measured at approximately 0.06 m below ground surface (elevation 92.72 m) on December 14, 2020.

BOREHOLE LOG WITH WELL2 20-732.GPJ CMT_TEMPLATE_2020-05-15.GDT 21-1-4

CMT Engineering Inc.
1011 Industrial Crescent, Unit 1
St. Clements, Ontario N0B 2M0
Telephone: 519-699-5775
Fax: 519-699-4664

BOREHOLE NUMBER 3

PROJECT: Geotechnical Investigation for Proposed Subdivsion
PROJECT ADDRESS: 31 Church Street
PROJECT NUMBER: 20-732
PROJECT LOCATION: Alma, Ontario
DRILLING DATE: 20-12-11
GROUND ELEVATION: 101.75 m
DRILLING CONTRACTOR: CMT Drilling Inc.
LOGGED BY: BB
DRILLING EQUIPMENT: Geoprobe 7822DT
SAMPLING METHOD: SPT/MC5

DEPTH (m)	MATERIAL DESCRIPTION	Depth, Elevation (m)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)
0	**TOPSOIL:** Loose, dark brown silty topsoil, moist (360 mm)	0.00, 101.75	SS 1	67	1-2-2-4 (4)
	CLAYEY SILT: Soft, mottled grey-brown clayey silt, some sand, trace gravel, drier than the plastic limit becoming stiff	0.36, 101.39	SS 2	100	6-6-6-7 (12)
1		0.76, 100.99			
	becoming very stiff, brown	1.52, 100.23	SS 3	100	5-9-12-12 (21)
2			SS 4	100	13-15-16-20 (31)
3			SS 5	100	9-12-18-20 (30)
4	becoming grey, more plastic (about the plastic limit)	4.22, 97.53	MC5 6	100	
			SS 7	100	8-29-16-18 (45)
5	(-5.03 m) wet silty sand seam encountered				
	(-5.49 m) saturated silty sand seam encountered		MC5 8	100	
6	**SILT:** Loose, grey silt, trace clay and sand, wet	5.89, 95.86			
			MC5 9	100	
7	becoming compact, moist	7.01, 94.74			

SPT N VALUE (10 20 30 40)
POCKET PEN. (kPa) (90 180 270 360)
MOISTURE CONTENT (%) (12 24 36 48)

WELL DIAGRAM: Water level measured at 1.26m (El. 100.49m) on Dec. 14, 2020. Bentonite Seal. 38mm Riser. #2 Sand Pack. 38mm Screen.

Bottom of borehole at 7.62 m, Elevation 94.13 m.

Groundwater measured at approximately 1.26 m below ground surface (elevation 100.49 m) on December 14, 2020.

BOREHOLE LOG WITH WELL2 20-732.GPJ CMT_TEMPLATE_2020-05-15.GDT 21-1-4

APPENDIX D: MECP WATER WELL RECORDS

Water Well Records

December 29, 2020

2:15:56 PM

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
KINCARDINE TOWNSHIP 03 035	17 539806 4842197 W	2006-08 7146						7034387 (Z49494) A	
NICHOL TOWNSHIP 003	17 540383 4841927 W	2006-01 2663	6.21	FR 0157	26/26/25/1:	DO		6715688 (Z41577) A039863	BRWN CLAY STNS 0155 GRVL 0157
NICHOL TOWNSHIP 003	17 540503 4841943 W	2005-10 2663	15.7	FR 0049	9/10/30/1:0	DO		6715575 (Z29024) A017819	BRWN CLAY STNS 0024 BRWN CLAY GRVL 0037 BRWN CLAY STNS 0047 GRVL 0049
NICHOL TOWNSHIP 11 001	17 540471 4841913 W	2006-10 6865	5.11	FR 0164	10/11/12/1:0	DO	0162 3	7039267 (Z56267) A039863	BRWN SILT SAND 0162 GRVL SAND 0169
NICHOL TOWNSHIP CON 11 001	17 540312 4842024 W	1954-04 1723	4 4	FR 0257	0///:	ST DO		6701848 ()	BRWN CLAY BLDR 0182 GRVL 0235 MSND 0248 LMSN 0257
NICHOL TOWNSHIP CON 11 001	17 540481 4841950 W	2004-09 2663	6.25	FR 0155 FR 0160	16/20/30/1:0	DO		6715199 (Z17931) A007148	BRWN CLAY STNS 0155 GRVL 0160
NICHOL TOWNSHIP CON 11 001	17 540214 4842048 W	1971-11 2519	30	FR 0027	25///:	DO		6704081 ()	GREY CLAY 0027 GREY SAND 0028 GREY CLAY MUCK 0035
NICHOL TOWNSHIP CON 11 001	17 540148 4842061 W	1997-03 6865	6	FR 0194	5/7/15/1:0	DO		6712215 (176918)	LOAM 0001 BRWN CLAY SNDY 0003 GREY CLAY GRVL 0040 GREY CLAY 0048 GREY CLAY GRVL 0101 GREY HPAN 0124 GREY CLAY GRVL 0142 GREY HPAN 0168 GREY CLAY GRVL 0183 BRWN SAND GRVL 0194
NICHOL TOWNSHIP CON 11 001	17 540332 4841894 W	1998-12 2663	6	FR 0160	8/20/30/1:0	DO		6712770 (198833)	BRWN CLAY STNS GRVL 0035 BRWN CLAY GRVL 0075 BRWN GRVL SAND 0115 BRWN CLAY GRVL 0135 BRWN CLAY SAND GRVL 0154 GRVL 0160
NICHOL TOWNSHIP CON 11 001	17 540141 4841983 W	1999-09 6865	6	UK 0167	9/12/10/1:0	DO		6713131 (203987)	LOAM 0001 BRWN CLAY STNS 0012 GREY CLAY 0021 GREY SAND CLAY 0025 GREY HPAN CLAY 0042 GREY CLAY GRVL 0116 GREY HPAN CLAY 0143 GREY CLAY STNS 0162 BRWN GRVL SAND 0167
NICHOL TOWNSHIP CON 11 001	17 540264 4842159 W	1988-03 4643	5	FR 0175	15/80/40/1:0	DO		6709231 (02496)	BLCK LOAM 0001 RED CLAY 0168 BRWN GRVL 0179
NICHOL TOWNSHIP CON 11 001	17 540154 4842024 W	1996-04 2336	2		4///:	CO	0001 5	6711945 (168003)	BRWN GRVL SAND 0003 GREY GRVL SAND CLAY 0006
NICHOL TOWNSHIP CON 11 001	17 540127 4842004 W	1996-04 2336	2		4///:	CO	0001 5	6711944 (168002)	BRWN GRVL SAND 0003 GREY GRVL SAND CLAY 0006
NICHOL TOWNSHIP CON 11 001	17 540106 4842017 W	1996-04 2336	2		4///:	CO	0001 5	6711943 (168001)	BRWN GRVL CLAY 0002 GREY GRVL SAND CLAY 0006

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
NICHOL TOWNSHIP CON 11 001	17 540219 4842176 W	1965-12 3316	4 4	FR 0172	///:	DO		6701849 ()	GREY CLAY STNS GRVL 0170 GRVL 0172
NICHOL TOWNSHIP CON 11 001	17 540144 4842046 W	1996-04 2336	2		4///:	CO	0001 5	6711942 (167000)	BRWN GRVL CLAY FILL 0003 GREY GRVL CLAY 0006
NICHOL TOWNSHIP CON 11 001	17 540125 4842021 W	1990-10 4552	6	FR 0170	0/40/10/18:0	CO		6710491 (70360)	BRWN LOAM 0002 BRWN SAND CLAY 0011 GREY CLAY STNS 0118 BRWN CLAY 0166 BRWN GRVL 0170
NICHOL TOWNSHIP CON 11 002	17 540397 4841732 W	1996-02 6865	6	FR 0165	/15/30/1:30	DO		6711938 (168201)	BRWN LOAM 0002 BRWN CLAY SNDY STNS 0011 BRWN SAND GRVL 0017 GREY CLAY GRVL 0123 BRWN HPAN 0152 BRWN GRVL SAND 0165
NICHOL TOWNSHIP CON 11 002	17 540296 4841850 W	1999-04 2663	6	FR 0167	5/8/30/1:	DO		6712933 (198858)	BRWN CLAY STNS 0025 BRWN CLAY SAND GRVL 0085 BRWN SAND GRVL 0105 BRWN CLAY SAND GRVL 0162 GRVL 0167
NICHOL TOWNSHIP CON 11 003	17 540366 4841922 W	1999-04 2663	6	FR 0166	8/10/30/1:	DO		6712934 (198855)	BRWN CLAY STNS 0025 BRWN CLAY SAND GRVL 0075 BRWN SAND GRVL 0085 BRWN CLAY SAND GRVL 0120 BRWN SAND GRVL 0125 BRWN CLAY SAND GRVL 0160 GRVL 0166
NICHOL TOWNSHIP CON 11 012	17 540333 4841891 W	1999-04 2663	6	FR 0167	11/13/30/1:	DO		6712932 (198854)	BRWN CLAY STNS GRVL 0025 BRWN CLAY GRVL 0095 BRWN CLAY SAND GRVL 0165 GRVL 0167
NICHOL TOWNSHIP CON 11 019	17 540337 4842132 W	2002-05 2663	6	FR 0163	11/11/25/1:0	DO		6714058 (235155)	BRWN CLAY STNS GRVL 0102 BRWN CLAY HARD 0143 BRWN CLAY HARD 0160 GRVL 0163
NORTH DUMFRIES TOWNS 12 003	17 539792 4842186 W	2006-11 7146						7044591 (Z58071)	
PEEL TOWNSHIP	17 539687 4842189 W	2013-09 7146	6.11	0180	20/23/10/1:0	DO		7210467 (Z170184) A146919	
PEEL TOWNSHIP	17 539736 4841932 W	2015-08 7557			21/35/10/1:	DO		7248261 (Z218781) A193144	
PEEL TOWNSHIP	17 539768 4842165 W	2012-08 7146	6.11	FR 0205	20/30/20/1:0	PS		7195401 (Z140617) A136885	BRWN LOAM 0001 BRWN CLAY SAND 0060 BRWN CLAY STNS 0170 BRWN CLAY GRVL 0190 BRWN GRVL SAND 0205
PEEL TOWNSHIP	17 540063 4841984 W	2009-10 7238	1.78			MO	0005 10	7133280 (Z104442) A091557	BRWN SILT CLAY SAND 0008 BRWN TILL 0015
PEEL TOWNSHIP 006	17 539811 4841972 W	2001-07 2663	6	FR 0184	21/25/30/1:	DO		6713731 (225435)	BRWN CLAY 0080 BRWN CLAY GRVL 0085 BRWN CLAY 0120 BRWN GRVL CLAY 0126 BRWN CLAY 0131 GRVL 0144 BRWN CLAY 0178 GRVL 0184
PEEL TOWNSHIP 008	17 540145 4842210 W	2002-10 2663				NU		6714295 (247511) A	
PEEL TOWNSHIP 061	17 539873 4842064 W	2002-10 2663				NU		6714297 (247505) A	
PEEL TOWNSHIP 061	17 539887 4842059 W	2002-10 2663	6	FR 0160	/1/25/1:0	DO		6714296 (247504)	BRWN CLAY STNS GRVL 0155 BRWN SAND CLAY 0160 GRVL 0166

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
PEEL TOWNSHIP CON 11 001	17 540206 4842030 W	2002-08 2663	6 5	FR 0165	7/20/25/1:0	DO		6714210 (247563)	BRWN CLAY STNS BLDR 0113 BLDR 0115 BRWN CLAY STNS BLDR 0162 GRVL 0165
PEEL TOWNSHIP CON 13 021	17 539642 4842077 W	2002-05 6865	6	UK 0188	20/21/10/1:0	DO		6714086 (242335)	BRWN CLAY 0013 GREY CLAY 0032 GREY GRVL CLAY 0049 GREY CLAY STNS ROCK 0083 GREY CLAY HARD 0152 GREY CLAY GRVL 0186 BRWN GRVL SAND 0188
PEEL TOWNSHIP CON 13 021	17 539603 4841533 W	1974-09 1804	5	FR 0218	10/10/40/2:0	ST		6705312 ()	BLCK LOAM 0003 RED CLAY GRVL STNS 0214 GRVL 0218
PEEL TOWNSHIP CON 13 021	17 539964 4841973 W	1970-06 2519	30	FR 0022	14/25//:	DO		6703691 ()	BRWN CLAY 0009 GREY CLAY STNS 0022 GREY MSND GRVL 0025
PEEL TOWNSHIP CON 13 021	17 539626 4842029 W	1991-08 1660	6	FR 0232	27/35/10/2:0	DO		6710990 (43769)	BRWN CLAY 0004 BRWN CLAY SAND 0039 GREY CLAY FGVL 0098 GREY CLAY BLDR 0101 GREY CLAY SILT 0147 GREY CLAY 0189 GREY SAND MGVL 0226 GREY CGVL 0232
PEEL TOWNSHIP CON 13 022	17 539841 4841850 W	2017-09 6231						7298013 (Z250077) A	
PEEL TOWNSHIP CON 13 022	17 539914 4841843 W	1969-11 1657	5 5	FR 0185	5/25/20/1:0	DO		6703564 ()	BRWN CLAY 0005 BRWN MSND GRVL 0070 GREY CLAY BLDR 0185 GRVL 0193
PEEL TOWNSHIP CON 13 022	17 539756 4841976 W	1989-06 4643	6	FR 0210	15/60//1:0	DO		6709950 (15746)	BRWN FILL 0004 YLLW CLAY 0171 BLUE CLAY STNS 0209 BRWN GRVL 0214
PEEL TOWNSHIP CON 13 022	17 539715 4842006 W	1989-09 2665	5	FR 0192	20/20/15/72:0	DO		6709918 (69751)	BRWN CLAY STNS 0097 GRVL SAND 0101 BRWN CLAY STNS 0187 CGVL 0192
PEEL TOWNSHIP CON 13 022	17 539779 4841783 W	1966-05 1906	5	FR 0090	8/50/10/3:0	DO		6702085 ()	LOAM 0001 CLAY STNS 0028 STNS 0032 CLAY GRVL 0088 GRVL 0090
PEEL TOWNSHIP CON 13 022	17 539711 4841971 W	1988-11 1906	5	FR 0215	24/45/20/2:0	DO		6709471 (19524)	BRWN CLAY STNS 0210 CGVL 0215
PEEL TOWNSHIP CON 13 022	17 539743 4842144 W	2000-05 6865	6	UK 0168	50/75/8/1:	DO		6713386 (211312)	LOAM 0002 BRWN CLAY SNDY GRVL 0013 GREY CLAY GRVL 0101 GREY CLAY STNS 0114 GREY HPAN CLAY 0140 BRWN SAND CLAY 0158 BRWN GRVL SAND 0168
PEEL TOWNSHIP CON 13 022	17 539889 4841869 W	2002-09 6865	6	UK 0193	22/22/12/1:0	DO		6714226 (242365)	BRWN CLAY SNDY 0013 GREY CLAY STNS 0080 GREY CLAY GRVL 0093 GREY CLAY HARD 0119 GREY CLAY STNS 0132 GREY CLAY HARD 0166 GREY CLAY GRVL 0189 BRWN GRVL SAND 0193
PEEL TOWNSHIP CON 13 022	17 539853 4841839 W	1987-11 4854	30	FR 0012 FR 0019	10///:	DO		6709097 (24404)	BRWN CLAY 0014 GREY CLAY 0024 GREY CLAY BLDR 0035
PEEL TOWNSHIP CON 13 022	17 539602 4841605 W	1990-10 4552	6	FR 0212	20/80/30/1:20	IN		6710447 (61228)	BRWN FILL SOFT 0006 BRWN CLAY STNS SOFT 0080 GREY CLAY SOFT 0105 GREY GRVL SOFT 0112 GREY CLAY STNS HARD 0190 GREY CLAY GRVL PCKD 0200 GREY CLAY DNSE 0208 BRWN GRVL PCKD 0212
PEEL TOWNSHIP CON 13 022	17 539613 4841596 W	1990-09 4552	6	FR 0230	20/80/30/1:30	IN		6710446 (61227)	BRWN FILL SOFT 0007 BRWN CLAY PCKD 0020 BRWN CLAY DNSE 0030 BRWN CLAY HARD 0080 GREY CLAY DNSE 0105 GREY GRVL SOFT 0112 GREY CLAY DNSE 0220 BRWN GRVL PCKD 0230

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
PEEL TOWNSHIP CON 13 022	17 540042 4841990 W	1990-06 2663	6	FR 0085	15//5/1:0	DO		6710424 (83518)	LOAM 0002 CLAY 0025 CLAY GRVL 0045 SAND CGVL 0075 SAND 0085
PEEL TOWNSHIP CON 13 022	17 539914 4841823 W	1980-07 4716	5	FR 0179	17/18/8/10:0	DO		6707296 ()	BLCK LOAM 0002 BRWN CLAY STNS 0018 GREY CLAY STNS 0032 GREY CLAY GRVL STNS 0078 BRWN CLAY SILT GRVL 0100 BRWN CLAY SAND GRVL 0148 GREY SAND SILT 0154 BRWN CLAY 0179 GREY GRVL CSND 0181
PEEL TOWNSHIP CON 14 021	17 539632 4842067 W	1996-01 2663	6	FR 0190 FR 0202	25//15/1:0	DO		6711918 (169058)	BRWN CLAY 0040 SAND 0050 CLAY SLTY GRVL 0100 GRVL CLAY 0140 HPAN CLAY GRVL 0170 CLAY SLTY GRVL 0202
PEEL TOWNSHIP CON 14 021	17 539577 4842107 W	1991-08 2663	6	FR 0190 FR 0200	32//15/1:0	DO		6710718 (109364)	BRWN CLAY 0040 SAND 0050 CLAY SLTY GRVL 0100 CLAY GRVL 0140 CLAY GRVL HPAN 0170 CLAY GRVL SLTY 0200
PEEL TOWNSHIP CON 14 021	17 539659 4842049 W	1990-06 2663	6 6	FR 0190 FR 0195	50//20/1:0	DO		6710425 (83519)	CLAY 0015 CLAY GRVL 0040 SAND GRVL 0060 CLAY GRVL 0100 CLAY HPAN 0140 CLAY GRVL 0146 CLAY HPAN 0190 GRVL 0195
PEEL TOWNSHIP CON 14 021	17 539577 4842107 W	1991-07 2663	6	FR 0190 FR 0200	32//15/1:0	DO		6710696 (83487)	BRWN CLAY 0040 SAND 0050 CLAY SLTY GRVL 0100 CLAY GRVL 0140 CLAY GRVL HPAN 0170 CLAY GRVL SLTY 0200
PEEL TOWNSHIP CON 14 021	17 539572 4842114 W	1990-07 2663	6 6	FR 0190 FR 0200	25//15/1:0	DO		6710426 (83516)	BRWN CLAY 0040 SAND 0050 CLAY SLTY GRVL 0100 GRVL CLAY 0140 HPAN CLAY GRVL 0170 CLAY SLTY GRVL 0200
PEEL TOWNSHIP CON 14 022	17 539827 4841977 W	1988-11 3518	6	FR 0219	18/50/20/1:0	DO		6709663 (55180)	BRWN FILL STNS 0002 GREY CLAY STNS BLDR 0208 BRWN GRVL SAND LOOS 0219
PEEL TOWNSHIP CON 14 022	17 539881 4841994 W	1989-07 4854	30	FR 0022 FR 0038	18///:	DO		6709909 (39128)	BRWN CLAY 0004 GREY CLAY 0021 GREY CLAY BLDR 0023 BLUE CLAY 0038 GREY SAND 0039 GREY CLAY 0042
PEEL TOWNSHIP CON 14 022	17 540005 4841950 W	2013-02 7221						7198194 (Z159296) A	
PEEL TOWNSHIP CON 14 022	17 540032 4841988 W	1995-05 6865	6 6	FR 0201	10//15/1:0	DO		6711790 (146657)	BRWN LOAM 0001 BRWN CLAY SNDY 0007 GREY CLAY STNS 0020 GREY GRVL 0023 BRWN CLAY GRVL 0029 GREY CLAY GRVL 0075 GREY GRVL CLAY 0133 BRWN HPAN 0161 GREY GRVL CLAY 0197 GREY FGVL MSND 0201
PEEL TOWNSHIP CON 14 022	17 540052 4842019 W	1995-05 6865	6 6	FR 0201	3/3/15/1:0	DO		6711789 (146655)	BRWN LOAM 0003 BRWN FILL WDFR LOOS 0007 BRWN CLAY GRVL 0012 GREY GRVL CLAY 0021 GREY CLAY 0033 GREY GRVL CLAY STNS 0130 BRWN HPAN 0166 GREY GRVL CLAY 0199 GREY CGVL 0204
PEEL TOWNSHIP CON 14 022	17 539874 4842201 W	1994-09 2336	6	FR 0180	13/20/30/1:0	DO		6711541 (139394)	BRWN CLAY GRVL 0015 GREY CLAY STNS 0070 GREY CLAY GRVL 0140 GREY HPAN 0180
PEEL TOWNSHIP CON 14 022	17 539905 4841959 W	1992-09 2576	6	FR 0191	7//200/1:0	DO		6710986 (114454)	PRDR 0167 BRWN GRVL CLAY 0170 BRWN CLAY STNS GRVL 0191 GRVL 0201
PEEL TOWNSHIP CON 14 022	17 539922 4842064 W	1987-08 4643	5	FR 0200	/50/30/1:0	DO		6708913 (01294)	RED CLAY BLDR 0198 BRWN GRVL 0203
PEEL TOWNSHIP CON 14 022	17 539774 4841917 W	1989-04 4643	6	FR 0215	27/60/40/2:15	DO		6709952 (15748)	BRWN CLAY 0040 YLLW CLAY 0186 BLUE CLAY 0213 BRWN GRVL 0218
PEEL TOWNSHIP CON 14 022	17 539814 4842123 W	1976-07 2519	30	FR 0027	20///:	DO		6706187 ()	BLCK LOAM 0001 GREY CLAY 0027 BRWN GRVL BLDR 0028

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
PEEL TOWNSHIP CON 14 022	17 539805 4842059 W	2018-08 7557			15/40/15/1:0	DO		7325734 (Z284215) A256238	
PEEL TOWNSHIP CON 14 022	17 539835 4841896 W	1990-09 1737	6	FR 0229	30/55/10/2:0	DO	0234 3	6710477 (85493)	BRWN FILL SOFT 0014 BRWN CLAY STNS GRVL 0085 GREY CLAY STNS HARD 0135 GREY CLAY HARD 0229 GREY GRVL SOFT 0237
PEEL TOWNSHIP CON 14 022	17 539885 4841945 W	1988-11 3518	6	FR 0190	15/56/20/1:0	DO		6709664 (55158)	RED CLAY SOFT 0004 BRWN SAND CLAY STNS 0021 GREY CLAY STNS BLDR 0176 BRWN GRVL LOOS 0201
PEEL TOWNSHIP CON 14 022	17 540046 4842116 W	2010-06 7154	6.25	FR 0185	10/31/10/2:0	DO		7150215 (Z107344) A084724	BRWN CLAY STNS 0067 GREY CLAY 0174 GREY GRVL HARD 0185
PEEL TOWNSHIP CON 14 022	17 539823 4842193 W	2009-05 7146	6.25		22/50/40/1:0	DO		7123133 (Z93328) A078583	
PEEL TOWNSHIP CON 14 022	17 539814 4842193 W	1968-07 3518	5	FR 0196	14/20/20/5:0	DO		6703296 ()	LOAM 0002 CLAY BLDR 0024 CLAY HPAN 0160 HPAN 0165 CLAY HPAN 0196 GRVL 0197
PEEL TOWNSHIP CON 14 022	17 539875 4842085 W	1967-07 2519	30	FR 0015		DO		6702101 ()	BRWN CLAY 0012 BLUE CLAY MSND 0022 CLAY STNS 0025 HPAN 0030
PEEL TOWNSHIP CON 14 022	17 539950 4842096 W	2004-09 2663	6.25	FR 0179	39/43/30/1:0	DO		6715179 (Z17934) A007203	BLCK LOAM 0002 BRWN CLAY GRVL 0175 GRVL 0180
PEEL TOWNSHIP CON 14 022	17 540110 4842084 W	2004-08 6865	6.30	0166	8/10/7/1:0	DO		6715077 (Z05738) A005678	BRWN CLAY STNS 0018 GREY CLAY STNS 0089 GREY CLAY 0094 GREY CLAY GRVL 0105 GREY CLAY STNS STNS 0148 BRWN GRVL SAND SILT 0159 BRWN SAND GRVL 0165 BRWN GRVL SAND 0166
PEEL TOWNSHIP CON 14 022	17 540201 4842210 W	1964-12 2519	30	FR 0007 FR 0026	7/29//:	DO		6702100 ()	LOAM 0002 BRWN CLAY 0008 BRWN MSND 0009 BRWN CLAY 0026 MSND STNS 0030
PEEL TOWNSHIP CON 14 022	17 539938 4842063 W	2002-09 6865	6	UK 0182	8/12/12/1:0	DO		6714227 (242367)	LOAM 0001 BRWN CLAY 0010 GREY CLAY STNS 0081 GREY CLAY STNS HARD 0139 GREY CLAY STNS 0173 GREY CLAY GRVL 0180 BRWN GRVL SAND 0182
PEEL TOWNSHIP CON 14 022	17 539935 4842013 W	1973-08 3518	5	FR 0180	-2/15/15/2:0	DO		6704845 ()	BLCK LOAM 0002 GREY CLAY GRVL 0048 GREY STNS 0050 BRWN SAND GRVL 0060 GREY GRVL 0075 BRWN CLAY GRVL 0175 GREY GRVL 0183
PEEL TOWNSHIP CON 14 022	17 539886 4841961 W	1973-11 2519	30	FR 0023	20/35/0/:	DO		6704870 ()	BRWN CLAY 0012 GREY CLAY 0023 GREY GRVL SAND 0025 GREY CLAY STNS 0035
PEEL TOWNSHIP CON 14 022	17 539814 4842073 W	1979-08 2564	4	FR 0195	20/40/20/4:0	DO		6707125 ()	CLAY SNDY 0005 SILT SAND 0060 GRVL CMTD 0100 CLAY 0195 GRVL 0198
PEEL TOWNSHIP CON 14 022	17 540061 4842120 W	2010-06 7154						7150214 (Z107345) A	
PEEL TOWNSHIP CON 14 022	17 539864 4841924 W	1996-06 2576	6	FR 0190 UK 0196	5//80/1:30	DO		6712016 (157438)	BRWN CLAY GRVL 0009 GREY CLAY SLTY GRVL 0075 BRWN CLAY SLTY GRVL 0190 BRWN GRVL 0196

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
PEEL TOWNSHIP CON 14 022	17 539803 4841995 W	1988-12 3518	6	FR 0201	48/130/20/1:0	DO		6709697 (55159)	GREY CLAY STNS BLDR 0170 BRWN STNS SAND CLAY 0198 BRWN CGVL LOOS 0201
PEEL TOWNSHIP CON 14 022	17 539964 4842123 W	1979-10 4544	5	FR 0180	3//25/1:0	CO		6707219 ()	BLCK LOAM 0001 RED CLAY 0047 BRWN GRVL 0052 RED CLAY 0180 BRWN GRVL 0185
PEEL TOWNSHIP CON 14 022	17 539902 4842068 W	1973-11 2519	30	FR 0017	4/30/0/:	DO		6704872 ()	BRWN CLAY 0010 GREY CLAY 0017 GREY SAND GRVL 0020 GREY CLAY ROCK 0030
PEEL TOWNSHIP CON 14 022	17 539854 4842103 W	1975-02 2519	30	FR 0020	8//5/:	DO		6705447 ()	FILL 0003 LOAM 0004 BRWN CLAY 0012 BRWN CLAY SNDY 0020 SAND GRVL 0026 GREY CLAY STNS 0028
PEEL TOWNSHIP CON 14 022	17 540114 4842083 W	1975-06 2519	30	FR 0020	19//3/:	DO		6705541 ()	BRWN CLAY 0012 GREY CLAY 0020 BRWN SAND 0021 GREY CLAY 0032
PEEL TOWNSHIP CON 14 022	17 540064 4842173 W	1978-08 5469	30	FR 0021	20/30/3/:	DO		6706754 ()	BRWN CLAY 0016 GREY CLAY 0020 GRVL 0021 GREY SAND GRVL 0030
PEEL TOWNSHIP CON 14 022	17 539831 4842110 W	1973-11 2519	30	FR 0015	10/30/0/:	DO		6704871 ()	BRWN CLAY 0010 GREY GRVL 0015 GREY SAND 0017 GREY CLAY STNS 0030
PEEL TOWNSHIP CON 14 022	17 540055 4842074 W	1958-07 3524	6	FR 0164	/164//:	CO DO		6702096 ()	PRDG 0012 CLAY FSND 0032 BLUE CLAY 0068 HPAN 0078 GRVL CLAY 0086 HPAN 0140 GRVL HPAN 0160 0164
PEEL TOWNSHIP CON 14 022	17 539982 4841953 W	2013-02 7221	6.26	UT 0201	10/13/3/1:0	DO		7198193 (Z159297) A118971	BRWN CLAY 0012 GREY CLAY 0043 GREY FSND 0052 GREY CLAY 0109 GREY CLAY 0194 GREY SAND 0204
PEEL TOWNSHIP CON 14 022	17 540151 4842116 W	2000-09 1737	6	FR 0205	25/45/10/3:30	DO	0202 3	6713592 (217912)	LOAM 0001 BRWN CLAY SAND SOFT 0025 GREY CLAY STNS HARD 0097 GREY CLAY HARD 0193 BRWN CGVL 0205
PEEL TOWNSHIP CON 14 022	17 539826 4841937 W	1987-06 5469	5	FR 0182	1//30/2:	DO		6708850 (09408)	BRWN CLAY LOOS 0050 BRWN GRVL CLAY PORS 0054 BLUE CLAY BLDR DNSE 0182
PEEL TOWNSHIP CON 61 012	17 540424 4842136 W	2007-01 2663	6.25	FR 0166	33/39/8/1:0	DO		7040811 (Z41615) A039545	BRWN CLAY STNS 0162 GRVL 0166
PILKINGTON TOWNSHIP	17 540012 4841854 W	2018-11 7556				PS		7323683 (Z291454) A	
PILKINGTON TOWNSHIP	17 540501 4841536 W	2019-02 7221	6 6		///:	CO		7331187 (Z306172) A090010 A	
PILKINGTON TOWNSHIP 01 001	17 539889 4841762 W	2006-08 2644	6.25	FR 0198	23/50/75/1:	DO		6715950 (Z41928) A037661	BRWN CLAY FILL 0004 GREY CLAY STNS 0018 GREY HPAN STNS 0096 GREY GRVL SLTY 0109 GREY HPAN STNS 0198 BRWN CGVL 0201
PILKINGTON TOWNSHIP 01 001	17 539839 4841695 W	2005-09 7154	6.25	FR 0204 FR 0204	22/72/10/2:0	DO	0201 3	6715501 (Z35593) A030082	BRWN CLAY SLTY STNS 0027 GREY CLAY STNS 0118 GREY CLAY 0197 GREY GRVL SAND SOFT 0204
PILKINGTON TOWNSHIP 01 001	17 540016 4841765 W	2005-08 7154	6.25	FR 0184 0187	12/21/12/1:0	DO	0184 3	6715448 (Z32403) A020155	BRWN CLAY SLTY 0011 BRWN CLAY STNS 0052 BRWN CLAY 0074 GREY GRVL 0084 GREY CLAY STNS 0124 GREY CLAY 0177 GREY GRVL SAND SOFT 0187

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
PILKINGTON TOWNSHIP 01 001	17 539863 4841739 W	2007-06 6865	6.30	0198	24/25/13/1:	DO		7047188 (Z56280) A034702	BRWN CLAY 0016 GREY CLAY STNS 0089 GREY CLAY SAND SILT 0118 BRWN CLAY STNS HARD 0159 GREY CLAY STNS STNS 0183 BRWN SAND GRVL CLAY 0195 BRWN GRVL SAND 0198
PILKINGTON TOWNSHIP P 099	17 540137 4841873 W	1998-06 2663	6	FR 0080	34/60/30/1:0	DO		6712554 (192804)	LOAM 0001 BRWN CLAY SAND 0040 BRWN CLAY SAND GRVL 0065 BRWN SAND GRVL 0075 GRVL 0080
PILKINGTON TOWNSHIP P 131	17 540202 4841890 W	1998-06 2663	6	FR 0161	6/6/30/1:0	DO		6712553 (192805)	LOAM 0001 BRWN CLAY SAND STNS 0020 BRWN CLAY GRVL 0040 GRVL 0045 BRWN CLAY SAND GRVL 0080 BRWN SAND GRVL 0104 BRWN CLAY GRVL HARD 0157 GRVL 0161
PILKINGTON TOWNSHIP P 132	17 540091 4841973 W	1998-06 2663	6	FR 0160	7/78/30/1:0	DO		6712555 (192803)	LOAM 0002 BRWN CLAY STNS 0030 BRWN CLAY SAND GRVL 0045 BRWN SAND GRVL 0055 BRWN CLAY GRVL HPAN 0158 GRVL CGRD 0160
PILKINGTON TOWNSHIP GR W 01 001	17 540068 4841960 W	1996-08 6865	6	FR 0194	0/6/15/1:0	DO		6712097 (169678)	LOAM 0002 BRWN CLAY 0009 GREY CLAY GRVL STNS 0095 BRWN HPAN 0156 GREY CLAY GRVL 0186 GRVL 0194
PILKINGTON TOWNSHIP GR W 01 001	17 540002 4841909 W	1999-10 6865	6	FR 0171	6/9/10/1:0	DO		6713137 (203999)	LOAM 0002 BRWN CLAY 0017 BRWN GRVL SAND 0021 GREY CLAY STNS 0083 GREY HPAN 0115 GREY CLAY STNS 0167 BRWN GRVL SAND 0171
PILKINGTON TOWNSHIP GR W 01 001	17 540330 4841769 W	2002-03 6865	6	UK 0158	-4/2/6/:	DO		6714068 (225340)	BRWN CLAY SAND GRVL 0010 GREY CLAY STNS 0089 GREY CLAY HARD 0110 GREY CLAY GRVL 0151 GREY CLAY HARD 0157 BRWN GRVL SAND 0158
PILKINGTON TOWNSHIP GR W 01 001	17 540290 4841711 W	2002-09 6865	6	UK 0156	-4/-2//:	DO		6714320 (242376)	BRWN GRVL CLAY SNDY 0014 GREY CLAY HARD 0026 GREY CLAY STNS 0096 GREY CLAY HARD 0146 GREY CLAY STNS 0155 BRWN SAND GRVL 0156
PILKINGTON TOWNSHIP GR W 01 001	17 540322 4841678 W	2002-09 6865	6	UK 0155	-5/-2/10/1:0	DO		6714321 (242375)	BRWN CLAY GRVL SNDY 0013 GREY CLAY HARD 0028 GREY CLAY STNS STNS 0083 GREY CLAY GRVL 0110 GREY CLAY STNS 0149 GREY CLAY HARD 0153 BRWN GRVL SAND 0155
PILKINGTON TOWNSHIP GR W 01 001	17 540211 4841771 W	1998-06 2663	6	FR 0159	/2/30/1:0	DO		6712605 (192829)	LOAM 0001 BRWN CLAY 0010 BRWN SAND GRVL 0025 BRWN CLAY SAND GRVL 0080 BRWN BLDR LTCL 0082 BRWN SAND GRVL 0095 BRWN CLAY SAND GRVL 0120 BRWN CLAY GRVL 0130 GRVL 0154 UNKN 0159
PILKINGTON TOWNSHIP GR W 01 001	17 540123 4841887 W	2009-07 7221						7129535 (Z102430) A	
PILKINGTON TOWNSHIP GR W 01 001	17 540132 4841962 W	1998-06 2663	6	FR 0160	5/14/30/1:0	DO		6712560 (192811)	LOAM 0001 FILL 0015 BRWN CLAY SAND STNS 0025 BRWN CLAY SAND GRVL 0085 BRWN SAND GRVL 0095 BRWN CLAY GRVL HPAN 0157 GRVL 0160
PILKINGTON TOWNSHIP GR W 01 001	17 540063 4841984 W	2009-10 7238	1.76			MO	0005 10	7133279 (Z104444) A090730	BRWN CLAY SILT SAND 0008 BRWN TILL 0015
PILKINGTON TOWNSHIP GR W 01 001	17 540083 4841996 W	2009-10 7238	1.76			MO	0005 10	7133281 (Z104443) A091556	BRWN SILT CLAY SAND 0008 BRWN TILL 0015

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
PILKINGTON TOWNSHIP GR W 01 001	17 539922 4841816 W	2010-07 7221	6.26	UT 0189	23/25/12/1:0	DO		7161965 (Z118761) A090016	BRWN CLAY HARD 0010 GREY CLAY STNS 0100 GREY CLAY HARD 0172 GREY CLAY STNS 0184 BRWN GRVL SAND 0189
PILKINGTON TOWNSHIP GR W 01 001	17 540094 4841959 W	2014-05 7154						7221972 (Z181427) A	
PILKINGTON TOWNSHIP GR W 01 001	17 540231 4841698 W	2016-03 7556				DO		7262913 (Z226395) A199518	
PILKINGTON TOWNSHIP GR W 01 001	17 540045 4841816 W	2009-07 7146						7127595 (Z099228) A	
PILKINGTON TOWNSHIP GR W 01 001	17 540135 4841956 W	1998-06 2663	6	FR 0163	6/12/30/1:0	DO		6712558 (192810)	LOAM 0001 BRWN CLAY SAND STNS 0025 BRWN CLAY SAND GRVL 0090 BRWN CLAY GRVL HARD 0158 GRVL 0163
PILKINGTON TOWNSHIP GR W 01 001	17 540073 4841930 W	1996-04 2336	2		4///:	CO	0016 5	6711946 (168004)	BRWN GRVL FILL 0002 GREY CLAY 0017 BRWN SAND 0018 GREY CLAY 0021
PILKINGTON TOWNSHIP GR W 01 001	17 540066 4841951 W	1996-04 2336	2		5///:	CO	0016 5	6711947 (168005)	BRWN GRVL FILL 0001 GREY CLAY 0017 GREY SAND 0018 GREY CLAY 0021
PILKINGTON TOWNSHIP GR W 01 001	17 540044 4841932 W	1996-04 2336	2		4///:	CO	0016 5	6711948 (168006)	BRWN GRVL FILL 0001 GREY CLAY 0017 GREY SAND 0018 GREY CLAY 0021
PILKINGTON TOWNSHIP GR W 01 001	17 540037 4841940 W	1996-04 2336	2		4///:	CO	0016 5	6711949 (168007)	GRVL 0001 GREY CLAY 0017 GREY SAND 0018 GREY CLAY 0021
PILKINGTON TOWNSHIP GR W 01 001	17 540066 4841965 W	1996-04 2336	2		4///:	CO	0016 5	6711950 (168008)	GRVL 0001 GREY CLAY 0017 GREY SAND 0018 GREY CLAY 0021
PILKINGTON TOWNSHIP GR W 01 001	17 540206 4841876 W	1998-07 2663	6	FR 0161	0/2/30/1:0	DO		6712606 (192828)	LOAM 0001 BRWN CLAY STNS 0035 BRWN CLAY SAND GRVL 0080 BRWN SAND GRVL 0090 BRWN CLAY GRVL 0157 GRVL 0161
PILKINGTON TOWNSHIP GR W 01 001	17 540144 4841849 W	1998-06 2663	6	FR 0160	/6/30/1:0	DO		6712557 (192812)	LOAM 0001 BRWN CLAY SAND STNS 0040 BRWN CLAY SAND GRVL 0065 BRWN SAND GRVL 0070 BRWN CLAY SAND GRVL 0090 BRWN SAND GRVL 0100 BRWN CLAY GRVL HARD 0155 GRVL 0160
PILKINGTON TOWNSHIP GR W 01 001	17 540159 4841750 W	1992-09 6624	5	FR 0100	17/40/12/4:0	DO		6710987 (093827)	BRWN LOAM 0001 BRWN CLAY GRVL SAND 0019 BRWN CLAY HPAN GRVL 0022 BRWN CLAY FGVL 0062 GREY CLAY GRVL STNS 0095 GRVL SAND 0102
PILKINGTON TOWNSHIP GR W 01 001	17 540314 4841623 W	1977-12 5469	30	FR 0013	12//4/1:0	DO		6706635 ()	BLCK LOAM 0003 BRWN CLAY 0011 GREY CLAY 0013 SAND GRVL 0014 GREY CLAY 0026 GRVL SAND 0027
PILKINGTON TOWNSHIP GR W 01 001	17 540173 4841834 W	1998-06 2663	6	FR 0164	/1/30/1:0	DO		6712559 (192813)	LOAM 0001 BRWN CLAY SAND STNS 0035 BRWN CLAY SAND GRVL 0075 BRWN SAND GRVL 0090 BRWN CLAY GRVL 0155 GRVL 0164
PILKINGTON TOWNSHIP GR W 01 001	17 540134 4841903 W	1976-08 2519	30	FR 0028	20///:	DO		6706179 ()	BRWN LOAM 0001 BRWN CLAY 0008 GREY CLAY 0028 BRWN GRVL 0028
PILKINGTON TOWNSHIP GR W 01 002	17 540364 4841673 W	1976-03 2519	30	FR 0020	9//4/1:0	DO		6705957 ()	BRWN FILL 0004 BRWN CLAY 0009 BRWN SAND GRVL 0021 GREY CLAY 0030

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
PILKINGTON TOWNSHIP GR W 01 002	17 540169 4841223 L	1998-06 2663	6 5	FR 0155	45/45/30/1:0	DO		6712556 (192802)	LOAM 0002 BRWN CLAY STNS 0020 BRWN SAND GRVL 0030 GREY CLAY GRVL 0085 BRWN CLAY SAND GRVL 0100 BRWN CLAY GRVL HPAN 0140 BRWN CLAY BLDR HPAN 0153 GRVL CGRD 0155
PILKINGTON TOWNSHIP GR W 07 001	17 540240 4841847 W	1998-06 2663	6	FR 0161	6/2/30/1:0	DO		6712607 (192827)	LOAM 0001 BRWN CLAY STNS 0020 BRWN SAND GRVL 0025 BRWN CLAY GRVL 0130 BRWN CLAY SAND GRVL 0140 BRWN CLAY GRVL 0157 GRVL CGRD 0161
PUSLINCH TOWNSHIP CON 12 028	17 539871 4842178 W	2001-01 2663	6	FR 0205	30/30/25/1:	DO		6713608 (225372)	BRWN CLAY 0075 BRWN CLAY SAND STNS 0100 BRWN CLAY HPAN 0203 CGVL 0205

Notes:
UTM: UTM in Zone, Easting, Northing and Datum is NAD83; L: UTM estimated from Centroid of Lot; W: UTM not from Lot Centroid
DATE CNTR: Date Work Completedand Well Contractor Licence Number
CASING DIA: .Casing diameter in inches
WATER: Unit of Depth in Fee. See Table 4 for Meaning of Code
PUMP TEST: Static Water Level in Feet / Water Level After Pumping in Feet / Pump Test Rate in GPM / Pump Test Duration in Hour : Minutes
WELL USE: See Table 3 for Meaning of Code
SCREEN: Screen Depth and Length in feet
WELL: WEL (AUDIT #) Well Tag . A: Abandonment; P: Partial Data Entry Only
FORMATION: See Table 1 and 2 for Meaning of Code

1. Core Material and Descriptive terms

Code	Description	Code	Description	Code	Description	Code	Description	Code	Description
BLDR	BOULDERS	FCRD	FRACTURED	IRFM	IRON FORMATION	PORS	POROUS	SOFT	SOFT
BSLT	BASALT	FGRD	FINE-GRAINED	LIMY	LIMY	PRDG	PREVIOUSLY DUG	SPST	SOAPSTONE
CGRD	COARSE-GRAINED	FGVL	FINE GRAVEL	LMSN	LIMESTONE	PRDR	PREV. DRILLED	STKY	STICKY
CGVL	COARSE GRAVEL	FILL	FILL	LOAM	TOPSOIL	QRTZ	QUARTZITE	STNS	STONES
CHRT	CHERT	FLDS	FELDSPAR	LOOS	LOOSE	QSND	QUICKSAND	STNY	STONEY
CLAY	CLAY	FLNT	FLINT	LTCL	LIGHT-COLOURED	QTZ	QUARTZ	THIK	THICK
CLN	CLEAN	FOSS	FOSILIFEROUS	LYRD	LAYERED	ROCK	ROCK	THIN	THIN
CLYY	CLAYEY	FSND	FINE SAND	MARL	MARL	SAND	SAND	TILL	TILL
CMTD	CEMENTED	GNIS	GNEISS	MGRD	MEDIUM-GRAINED	SHLE	SHALE	UNKN	UNKNOWN TYPE
CONG	CONGLOMERATE	GRNT	GRANITE	MGVL	MEDIUM GRAVEL	SHLY	SHALY	VERY	VERY
CRYS	CRYSTALLINE	GRSN	GREENSTONE	MRBL	MARBLE	SHRP	SHARP	WBRG	WATER-BEARING
CSND	COARSE SAND	GRVL	GRAVEL	MSND	MEDIUM SAND	SHST	SCHIST	WDFR	WOOD FRAGMENTS
DKCL	DARK-COLOURED	GRWK	GREYWACKE	MUCK	MUCK	SILT	SILT	WTHD	WEATHERED
DLMT	DOLOMITE	GVLY	GRAVELLY	OBDN	OVERBURDEN	SLTE	SLATE		
DNSE	DENSE	GYPS	GYPSUM	PCKD	PACKED	SLTY	SILTY		
DRTY	DIRTY	HARD	HARD	PEAT	PEAT	SNDS	SANDSTONE		
DRY	DRY	HPAN	HARDPAN	PGVL	PEA GRAVEL	SNDY	SANDYOAPSTONE		

2. Core Color

Code	Description
WHIT	WHITE
GREY	GREY
BLUE	BLUE
GREN	GREEN
YLLW	YELLOW
BRWN	BROWN
RED	RED
BLCK	BLACK
BLGY	BLUE-GREY

3. Well Use

Code	Description	Code	Description
DO	Domestic	OT	Other
ST	Livestock	TH	Test Hole
IR	Irrigation	DE	Dewatering
IN	Industrial	MO	Monitoring
CO	Commercial	MT	Monitoring TestHole
MN	Municipal		
PS	Public		
AC	Cooling And A/C		
NU	Not Used		

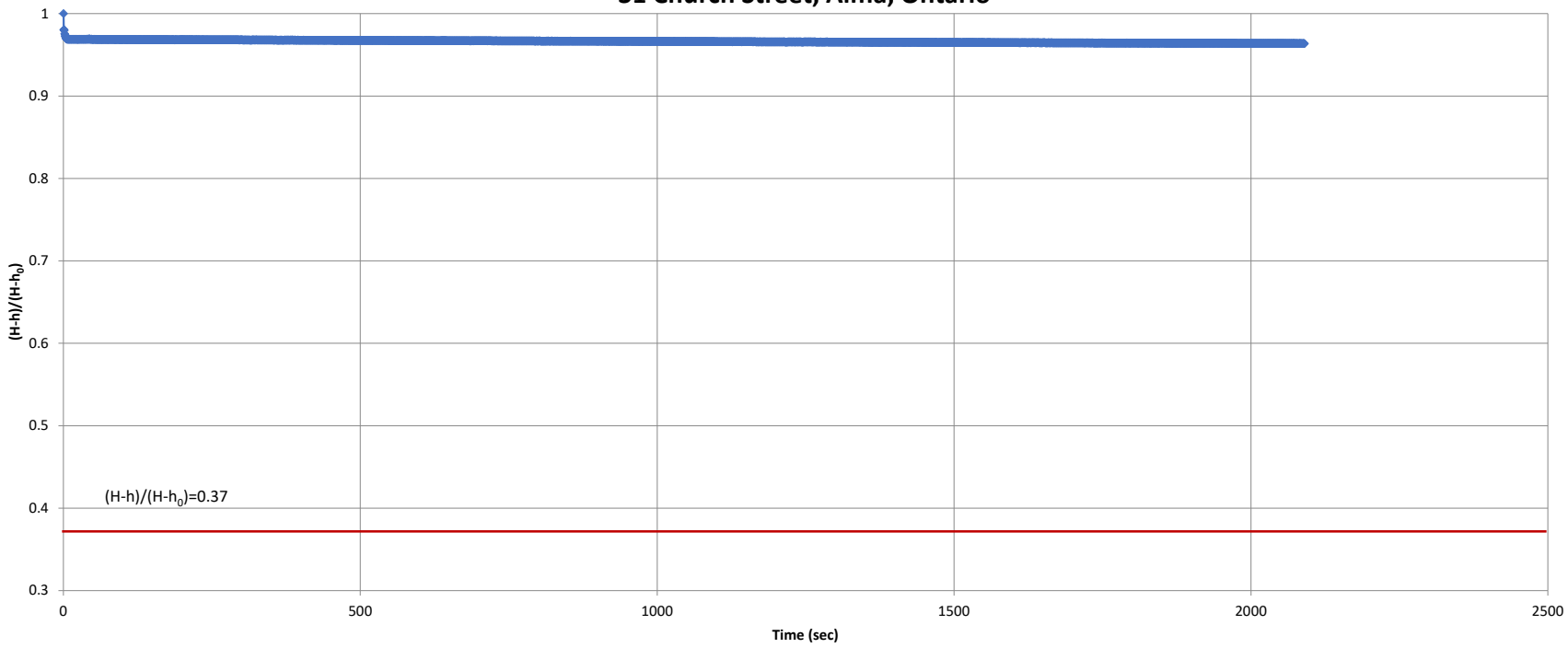
4. Water Detail

Code	Description	Code	Description
FR	Fresh	GS	Gas
SA	Salty	IR	Iron
SU	Sulphur		
MN	Mineral		
UK	Unknown		

APPENDIX E: SLUG TEST ANALYSIS GRAPHS

Figure 1-3: BH 01-20 to BH 03-20

Figure 1
BH01-20 Slug Test Analysis
31 Church Street, Alma, Ontario



Hvorslev Method for Slug Test Analysis

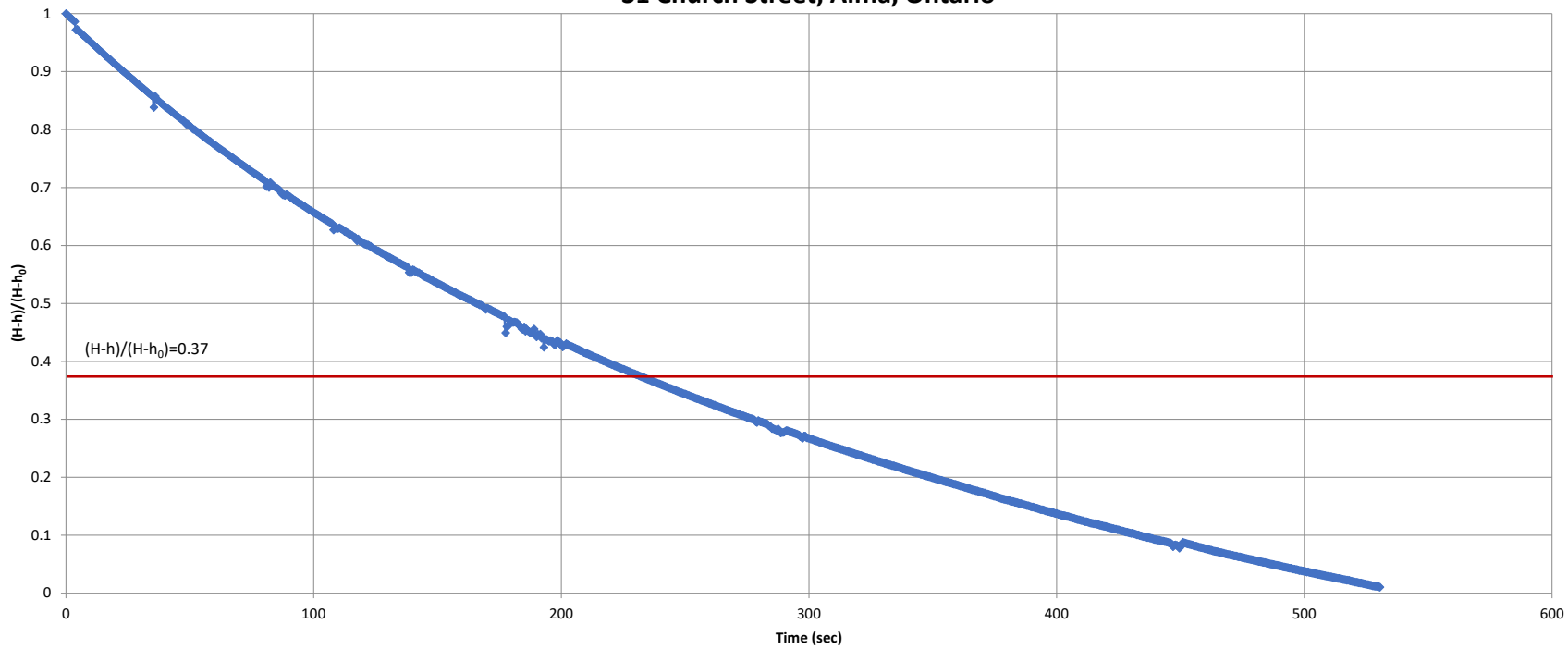
stickup=	1.01	m	casing stickup from ground surface
SWL=	8.41	m	Static Water Level (mBTOP)
r =	0.038	m	casing radius
L =	1.524	m	screen length
R =	0.10	m	borehole radius
$H-h_o$ =	9.80	m	Water level change at T=0
$T_{0.37}$ =	n/a	sec	T at $(H-h)/(H-h_0)=0.37$

$$k = \frac{r^2 \ln(L/R)}{2LT_{0.37}}$$

k= <1 x 10^{-8} m/sec

12/14/2020

Figure 2
BH02-20 Slug Test Analysis
31 Church Street, Alma, Ontario



Hvorslev Method for Slug Test Analysis

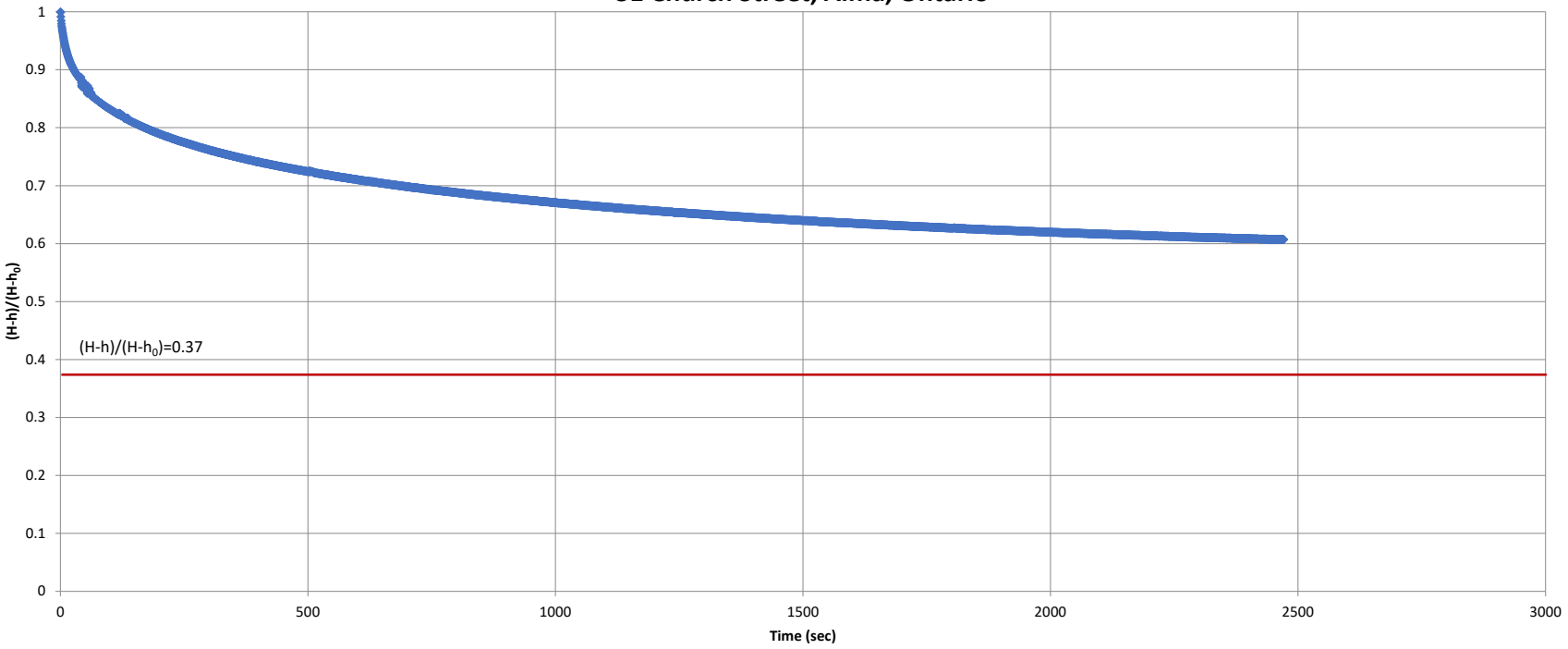
stickup=	0.97	m	casing stickup from ground surface
SWL=	1.03	m	Static Water Level (mBTOP)
r =	0.038	m	casing radius
L =	1.52	m	screen length
R =	0.15	m	borehole radius
$H-h_o$ =	-3.00	m	Water level change at T=0
$T_{0.37}$ =	232	sec	T at $(H-h)/(H-h_0)=0.37$

$$k = \frac{r^2 \ln(L/R)}{2LT_{0.37}}$$

k= 4.7E-06 m/sec

12/14/2020

Figure 3
BH03-20 Slug Test Analysis
31 Church Street, Alma, Ontario



Hvorslev Method for Slug Test Analysis

stickup=	0.98	m	casing stickup from ground surface
SWL=	5.31	m	Static Water Level (mBTOP)
r =	0.038	m	casing radius
L =	1.52	m	screen length
R =	0.15	m	borehole radius
$H-h_o$ =	5.19	m	Water level change at T=0
$T_{0.37}$ =	n/a	sec	T at $(H-h)/(H-h_0)=0.37$

$$k = \frac{r^2 \ln(L/R)}{2LT_{0.37}}$$

k= <1 x 10^{-8} m/sec

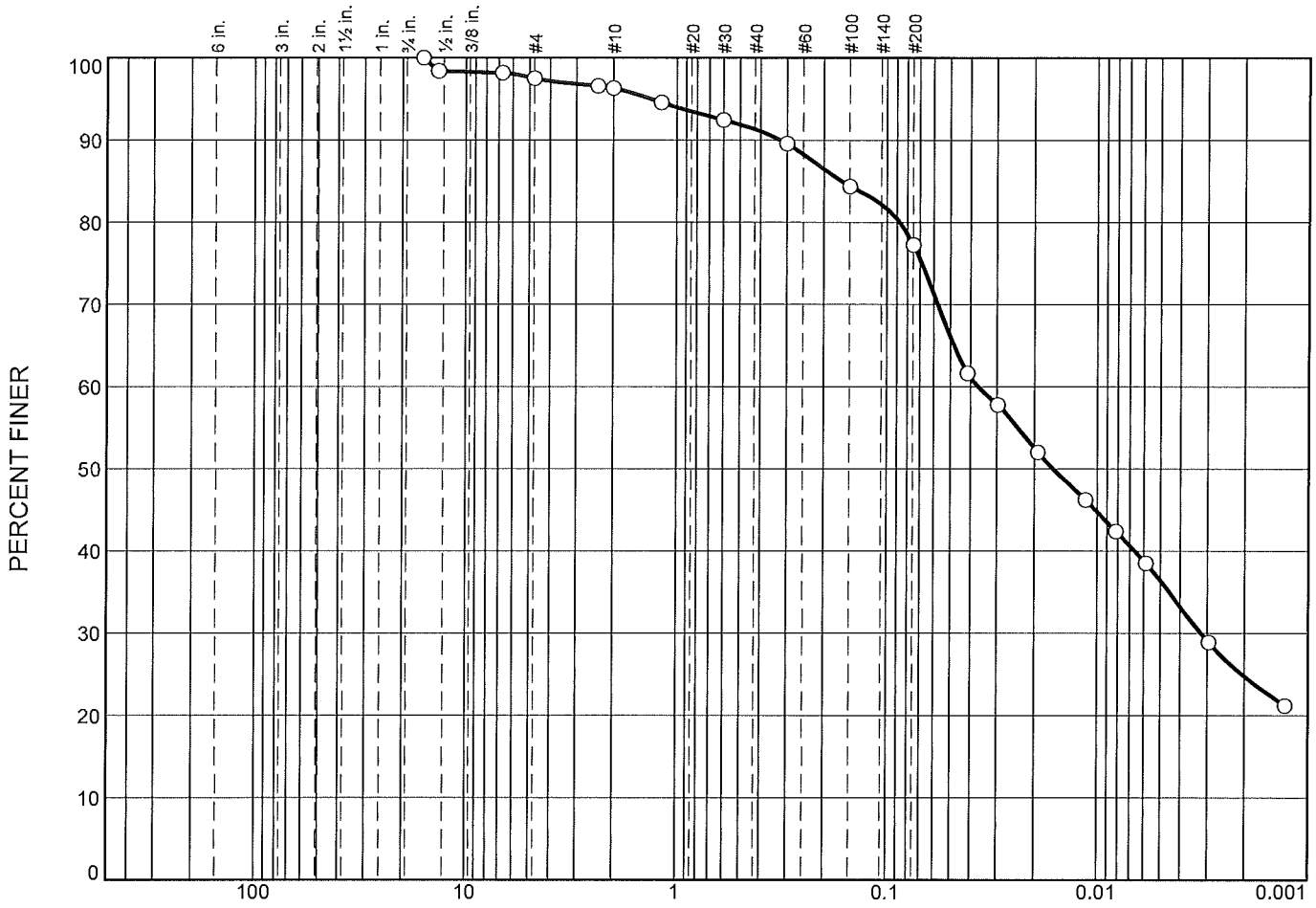
HCS HYDROGEOLOGY CONSULTING SERVICES

12/14/2021

APPENDIX F: GRAIN SIZE ANALYSIS GRAPHS

Figures 1-3

Particle Size Distribution Report



	% Cobbles	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	2.5	1.2	5.0	14.1	52.4	24.8

SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○	BH1	3	1.52-2.13m	clayey, sandy silt, trace gravel	ML
				Estimated Percolation Rate; T = 50 min/cm	
				Sampled by BB of CMT Engineering Inc., December 11, 2020	
				Tested by MS of CMT Engineering Ine., December 15, 2020	

CMT Engineering Inc.

St. Clements, ON

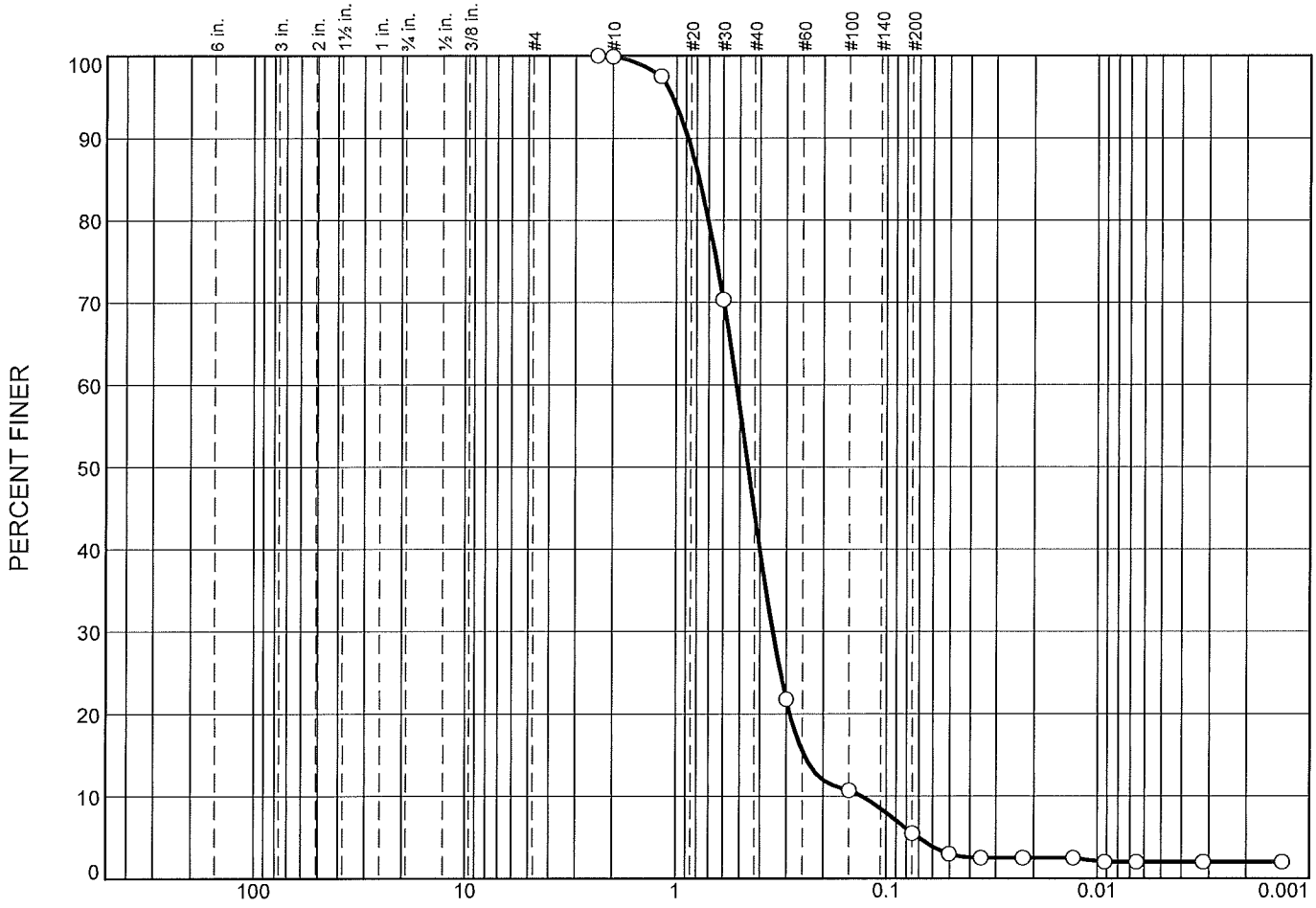
Client: Exact Construction

Project: Proposed Subdivision
31 Church Strcet, Alma, Ontario

Project No.: 20-732

Figure 1

Particle Size Distribution Report



	% Cobbles	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.1	55.4	39.0	3.5	2.0

SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○	BH2	10	7.62-9.14m	sand, trace silt and clay	SP-SM
				Sampled by BB of CMT Engineering Inc., December 11, 2020	
				Tested by MS of CMT Engineering Inc., December 15, 2020	

CMT Engineering Inc.

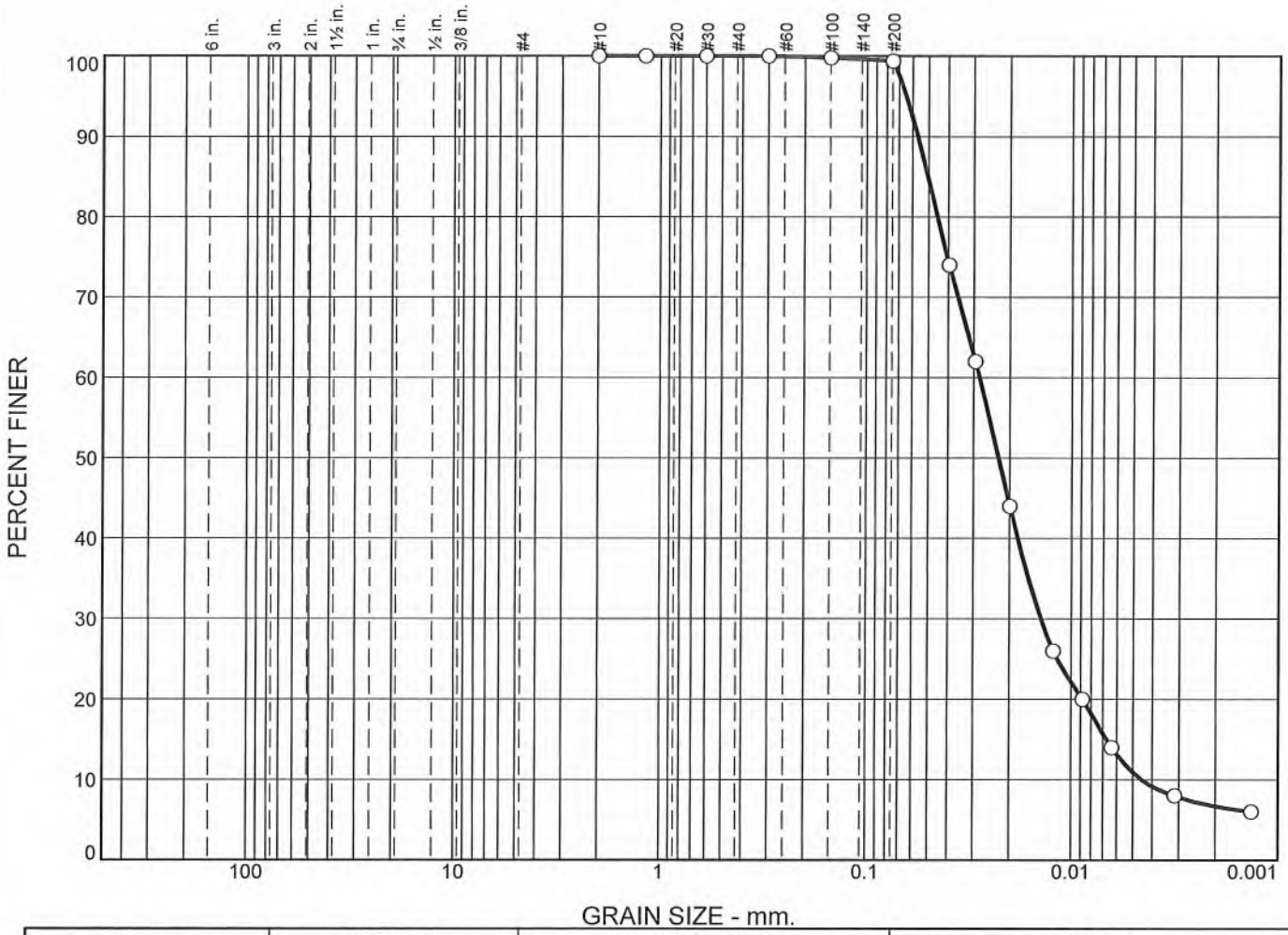
St. Clements, ON

Client: Exact Construction

Project: Proposed Subdivision
31 Church Street, Alma, Ontario

Project No.: 20-732 **Figure** 2

Particle Size Distribution Report



	% Cobbles	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.0	0.0	0.6	92.7	6.7

SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○	BH3	9	6.10-7.62m	silt, trace clay and sand	ML
				Sampled by BB of CMT Engineering Inc., December 11, 2020	
				Tested by MS of CMT Engineering Inc., December 15, 2020	

CMT Engineering Inc.

St. Clements, ON

Client: Exact Construction

Project: Proposed Subdivision
31 Church Street, Alma, Ontario

Project No.: 20-732

Figure 3

APPENDIX G: LABORATORY CERTIFICATE OF ANALYSIS

L2540181

Hydrogeology Consulting Services
(Kitchener)
ATTN: Chris F Helmer
6 Lynn Court
Kitchener ON N2A 4H6

Date Received: 14-DEC-20
Report Date: 21-DEC-20 07:11 (MT)
Version: FINAL

Client Phone: 905-550-0969

Certificate of Analysis

Lab Work Order #: L2540181

Project P.O. #: NOT SUBMITTED
Job Reference: CHURCH ST-ALMA
C of C Numbers:
Legal Site Desc:

Emily Smith
Account Manager

CHURCH ST-ALMA

Sample Details Grouping / Analyte	Result	Qualifier	D.L.	Units	Analyzed	Guideline Limits #1	Guideline Limits #2
L2540181-1 BH03-20							
Sampled By: CLIENT on 14-DEC-20 @ 11:53							
Matrix: WATER							
Physical Tests							
Colour, Apparent	9.7		2.0	CU	15-DEC-20		*5
Conductivity	1480		3.0	umhos/cm	17-DEC-20		
Hardness (as CaCO3)	17500	HTC	13	mg/L	16-DEC-20		*80-100
pH	7.74		0.10	pH units	17-DEC-20		6.5-8.5
Total Dissolved Solids	1150	DLM	80	mg/L	16-DEC-20		*500
Turbidity	>4000		0.10	NTU	15-DEC-20		*5
Anions and Nutrients							
Alkalinity, Total (as CaCO3)	324		10	mg/L	17-DEC-20		30-500
Ammonia, Total (as N)	0.048		0.010	mg/L	16-DEC-20		
Chloride (Cl)	278	DLDS	2.5	mg/L	16-DEC-20		*250
Fluoride (F)	0.15	DLDS	0.10	mg/L	16-DEC-20	1.5	
Nitrate (as N)	<0.10	DLDS	0.10	mg/L	16-DEC-20	10	
Nitrite (as N)	<0.050	DLDS	0.050	mg/L	16-DEC-20	1	
Orthophosphate-Dissolved (as P)	<0.0030		0.0030	mg/L	18-DEC-20		
Sulfate (SO4)	86.8	DLDS	1.5	mg/L	16-DEC-20		500
Total Metals							
Aluminum (Al)-Total	62.4	DLHC	0.50	mg/L	15-DEC-20		*0.1
Antimony (Sb)-Total	<0.010	DLHC	0.010	mg/L	15-DEC-20	**0.006	
Arsenic (As)-Total	0.050	DLHC	0.010	mg/L	15-DEC-20	*0.0100	
Barium (Ba)-Total	1.26	DLHC	0.010	mg/L	15-DEC-20	*1	
Beryllium (Be)-Total	<0.010	DLHC	0.010	mg/L	15-DEC-20		
Bismuth (Bi)-Total	<0.0050	DLHC	0.0050	mg/L	15-DEC-20		
Boron (B)-Total	<1.0	DLHC	1.0	mg/L	15-DEC-20	5	
Cadmium (Cd)-Total	0.00305	DLHC	0.00050	mg/L	15-DEC-20	0.005	
Calcium (Ca)-Total	5000	DLHC	5.0	mg/L	15-DEC-20		
Cesium (Cs)-Total	0.0049	DLHC	0.0010	mg/L	15-DEC-20		
Chromium (Cr)-Total	0.192	DLHC	0.050	mg/L	16-DEC-20	*0.05	
Cobalt (Co)-Total	0.080	DLHC	0.010	mg/L	15-DEC-20		
Copper (Cu)-Total	0.318	DLHC	0.050	mg/L	15-DEC-20		1
Iron (Fe)-Total	153	DLHC	1.0	mg/L	15-DEC-20		*0.3
Lead (Pb)-Total	0.267	DLHC	0.0050	mg/L	16-DEC-20	*0.01	
Magnesium (Mg)-Total	1230	DLHC	0.50	mg/L	15-DEC-20		
Manganese (Mn)-Total	14.9	DLHC	0.050	mg/L	15-DEC-20		*0.05
Molybdenum (Mo)-Total	0.0090	DLHC	0.0050	mg/L	15-DEC-20		
Nickel (Ni)-Total	0.165	DLHC	0.050	mg/L	15-DEC-20		
Phosphorus (P)-Total	14.6	DLHC	5.0	mg/L	15-DEC-20		
Potassium (K)-Total	19.4	DLHC	5.0	mg/L	15-DEC-20		
Rubidium (Rb)-Total	0.103	DLHC	0.020	mg/L	15-DEC-20		
Selenium (Se)-Total	<0.0050	DLHC	0.0050	mg/L	15-DEC-20	0.05	
Silicon (Si)-Total	83	DLHC	10	mg/L	15-DEC-20		
Silver (Ag)-Total	<0.0050	DLHC	0.0050	mg/L	15-DEC-20		
Sodium (Na)-Total	62.3	DLHC	5.0	mg/L	15-DEC-20	*20	200
Strontium (Sr)-Total	6.09	DLHC	0.10	mg/L	15-DEC-20		
Sulfur (S)-Total	58	DLHC	50	mg/L	15-DEC-20		
Tellurium (Te)-Total	<0.020	DLHC	0.020	mg/L	15-DEC-20		
Thallium (Tl)-Total	0.0014	DLHC	0.0010	mg/L	15-DEC-20		

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
* Analytical result for this parameter exceeds Guideline Limit listed on this report. Guideline Limits applied:

Ontario Drinking Water Regulation (ODWQS) JAN.1,2020 = [Suite] - ON-DW-STANDARD+GUIDELINES

#1: Schedule 1 (Microbiological) and 2 (Chemical) Standards (JAN,2020) **#2: Ontario DW Aesthetic and Operational Guidelines (June, 2006)**

Sample Details Grouping	Analyte	Result	Qualifier	D.L.	Units	Analyzed	Guideline Limits #1	#2		
L2540181-1	BH03-20									
Sampled By:	CLIENT on 14-DEC-20 @ 11:53									
Matrix:	WATER									
Total Metals										
	Thorium (Th)-Total	0.042	DLHC	0.010	mg/L	15-DEC-20				
	Tin (Sn)-Total	<0.010	DLHC	0.010	mg/L	15-DEC-20				
	Titanium (Ti)-Total	0.791	DLHC	0.030	mg/L	15-DEC-20				
	Tungsten (W)-Total	<0.010	DLHC	0.010	mg/L	15-DEC-20				
	Uranium (U)-Total	0.0235	DLHC	0.0010	mg/L	15-DEC-20	*0.02			
	Vanadium (V)-Total	0.139	DLHC	0.050	mg/L	15-DEC-20				
	Zinc (Zn)-Total	0.91	DLHC	0.30	mg/L	15-DEC-20		5		
	Zirconium (Zr)-Total	<0.020	DLHC	0.020	mg/L	15-DEC-20				
L2540181-2	BH01-20									
Sampled By:	CLIENT on 14-DEC-20 @ 16:04									
Matrix:	WATER						#1	#2		
Physical Tests										
	Colour, Apparent	24.7		2.0	CU	15-DEC-20		*5		
	Conductivity	906		3.0	umhos/cm	17-DEC-20				
	Hardness (as CaCO3)	22000	HTC	13	mg/L	16-DEC-20		*80-100		
	pH	8.12		0.10	pH units	17-DEC-20		6.5-8.5		
	Total Dissolved Solids	646	DLM	80	mg/L	16-DEC-20		*500		
	Turbidity	>4000		0.10	NTU	15-DEC-20		*5		
Anions and Nutrients										
	Alkalinity, Total (as CaCO3)	253		10	mg/L	17-DEC-20		30-500		
	Ammonia, Total (as N)	0.164		0.010	mg/L	16-DEC-20				
	Chloride (Cl)	156		0.50	mg/L	16-DEC-20		250		
	Fluoride (F)	0.267		0.020	mg/L	16-DEC-20	1.5			
	Nitrate (as N)	0.471		0.020	mg/L	16-DEC-20	10			
	Nitrite (as N)	<0.010		0.010	mg/L	16-DEC-20	1			
	Orthophosphate-Dissolved (as P)	<0.0030		0.0030	mg/L	18-DEC-20				
	Sulfate (SO4)	23.0		0.30	mg/L	16-DEC-20		500		
Total Metals										
	Aluminum (Al)-Total	38.4	DLHC	0.50	mg/L	15-DEC-20		*0.1		
	Antimony (Sb)-Total	<0.010	DLHC	0.010	mg/L	15-DEC-20	**0.006			
	Arsenic (As)-Total	0.022	DLHC	0.010	mg/L	15-DEC-20	*0.0100			
	Barium (Ba)-Total	1.33	DLHC	0.010	mg/L	15-DEC-20	*1			
	Beryllium (Be)-Total	<0.010	DLHC	0.010	mg/L	15-DEC-20				
	Bismuth (Bi)-Total	<0.0050	DLHC	0.0050	mg/L	15-DEC-20				
	Boron (B)-Total	<1.0	DLHC	1.0	mg/L	15-DEC-20	5			
	Cadmium (Cd)-Total	0.00458	DLHC	0.00050	mg/L	15-DEC-20	0.005			
	Calcium (Ca)-Total	6040	DLHC	5.0	mg/L	15-DEC-20				
	Cesium (Cs)-Total	0.0029	DLHC	0.0010	mg/L	15-DEC-20				
	Chromium (Cr)-Total	0.125	DLHC	0.050	mg/L	16-DEC-20	*0.05			
	Cobalt (Co)-Total	0.067	DLHC	0.010	mg/L	15-DEC-20				
	Copper (Cu)-Total	0.338	DLHC	0.050	mg/L	15-DEC-20		1		
	Iron (Fe)-Total	16.8	DLHC	1.0	mg/L	15-DEC-20		*0.3		
	Lead (Pb)-Total	0.290	DLHC	0.0050	mg/L	16-DEC-20	*0.01			
	Magnesium (Mg)-Total	1670	DLHC	0.50	mg/L	15-DEC-20				
	Manganese (Mn)-Total	16.4	DLHC	0.050	mg/L	15-DEC-20		*0.05		

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
* Analytical result for this parameter exceeds Guideline Limit listed on this report. Guideline Limits applied:

Ontario Drinking Water Regulation (ODWQS) JAN.1,2020 = [Suite] - ON-DW-STANDARD+GUIDELINES

#1: Schedule 1 (Microbiological) and 2 (Chemical) Standards (JAN,2020) **#2: Ontario DW Aesthetic and Operational Guidelines (June, 2006)**

Sample Details Grouping	Analyte	Result	Qualifier	D.L.	Units	Analyzed	Guideline Limits #1	#2		
L2540181-2	BH01-20									
Sampled By:	CLIENT on 14-DEC-20 @ 16:04									
Matrix:	WATER									
Total Metals										
	Molybdenum (Mo)-Total	<0.0050	DLHC	0.0050	mg/L	15-DEC-20				
	Nickel (Ni)-Total	0.140	DLHC	0.050	mg/L	15-DEC-20				
	Phosphorus (P)-Total	<5.0	DLHC	5.0	mg/L	15-DEC-20				
	Potassium (K)-Total	30.1	DLHC	5.0	mg/L	15-DEC-20				
	Rubidium (Rb)-Total	0.076	DLHC	0.020	mg/L	15-DEC-20				
	Selenium (Se)-Total	<0.0050	DLHC	0.0050	mg/L	15-DEC-20	0.05			
	Silicon (Si)-Total	56	DLHC	10	mg/L	15-DEC-20				
	Silver (Ag)-Total	<0.0050	DLHC	0.0050	mg/L	15-DEC-20				
	Sodium (Na)-Total	59.0	DLHC	5.0	mg/L	15-DEC-20	*20	200		
	Strontium (Sr)-Total	6.81	DLHC	0.10	mg/L	15-DEC-20				
	Sulfur (S)-Total	<50	DLHC	50	mg/L	15-DEC-20				
	Tellurium (Te)-Total	<0.020	DLHC	0.020	mg/L	15-DEC-20				
	Thallium (Tl)-Total	0.0011	DLHC	0.0010	mg/L	15-DEC-20				
	Thorium (Th)-Total	<0.010	DLHC	0.010	mg/L	15-DEC-20				
	Tin (Sn)-Total	<0.010	DLHC	0.010	mg/L	15-DEC-20				
	Titanium (Ti)-Total	<0.050	DLUI	0.050	mg/L	15-DEC-20				
	Tungsten (W)-Total	<0.010	DLHC	0.010	mg/L	15-DEC-20				
	Uranium (U)-Total	0.0174	DLHC	0.0010	mg/L	15-DEC-20	0.02			
	Vanadium (V)-Total	<0.050	DLHC	0.050	mg/L	15-DEC-20				
	Zinc (Zn)-Total	0.91	DLHC	0.30	mg/L	15-DEC-20		5		
	Zirconium (Zr)-Total	<0.020	DLHC	0.020	mg/L	15-DEC-20				

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
* Analytical result for this parameter exceeds Guideline Limit listed on this report. Guideline Limits applied:

Ontario Drinking Water Regulation (ODWQS) JAN.1,2020 = [Suite] - ON-DW-STANDARD+GUIDELINES

#1: Schedule 1 (Microbiological) and 2 (Chemical) Standards (JAN,2020) **#2: Ontario DW Aesthetic and Operational Guidelines (June, 2006)**

Reference Information

Sample Parameter Qualifier key listed:

Qualifier	Description
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
DLUI	Detection Limit Raised: Unknown Interference generated an apparent false positive test result.
HTC	Hardness was calculated from Total Ca and/or Mg concentrations and may be biased high (dissolved Ca/Mg results unavailable).
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference***
ALK-WT	Water	Alkalinity, Total (as CaCO3)	APHA 2320B

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint.

CL-IC-N-WT	Water	Chloride by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

COLOUR-APPARENT-WT	Water	Colour	APHA 2120

Apparent Colour is measured spectrophotometrically by comparison to platinum-cobalt standards using the single wavelength method after sample decanting. Colour measurements can be highly pH dependent, and apply to the pH of the sample as received (at time of testing), without pH adjustment. Concurrent measurement of sample pH is recommended.

EC-SCREEN-WT	Water	Conductivity Screen (Internal Use Only)	APHA 2510

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

EC-WT	Water	Conductivity	APHA 2510 B

Water samples can be measured directly by immersing the conductivity cell into the sample.

F-IC-N-WT	Water	Fluoride in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

HARDNESS-CALC-WT	Water	Hardness	APHA 2340 B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

MET-T-CCMS-WT	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

NH3-F-WT	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-IC-WT	Water	Nitrite in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-IC-WT	Water	Nitrate in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-WT	Water	pH	APHA 4500 H-Electrode

Water samples are analyzed directly by a calibrated pH meter.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011). Holdtime for samples under this regulation is 28 days

Reference Information

PO4-DO-COL-WT	Water	Diss. Orthophosphate in Water by Colour	APHA 4500-P PHOSPHORUS

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

SO4-IC-N-WT	Water	Sulfate in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

SOLIDS-TDS-WT	Water	Total Dissolved Solids	APHA 2540C

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TURBIDITY-WT	Water	Turbidity	APHA 2130 B

Sample result is based on a comparison of the intensity of the light scattered by the sample under defined conditions with the intensity of light scattered by a standard reference suspension under the same conditions. Sample readings are obtained from a Nephelometer.

*** ALS test methods may incorporate modifications from specified reference methods to improve performance.

Chain of Custody numbers:

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location	Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA		

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, fitness for a particular purpose, or non-infringement. ALS assumes no responsibility for errors or omissions in the information. Guideline limits are not adjusted for the hardness, pH or temperature of the sample (the most conservative values are used). Measurement uncertainty is not applied to test results prior to comparison with specified criteria values.

Quality Control Report

Workorder: L2540181 Report Date: 21-DEC-20

Client: Hydrogeology Consulting Services (Kitchener)
6 Lynn Court
Kitchener ON N2A 4H6
Contact: Chris F Helmer

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ALK-WT	**Water**							
Batch R5319109								
WG3463635-4 DUP		**WG3463635-3**						
Alkalinity, Total (as CaCO3)		<10	<10	RPD-NA	mg/L	N/A	20	17-DEC-20
WG3463635-2 LCS								
Alkalinity, Total (as CaCO3)			99.9		%		85-115	17-DEC-20
WG3463635-1 MB								
Alkalinity, Total (as CaCO3)			<10		mg/L		10	17-DEC-20
CL-IC-N-WT	**Water**							
Batch R5318533								
WG3462929-10 DUP		**L2540181-2**						
Chloride (Cl)		156	154		mg/L	0.7	20	16-DEC-20
WG3462929-7 LCS								
Chloride (Cl)			100.7		%		90-110	16-DEC-20
WG3462929-6 MB								
Chloride (Cl)			<0.50		mg/L		0.5	16-DEC-20
WG3462929-9 MS		**L2540181-2**						
Chloride (Cl)			N/A	MS-B	%		-	16-DEC-20
COLOUR-APPARENT-WT	**Water**							
Batch R5317729								
WG3462461-3 DUP		**WG3462461-4**						
Colour, Apparent		54.9	56.5		CU	2.9	20	15-DEC-20
WG3462461-2 LCS								
Colour, Apparent			103.3		%		85-115	15-DEC-20
WG3462461-1 MB								
Colour, Apparent			<2.0		CU		2	15-DEC-20
EC-WT	**Water**							
Batch R5319109								
WG3463635-4 DUP		**WG3463635-3**						
Conductivity		<3.0	<3.0	RPD-NA	umhos/cm	N/A	10	17-DEC-20
WG3463635-2 LCS								
Conductivity			98.4		%		90-110	17-DEC-20
WG3463635-1 MB								
Conductivity			<3.0		umhos/cm		3	17-DEC-20
F-IC-N-WT	**Water**							
Batch R5318533								
WG3462929-10 DUP		**L2540181-2**						
Fluoride (F)		0.267	0.261		mg/L	2.2	20	16-DEC-20
WG3462929-7 LCS								

Quality Control Report

Client: Hydrogeology Consulting Services (Kitchener)
6 Lynn Court
Kitchener ON N2A 4H6
Contact: Chris F Helmer

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
F-IC-N-WT	**Water**							
Batch R5318533								
WG3462929-7 LCS								
Fluoride (F)			104.4		%		90-110	16-DEC-20
WG3462929-6 MB								
Fluoride (F)			<0.020		mg/L		0.02	16-DEC-20
WG3462929-9 MS		**L2540181-2**						
Fluoride (F)			91.9		%		75-125	16-DEC-20
MET-T-CCMS-WT	**Water**							
Batch R5316920								
WG3461819-4 DUP		**WG3461819-3**						
Aluminum (Al)-Total		0.0173	0.0168		mg/L	3.2	20	15-DEC-20
Antimony (Sb)-Total		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	15-DEC-20
Arsenic (As)-Total		0.00483	0.00483		mg/L	0.1	20	15-DEC-20
Barium (Ba)-Total		0.300	0.291		mg/L	2.8	20	15-DEC-20
Beryllium (Be)-Total		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	15-DEC-20
Bismuth (Bi)-Total		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	15-DEC-20
Boron (B)-Total		0.026	0.027		mg/L	2.9	20	15-DEC-20
Cadmium (Cd)-Total		<0.0000050	<0.000005C	RPD-NA	mg/L	N/A	20	15-DEC-20
Calcium (Ca)-Total		130	134		mg/L	3.1	20	15-DEC-20
Chromium (Cr)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	15-DEC-20
Cesium (Cs)-Total		<0.000010	<0.000010	RPD-NA	mg/L	N/A	20	15-DEC-20
Cobalt (Co)-Total		0.00028	0.00027		mg/L	1.3	20	15-DEC-20
Copper (Cu)-Total		0.00068	0.00064		mg/L	5.5	20	15-DEC-20
Iron (Fe)-Total		0.633	0.643		mg/L	1.5	20	15-DEC-20
Lead (Pb)-Total		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	15-DEC-20
Magnesium (Mg)-Total		43.0	44.0		mg/L	2.3	20	15-DEC-20
Manganese (Mn)-Total		0.0669	0.0684		mg/L	2.2	20	15-DEC-20
Molybdenum (Mo)-Total		0.00105	0.00107		mg/L	1.5	20	15-DEC-20
Nickel (Ni)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	15-DEC-20
Phosphorus (P)-Total		<0.050	<0.050	RPD-NA	mg/L	N/A	20	15-DEC-20
Potassium (K)-Total		2.90	3.00		mg/L	3.2	20	15-DEC-20
Rubidium (Rb)-Total		0.00096	0.00095		mg/L	0.5	20	15-DEC-20
Selenium (Se)-Total		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	15-DEC-20
Silicon (Si)-Total		10.4	10.4		mg/L	0.9	20	15-DEC-20
Silver (Ag)-Total		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	15-DEC-20

Quality Control Report

Client: Hydrogeology Consulting Services (Kitchener)
6 Lynn Court
Kitchener ON N2A 4H6
Contact: Chris F Helmer

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-WT	**Water**							
Batch R5316920								
WG3461819-4 DUP		**WG3461819-3**						
Sodium (Na)-Total		200	197		mg/L	1.8	20	15-DEC-20
Strontium (Sr)-Total		0.420	0.423		mg/L	0.7	20	15-DEC-20
Sulfur (S)-Total		24.3	24.6		mg/L	1.3	25	15-DEC-20
Thallium (Tl)-Total		<0.000010	<0.000010	RPD-NA	mg/L	N/A	20	15-DEC-20
Tellurium (Te)-Total		<0.00020	<0.00020	RPD-NA	mg/L	N/A	20	15-DEC-20
Thorium (Th)-Total		<0.00010	<0.00010	RPD-NA	mg/L	N/A	25	15-DEC-20
Tin (Sn)-Total		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	15-DEC-20
Titanium (Ti)-Total		0.00036	0.00050	J	mg/L	0.00014	0.0006	15-DEC-20
Tungsten (W)-Total		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	15-DEC-20
Uranium (U)-Total		0.00159	0.00161		mg/L	1.7	20	15-DEC-20
Vanadium (V)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	15-DEC-20
Zinc (Zn)-Total		0.0148	0.0145		mg/L	2.1	20	15-DEC-20
Zirconium (Zr)-Total		<0.00020	<0.00020	RPD-NA	mg/L	N/A	20	15-DEC-20
WG3461819-2 LCS								
Aluminum (Al)-Total			101.6		%		80-120	15-DEC-20
Antimony (Sb)-Total			103.8		%		80-120	15-DEC-20
Arsenic (As)-Total			102.1		%		80-120	15-DEC-20
Barium (Ba)-Total			101.3		%		80-120	15-DEC-20
Beryllium (Be)-Total			98.0		%		80-120	15-DEC-20
Bismuth (Bi)-Total			101.6		%		80-120	15-DEC-20
Boron (B)-Total			94.6		%		80-120	15-DEC-20
Cadmium (Cd)-Total			103.6		%		80-120	15-DEC-20
Calcium (Ca)-Total			98.5		%		80-120	15-DEC-20
Chromium (Cr)-Total			102.2		%		80-120	15-DEC-20
Cesium (Cs)-Total			102.8		%		80-120	15-DEC-20
Cobalt (Co)-Total			101.3		%		80-120	15-DEC-20
Copper (Cu)-Total			101.7		%		80-120	15-DEC-20
Iron (Fe)-Total			101.6		%		80-120	15-DEC-20
Lead (Pb)-Total			102.1		%		80-120	15-DEC-20
Magnesium (Mg)-Total			105.0		%		80-120	15-DEC-20
Manganese (Mn)-Total			101.5		%		80-120	15-DEC-20
Molybdenum (Mo)-Total			99.9		%		80-120	15-DEC-20
Nickel (Ni)-Total			101.1		%		80-120	15-DEC-20

Quality Control Report

Client: Hydrogeology Consulting Services (Kitchener)
6 Lynn Court
Kitchener ON N2A 4H6
Contact: Chris F Helmer

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-WT	**Water**							
Batch R5316920								
WG3461819-2 LCS								
Phosphorus (P)-Total			109.9		%		70-130	15-DEC-20
Potassium (K)-Total			102.7		%		80-120	15-DEC-20
Rubidium (Rb)-Total			103.0		%		80-120	15-DEC-20
Selenium (Se)-Total			98.9		%		80-120	15-DEC-20
Silicon (Si)-Total			96.7		%		60-140	15-DEC-20
Silver (Ag)-Total			103.0		%		80-120	15-DEC-20
Sodium (Na)-Total			105.3		%		80-120	15-DEC-20
Strontium (Sr)-Total			104.9		%		80-120	15-DEC-20
Sulfur (S)-Total			96.7		%		80-120	15-DEC-20
Thallium (Tl)-Total			102.3		%		80-120	15-DEC-20
Tellurium (Te)-Total			95.0		%		80-120	15-DEC-20
Thorium (Th)-Total			104.6		%		70-130	15-DEC-20
Tin (Sn)-Total			97.2		%		80-120	15-DEC-20
Titanium (Ti)-Total			97.8		%		80-120	15-DEC-20
Tungsten (W)-Total			98.4		%		80-120	15-DEC-20
Uranium (U)-Total			103.8		%		80-120	15-DEC-20
Vanadium (V)-Total			102.9		%		80-120	15-DEC-20
Zinc (Zn)-Total			99.1		%		80-120	15-DEC-20
Zirconium (Zr)-Total			97.1		%		80-120	15-DEC-20
WG3461819-1 MB								
Aluminum (Al)-Total			<0.0050		mg/L		0.005	15-DEC-20
Antimony (Sb)-Total			<0.00010		mg/L		0.0001	15-DEC-20
Arsenic (As)-Total			<0.00010		mg/L		0.0001	15-DEC-20
Barium (Ba)-Total			<0.00010		mg/L		0.0001	15-DEC-20
Beryllium (Be)-Total			<0.00010		mg/L		0.0001	15-DEC-20
Bismuth (Bi)-Total			<0.000050		mg/L		0.00005	15-DEC-20
Boron (B)-Total			<0.010		mg/L		0.01	15-DEC-20
Cadmium (Cd)-Total			<0.000005(		mg/L		0.000005	15-DEC-20
Calcium (Ca)-Total			<0.050		mg/L		0.05	15-DEC-20
Chromium (Cr)-Total			<0.00050		mg/L		0.0005	16-DEC-20
Cesium (Cs)-Total			<0.000010		mg/L		0.00001	15-DEC-20
Cobalt (Co)-Total			<0.00010		mg/L		0.0001	15-DEC-20
Copper (Cu)-Total			<0.00050		mg/L		0.0005	15-DEC-20
Iron (Fe)-Total			<0.010		mg/L		0.01	15-DEC-20

Quality Control Report

Client: Hydrogeology Consulting Services (Kitchener)
6 Lynn Court
Kitchener ON N2A 4H6
Contact: Chris F Helmer

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-WT	**Water**							
Batch R5316920								
WG3461819-1 MB								
Lead (Pb)-Total			<0.000050		mg/L		0.00005	16-DEC-20
Magnesium (Mg)-Total			<0.0050		mg/L		0.005	15-DEC-20
Manganese (Mn)-Total			<0.00050		mg/L		0.0005	15-DEC-20
Molybdenum (Mo)-Total			<0.000050		mg/L		0.00005	15-DEC-20
Nickel (Ni)-Total			<0.00050		mg/L		0.0005	15-DEC-20
Phosphorus (P)-Total			<0.050		mg/L		0.05	15-DEC-20
Potassium (K)-Total			<0.050		mg/L		0.05	15-DEC-20
Rubidium (Rb)-Total			<0.00020		mg/L		0.0002	15-DEC-20
Selenium (Se)-Total			<0.000050		mg/L		0.00005	15-DEC-20
Silicon (Si)-Total			<0.10		mg/L		0.1	15-DEC-20
Silver (Ag)-Total			<0.000050		mg/L		0.00005	15-DEC-20
Sodium (Na)-Total			<0.050		mg/L		0.05	15-DEC-20
Strontium (Sr)-Total			<0.0010		mg/L		0.001	15-DEC-20
Sulfur (S)-Total			<0.50		mg/L		0.5	15-DEC-20
Thallium (Tl)-Total			<0.000010		mg/L		0.00001	15-DEC-20
Tellurium (Te)-Total			<0.00020		mg/L		0.0002	15-DEC-20
Thorium (Th)-Total			<0.00010		mg/L		0.0001	15-DEC-20
Tin (Sn)-Total			<0.00010		mg/L		0.0001	15-DEC-20
Titanium (Ti)-Total			<0.00030		mg/L		0.0003	15-DEC-20
Tungsten (W)-Total			<0.00010		mg/L		0.0001	15-DEC-20
Uranium (U)-Total			<0.000010		mg/L		0.00001	15-DEC-20
Vanadium (V)-Total			<0.00050		mg/L		0.0005	15-DEC-20
Zinc (Zn)-Total			<0.0030		mg/L		0.003	15-DEC-20
Zirconium (Zr)-Total			<0.00020		mg/L		0.0002	15-DEC-20
WG3461819-5 MS		**WG3461819-3**						
Aluminum (Al)-Total			102.9		%		70-130	15-DEC-20
Antimony (Sb)-Total			101.3		%		70-130	15-DEC-20
Arsenic (As)-Total			101.1		%		70-130	15-DEC-20
Barium (Ba)-Total			N/A	MS-B	%		-	15-DEC-20
Beryllium (Be)-Total			106.7		%		70-130	15-DEC-20
Bismuth (Bi)-Total			89.5		%		70-130	15-DEC-20
Boron (B)-Total			103.3		%		70-130	15-DEC-20
Cadmium (Cd)-Total			92.9		%		70-130	15-DEC-20
Calcium (Ca)-Total			N/A	MS-B	%		-	15-DEC-20

Quality Control Report

Client: Hydrogeology Consulting Services (Kitchener)
6 Lynn Court
Kitchener ON N2A 4H6
Contact: Chris F Helmer

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-WT	**Water**							
Batch R5316920								
WG3461819-5 MS		**WG3461819-3**						
Chromium (Cr)-Total			99.5		%		70-130	15-DEC-20
Cesium (Cs)-Total			102.4		%		70-130	15-DEC-20
Cobalt (Co)-Total			96.7		%		70-130	15-DEC-20
Copper (Cu)-Total			91.9		%		70-130	15-DEC-20
Iron (Fe)-Total			N/A	MS-B	%		-	15-DEC-20
Lead (Pb)-Total			90.5		%		70-130	15-DEC-20
Magnesium (Mg)-Total			N/A	MS-B	%		-	15-DEC-20
Manganese (Mn)-Total			N/A	MS-B	%		-	15-DEC-20
Molybdenum (Mo)-Total			103.6		%		70-130	15-DEC-20
Nickel (Ni)-Total			93.7		%		70-130	15-DEC-20
Phosphorus (P)-Total			108.4		%		70-130	15-DEC-20
Potassium (K)-Total			N/A	MS-B	%		-	15-DEC-20
Rubidium (Rb)-Total			101.6		%		70-130	15-DEC-20
Selenium (Se)-Total			96.0		%		70-130	15-DEC-20
Silicon (Si)-Total			N/A	MS-B	%		-	15-DEC-20
Silver (Ag)-Total			93.1		%		70-130	15-DEC-20
Sodium (Na)-Total			N/A	MS-B	%		-	15-DEC-20
Strontium (Sr)-Total			N/A	MS-B	%		-	15-DEC-20
Sulfur (S)-Total			N/A	MS-B	%		-	15-DEC-20
Thallium (Tl)-Total			91.6		%		70-130	15-DEC-20
Tellurium (Te)-Total			87.1		%		70-130	15-DEC-20
Thorium (Th)-Total			100.2		%		70-130	15-DEC-20
Tin (Sn)-Total			96.1		%		70-130	15-DEC-20
Titanium (Ti)-Total			106.5		%		70-130	15-DEC-20
Tungsten (W)-Total			96.3		%		70-130	15-DEC-20
Uranium (U)-Total			N/A	MS-B	%		-	15-DEC-20
Vanadium (V)-Total			107.5		%		70-130	15-DEC-20
Zinc (Zn)-Total			82.2		%		70-130	15-DEC-20
Zirconium (Zr)-Total			100.3		%		70-130	15-DEC-20
NH3-F-WT	**Water**							
Batch R5318437								
WG3462467-3 DUP		**WG3462467-5**						
Ammonia, Total (as N)		0.240	0.236		mg/L	1.6	20	16-DEC-20
WG3462467-2 LCS								

Quality Control Report

Client: Hydrogeology Consulting Services (Kitchener)
6 Lynn Court
Kitchener ON N2A 4H6
Contact: Chris F Helmer

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
NH3-F-WT	**Water**							
Batch R5318437								
WG3462467-2 LCS								
Ammonia, Total (as N)			108.0		%		85-115	16-DEC-20
WG3462467-1 MB								
Ammonia, Total (as N)			<0.010		mg/L		0.01	16-DEC-20
WG3462467-4 MS		**WG3462467-5**						
Ammonia, Total (as N)			N/A	MS-B	%		-	16-DEC-20
NO2-IC-WT	**Water**							
Batch R5318533								
WG3462929-10 DUP		**L2540181-2**						
Nitrite (as N)		<0.010	<0.010	RPD-NA	mg/L	N/A	20	16-DEC-20
WG3462929-7 LCS								
Nitrite (as N)			101.0		%		90-110	16-DEC-20
WG3462929-6 MB								
Nitrite (as N)			<0.010		mg/L		0.01	16-DEC-20
WG3462929-9 MS		**L2540181-2**						
Nitrite (as N)			97.8		%		75-125	16-DEC-20
NO3-IC-WT	**Water**							
Batch R5318533								
WG3462929-10 DUP		**L2540181-2**						
Nitrate (as N)		0.471	0.470		mg/L	0.2	20	16-DEC-20
WG3462929-7 LCS								
Nitrate (as N)			100.6		%		90-110	16-DEC-20
WG3462929-6 MB								
Nitrate (as N)			<0.020		mg/L		0.02	16-DEC-20
WG3462929-9 MS		**L2540181-2**						
Nitrate (as N)			96.1		%		75-125	16-DEC-20
PH-WT	**Water**							
Batch R5319109								
WG3463635-4 DUP		**WG3463635-3**						
pH		5.95	5.92	J	pH units	0.03	0.2	17-DEC-20
WG3463635-2 LCS								
pH			7.00		pH units		6.9-7.1	17-DEC-20
PO4-DO-COL-WT	**Water**							
Batch R5319344								
WG3463951-3 DUP		**L2540047-1**						
Orthophosphate-Dissolved (as P)		0.0100	0.0092		mg/L	8.7	20	18-DEC-20
WG3463951-2 LCS								

Quality Control Report

Workorder: L2540181 Report Date: 21-DEC-20

Client: Hydrogeology Consulting Services (Kitchener)
6 Lynn Court
Kitchener ON N2A 4H6
Contact: Chris F Helmer

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PO4-DO-COL-WT	**Water**							
Batch R5319344								
WG3463951-2 LCS								
Orthophosphate-Dissolved (as P)			106.1		%		80-120	18-DEC-20
WG3463951-1 MB								
Orthophosphate-Dissolved (as P)			<0.0030		mg/L		0.003	18-DEC-20
WG3463951-4 MS		**L2540047-1**						
Orthophosphate-Dissolved (as P)			106.0		%		70-130	18-DEC-20
SO4-IC-N-WT	**Water**							
Batch R5318533								
WG3462929-10 DUP		**L2540181-2**						
Sulfate (SO4)		23.0	23.0		mg/L	0.0	20	16-DEC-20
WG3462929-7 LCS								
Sulfate (SO4)			102.4		%		90-110	16-DEC-20
WG3462929-6 MB								
Sulfate (SO4)			<0.30		mg/L		0.3	16-DEC-20
WG3462929-9 MS		**L2540181-2**						
Sulfate (SO4)			98.5		%		75-125	16-DEC-20
SOLIDS-TDS-WT	**Water**							
Batch R5318732								
WG3462905-6 DUP		**L2540878-1**						
Total Dissolved Solids		1310	1330		mg/L	1.4	20	16-DEC-20
WG3462905-5 LCS								
Total Dissolved Solids			98.4		%		85-115	16-DEC-20
WG3462905-4 MB								
Total Dissolved Solids			<10		mg/L		10	16-DEC-20
TURBIDITY-WT	**Water**							
Batch R5316660								
WG3461927-3 DUP		**WG3461927-4**						
Turbidity		18.2	17.9		NTU	1.7	15	15-DEC-20
WG3461927-2 LCS								
Turbidity			103.0		%		85-115	15-DEC-20
WG3461927-1 MB								
Turbidity			<0.10		NTU		0.1	15-DEC-20

Quality Control Report

Workorder: L2540181 Report Date: 21-DEC-20

Client: Hydrogeology Consulting Services (Kitchener)
6 Lynn Court
Kitchener ON N2A 4H6
Contact: Chris F Helmer

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

Chain of Custody (COC) / Analytical Request Form

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2540181-COFC

COC Number: 17 -

Page 1 of 1

Report To	Contact and company name below will appear on the final report
Company:	Hydrogeology Consulting
Contact:	Chris Helmer
Phone:	905-550-0989
	Company address below will appear on the final report
Street:	28 Upper Mercer Street
City/Province:	Kitchener, ON
Postal Code:	N2A 4M9
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☐ YES ☐ NO
Company:	
Contact:	

Report Format / Distribution

Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report ☑ YES ☐ NO
☐ Compare Results to Criteria on Report - provide details below if box checked
Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax: chrishelmer@hydrog.ca
Email 2:
Email 3:

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax: chrishelmer@hydrog.ca
Email 2:

Project Information

ALS Account # / Quote #: Q73754
Job #: Church St-Alma
PO / AFE:
LSD:

Oil and Gas Required Fields (client use)

AFE/Cost Center: PO#:
Major/Minor Code: Routing Code:
Requisitioner:
Location:

ALS Lab Work Order # (lab use only): L2540181 COFC

ALS Contact: Emily Smith **Sampler:**

Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4-20%] ☐ | 3 day [P3-25%] ☐ | 2 day [P2-50%] ☐

EMERGENCY: 1 Business day [E - 100%] ☐ | Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] ☐

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	GENCHEM1-P-WT	SAMPLES ON HOLD	SUSPECTED HAZARD (see Special Instructions)
	BH03-20	14-Dec-20	11:53	GW	3	X		
	BH01-20	14-Dec-20	4:04	GW	3	X		

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO
Are samples for human consumption/ use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

please compare to ODWQS sched 1 & 2 operational/aesthetic.

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐
Ice Packs ☑ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐
Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
				4.4			

SHIPMENT RELEASE (client use)

Released by: Date: Dec 14, 2020 Time: 5:35 pm

INITIAL SHIPMENT RECEPTION (lab use only)

Received by: Date: Time:

FINAL SHIPMENT RECEPTION (lab use only)

Received by: Date: 12/14/20 Time: 1800

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

NOV 2018 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

May 5, 2022

Exact Construction LTD
RR #3
8262 Wellington Road 19
Fergus, ON
N1M 2W4

Attn: Kevin Vanleeuwen

Re: Supplementary Groundwater Level Monitoring
31 Church Street
Alma, Ontario

Hydrogeology Consulting Services (HCS) was retained by Exact Construction LTD to conduct twelve months of groundwater elevation monitoring at the above-referenced property as part of a hydrogeological investigation for the proposed subdivision development. This supplementary report should be appended to the HCS hydrogeological investigation report (Revision 1 dated November 11, 2021).

Water levels were manually measured using an electronic water level tape in all three monitoring wells on the property on a quarterly basis between April 22, 2021 and April 20, 2022. Electronic pressure transducers (dataloggers) were installed in each of the monitoring wells on the property to continuously record changes in water level during the monitoring period.

The attached Table 1 provides a summary of water levels measured below ground surface on each monitoring event and related to a geodetic datum (i.e. metres above sea level).

The attached Figures 1-3 show hydrographs of the datalogger data related to groundwater depth below ground surface, which have been barometrically compensated. The attached Figures 4-6 show hydrographs of the same datalogger data related to groundwater elevation in metres above sea level, which have also been barometrically compensated. The seasonal fluctuation in groundwater levels over the twelve month monitoring period is 2.35 m or less in all wells.

Generally the hydrographs for all wells show a gradual decline from April to late September, 2021 followed by recovery of water levels until early January, 2022, followed by more minor fluctuations through the winter and early spring of 2022. It is noted the hydrographs for all three wells show fairly abrupt fluctuations in groundwater levels late September and early October, 2021. Although it is possible this relates to infiltration of precipitation in the fall, the reason(s) for these fluctuations are not readily apparent.

Based on the observations and discussions above, it is concluded that the overall change in measured groundwater elevations beneath the subject property between April 2021 and April 2022 was less than 2.35 m. This fluctuation correlates relatively well with typical seasonal groundwater fluctuations in Southern Ontario.

Groundwater Levels and Groundwater Conditions

It is noted measured groundwater levels in BH 02-20 indicate the piezometric groundwater elevation in the confined water-bearing soils was very close to the ground surface, and exhibited pressurized and even artesian conditions during the monitoring period.

It is important to note; however, that BH 02-20 is screened in a confined saturated granular deposit at a depth of 7.82 mBGS, and that the measured water levels do not indicate shallow groundwater is encountered in near surface soils or exhibits flowing conditions on the property. Similarly, it is important to note that BH 01-20 and BH 03-20 are screened in a confined saturated silt deposit at a depth of 5.89 – 7.37 mBGS, and that the measured water levels in these locations also do not indicate shallow groundwater is encountered in near surface soils. The near-surface soils underlying the subject property are low permeability clayey-silt deposits that do not contain significant groundwater and do not represent an aquifer.

We trust this report satisfies your present requirements, and we thank you for this opportunity to be of service. If you have any questions, or require further hydrogeological consulting services, please feel free to contact the undersigned directly.

Respectfully submitted,

PROFESSIONAL GEOSCIENTIST
5-May-2022
CHRIS HELMER
PRACTICING MEMBER
2285
ONTARIO

Chris Helmer, B.Sc., P.Geo.
Senior Hydrogeologist
www.hydrog.ca

encl. Table 1 – Groundwater Level Measurements
encl. Figures 1-3 – Measured Groundwater Levels Hydrographs
encl. Figures 4-6 – Measured Groundwater Elevations Hydrographs

31 Church Street, Alma, Ontario
Table 1 - Groundwater Level Measurements

Name	Ground Surface Elevation (mASL)	Stickup (m)	14-Dec-20			22-Apr-21			15-Jul-21			29-Oct-21		
			WL (mBTOP)	WL (mBGS)	WL (mASL)	WL (mBTOP)	WL (mBGS)	WL (mASL)	WL (mBTOP)	WL (mBGS)	WL (mASL)	WL (mBTOP)	WL (mBGS)	WL (mASL)
BH 01-20	442.63	1.01	8.41	7.40	435.23	1.95	0.94	441.69	3.49	2.48	440.15	2.32	1.31	441.32
BH 02-20	438.21	0.97	1.03	0.06	438.15	1.02	0.05	438.16	1.35	0.38	437.83	1.15	0.18	438.03
BH 03-20	447.02	0.98	2.24	1.26	445.76	2.39	1.41	445.61	3.01	2.03	444.99	2.39	1.41	445.61

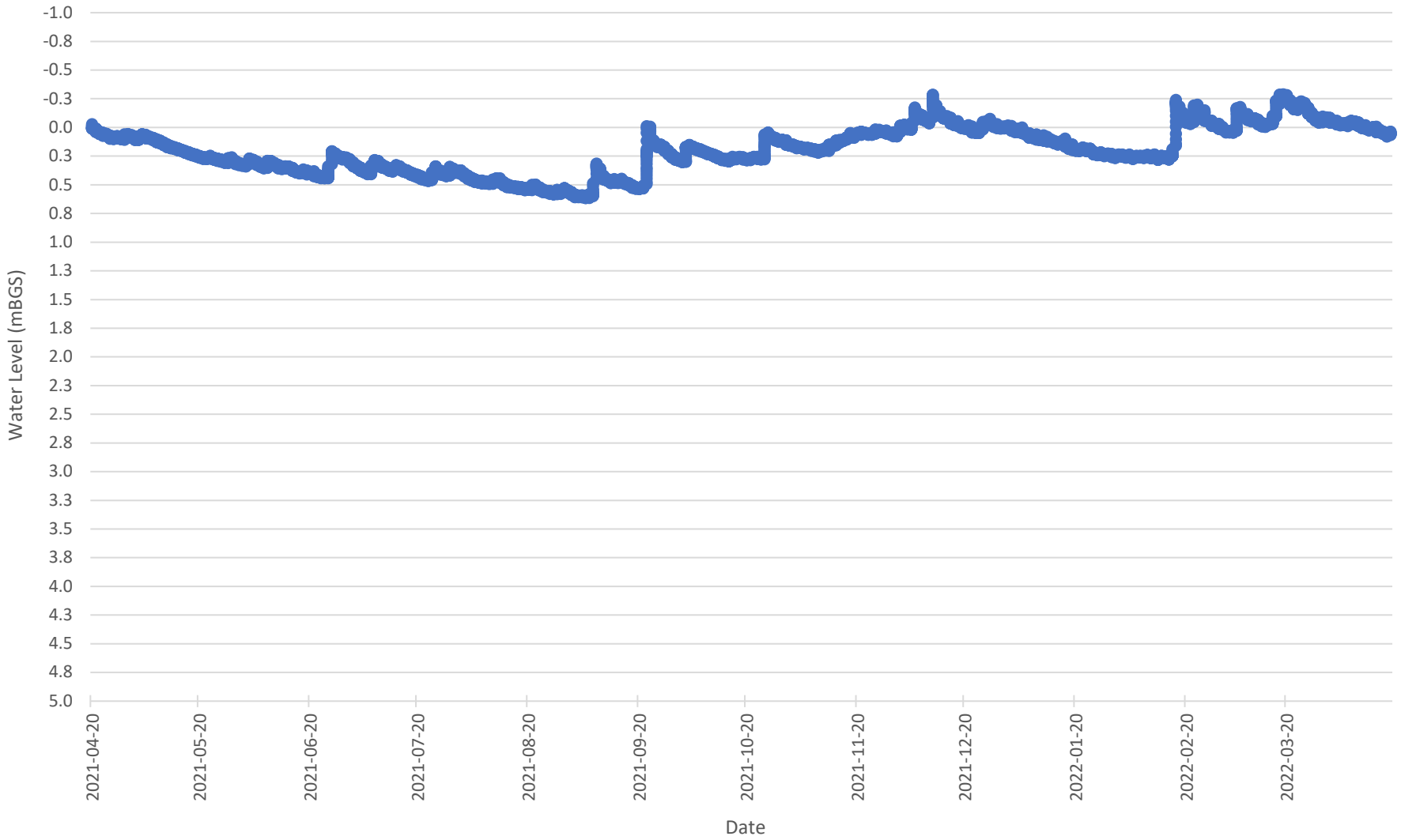
Name	Ground Surface Elevation (mASL)	Stickup (m)	10-Jan-22			20-Apr-22		
			WL (mBTOP)	WL (mBGS)	WL (mASL)	WL (mBTOP)	WL (mBGS)	WL (mASL)
BH 01-20	442.63	1.01	2.46	1.45	441.18	2.47	1.46	441.17
BH 02-20	438.21	0.97	1.20	0.23	437.98	1.06	0.09	438.12
BH 03-20	447.02	0.98	2.54	1.56	445.46	2.44	1.46	445.56

Measurement is considered erroneous
mASL - metres Above Sea Level
mBGS - metres Below Ground Surface

FIGURE 1
BH 01-20 - GROUNDWATER LEVEL MEASUREMENTS
31 Church Street, Alma, Ontario

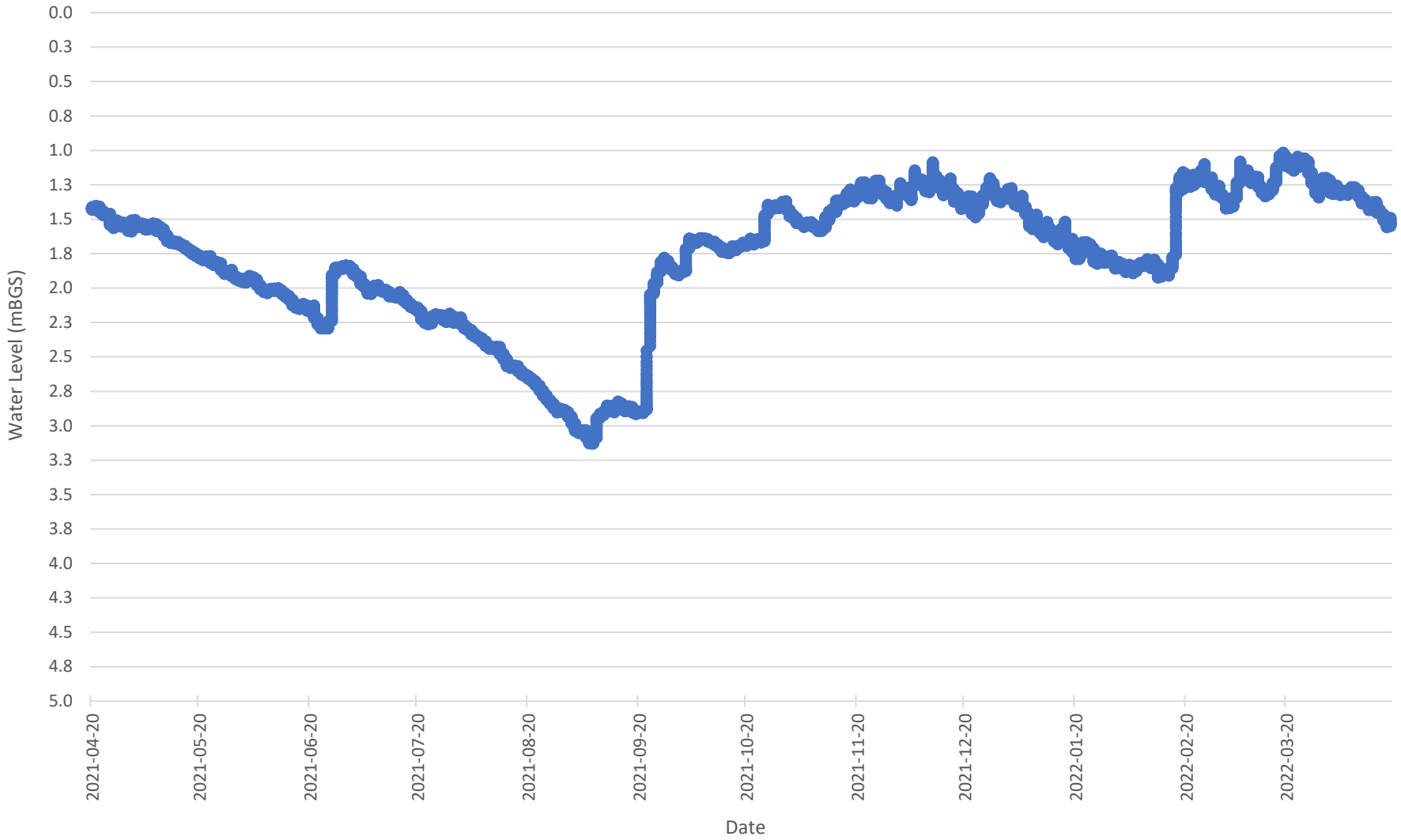
HCS HYDROGEOLOGY CONSULTING SERVICES

FIGURE 2
BH 02-20 - GROUNDWATER LEVEL MEASUREMENTS
31 Church Street, Alma, Ontario



HCS HYDROGEOLOGY CONSULTING SERVICES

FIGURE 3
BH 03-20 - GROUNDWATER LEVEL MEASUREMENTS
31 Church Street, Alma, Ontario

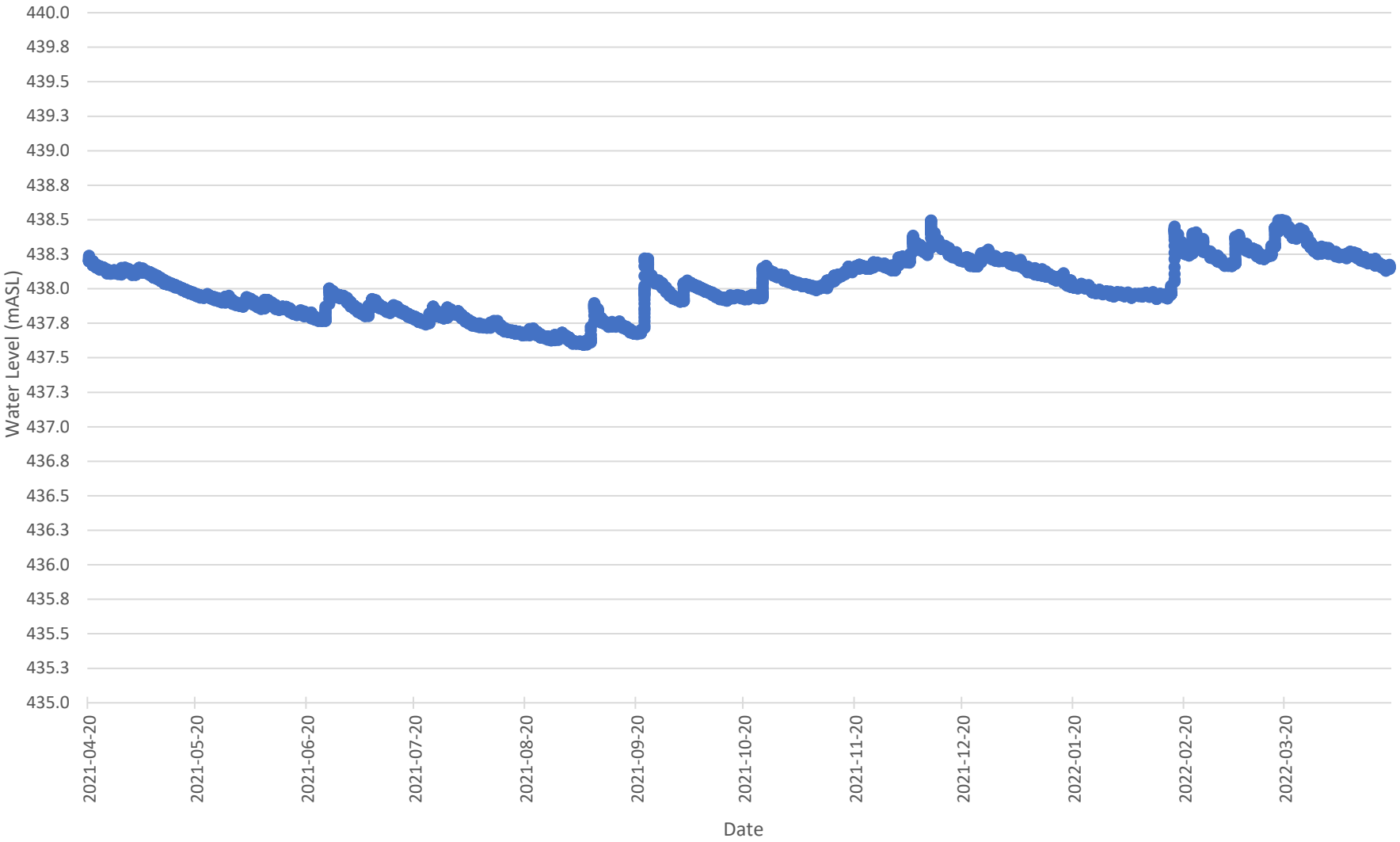


HCS HYDROGEOLOGY CONSULTING SERVICES

FIGURE 4
BH 01-20 - GROUNDWATER ELEVATIONS
31 Church Street, Alma, Ontario

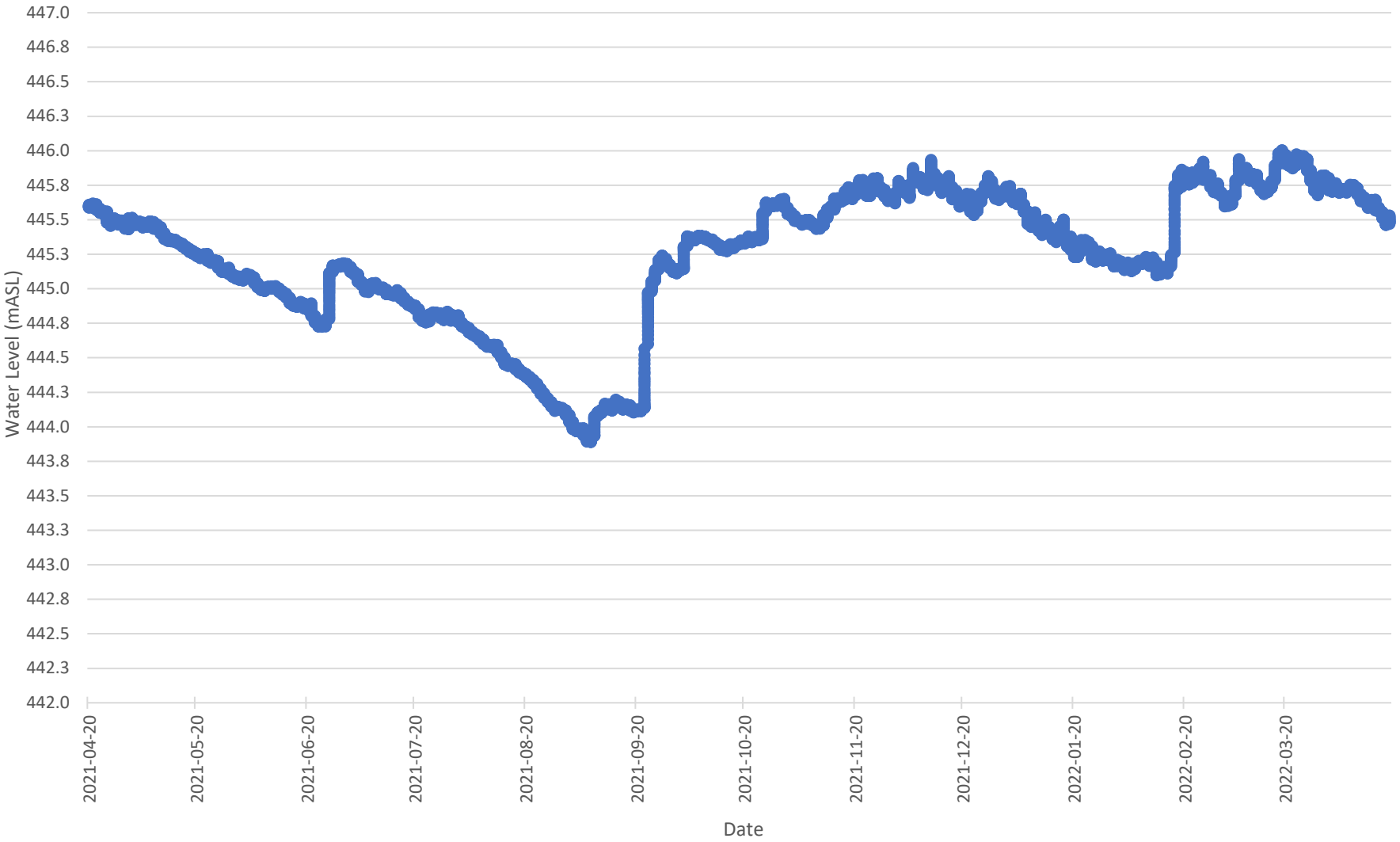
HCS HYDROGEOLOGY CONSULTING SERVICES

FIGURE 5
BH 02-20 - GROUNDWATER ELEVATIONS
31 Church Street, Alma, Ontario



HCS HYDROGEOLOGY CONSULTING SERVICES

FIGURE 6
BH 03-20 - GROUNDWATER ELEVATIONS
31 Church Street, Alma, Ontario



HCS HYDROGEOLOGY CONSULTING SERVICES

APPENDIX C

Sewage System & Water Supply Consultation, Van Harten Surveying Ltd., 2023

Van Harten
LAND SURVEYORS - ENGINEERS

September 29, 2023
29069-20

GM BluePlan
330 Trillium Drive, Unit D
Kitchener, ON
N2E 3J2

Attention: Angela Kroetsch, P. Eng.

Dear Madam:

Re: Sewage System & Water Supply Consultation
Proposed Alma Subdivision
Township of Mapleton

1.0 Introduction

Van Harten is pleased to provide this report regarding sewage disposal within a new estate lot subdivision being proposed within the Village of Alma.

The purpose of this engineering task is to identify the subsurface soil and groundwater conditions within the subdivision and provide preliminary design recommendations that will assist with the overall grading and drainage design being completed by your firm.

2.0 Background Information

CMT Engineering Inc. was retained to conduct a geotechnical investigation for the proposed subdivision. Three boreholes that were advanced within the lands to be developed, found surficial topsoil overlying an extensive deposit of clayey silt. Groundwater depths varied from 0.06 m below grade to 7.40 m below grade. The predominant soil was assigned a percolation rate of T = 50 min/cm.

HCS was retained to carry out a scoped hydrogeological assessment and provide recommendations for the proposed development. A predictive nitrate impact assessment carried out as part of this work has concluded that with the use of enhanced tertiary treatment units, the nitrate-N concentrations in groundwater at the downgradient property boundary will be below the ODWQS limit of 10 mg/L. The enhanced tertiary treatment systems in this subdivision are to be designed to achieve a maximum effluent nitrate-N concentration of 12 mg/L.

3.0 Sewage System Design

The project involves the proposed development of a new estate lot subdivision within the Village of Alma. The purpose of this work is to provide some preliminary sewage system design information that will assist with the overall grading and drainage design of this subdivision.

The percolation time of the predominant soil deposit has been determined by CMT Engineering Inc. to be T = 50 min/cm. For planning purposes, we will use a conservative value of T > 50 min/cm.

While final house plans are not available at this time, Van Harten has been provided with a set of house plans that are reported to be similar to what is being envisioned for this development. Referring to the plans provided, it is understood that houses will have less than about 200 m^2 of total living area with three to four bedrooms and no more than about twenty-eight (28) fixture units. The peak daily sewage flow calculated in accordance with Table 8.2.1.3.A of the OBC is anticipated to be in the order of Q = 1,600 to 2,400 L/day. A conservative peak flow of Q = 2,500 L/day is proposed for planning purposes.

Based on the nitrate reduction requirements established by HCS, the CAN/BNQ 3680-360 certified Waterloo Biofilter advanced sewage treatment system shall be used in conjunction with the Waterloo Biofilter WaterNOx-LS&D denitrification unit. Referring to the attached conceptual design drawings, the proposed sewage treatment system comprises of an anaerobic digester complete with an internal pump chamber that discharges to a biofilter tank. A portion of the treated effluent from the biofilter tank is then recirculated back to the inlet of the anaerobic digester with the remaining portion discharging to the WaterNOx-LS&D tank. An effluent pump located in the WaterNOx-LS&D tank will then dose the treated effluent to the leaching bed. Considering Unit Precast Ltd. as the supplier, the anerobic digester tank and WaterNOx tank will have a 2 m by 3 m footprint while the biofilter tank will have a 2.2 m square footprint.

With aerobically treated sewage, the two primary types of leaching beds are shallow buried trench leaching beds and Type A Dispersal Beds. The following paragraphs provide a brief summary of each type.

Consideration could be given to a shallow buried trench leaching bed designed in accordance with Section 8.7.6 of the OBC. In this case, aerobically treated effluent is time-dosed evenly over a 24-hour period to a closed loop of small diameter pressurized lines. Referring to the conceptual design layouts for Lots 2 and 6, somewhere in the order of 85 to 90 m of shallow buried trench would be designed at 2.0 m minimum spacing beneath prefabricated plastic dome structures. The shallow buried trench lines must be located a minimum of 5 m off of the dwelling and 3 m off of lot lines. The bottom of the chamber must provide a minimum 900 mm vertical separation to groundwater. Note that while the length of shallow buried trench is based on the underlying poor draining native soils, it is recommended that sand fill be imported to the bed areas as indicated on the conceptual layouts to provide a better drainage environment and minimize the potential of smearing during excavation. From a grading perspective, the leaching bed area must remain higher than the surrounding land to shed surface water runoff.

Considering a percolation rate of T > 50 min/cm and peak sewage flow of Q = 2,500 L/day, a Type A Dispersal Bed designed in accordance with Section 8.7.7 of the OBC could be considered. In this case, aerobically treated sewage is pumped to traditional 75 mm diameter perforated piping installed within a continuous layer of stone overlying a layer of sand. Referring to the conceptual design layout for Lot 8, the leaching bed comprises 4 runs of 9.2 m of distribution piping contained within 50 m^2 area of crushed stone overlying a 340 m^2 area of imported sand. The stone area must be located a minimum of 5 m off of the dwelling, 3 m off of lot lines and be provided with a sand mantle extending at least 15 m downgradient of the stone. For this type of system, a minimum 900 mm vertical separation must be provided between groundwater and the underside of stone layer. From a grading perspective, the final grade over the pipe and stone area must be kept no less than about 1 m above the final grade at the toe of the sand mantle extension.

We have outlined general sizing and construction requirements of both a shallow buried leaching bed and a Type A Dispersal Bed. The attached conceptual layouts demonstrate that both leaching bed styles are functional alternatives for this development. Decisions regarding which system is most appropriate and associated design details demonstrating compliance with the Ontario Building Code will be provided at the building permit application stage once the overall grading plan is established and once finalized house plans become available.

4.0 Operation and Maintenance

Following the requirements of the Ontario Building Code, each owner in this subdivision will receive an operations manual. This manual will outline the operating, servicing, and maintenance requirements of the unit and its related components to ensure proper operation in accordance with the design and specifications.

Each owner will need to enter into an agreement with a person who possesses a copy of a technical manual and is authorized by the manufacturer to service and maintain the chosen system. The person authorized by the manufacturer of the system shall take a grab sample of the treated effluent to determine the level of $CBOD_5$ and suspended solids with results submitted promptly to the chief building official. HCS may impose testing requirements related to nitrate removal that fall outside of the requirements of the Ontario Building Code.

5.0 Water Supply

It is understood that these lots will be serviced by individual private water wells. The wells shall be cased to a minimum depth of 6 m and located more than 15 m away from the treatment tanks and leaching beds.

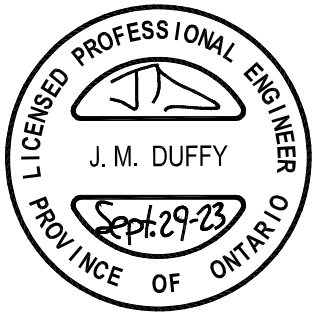
6.0 Approval and Construction Requirements

Once final house plans become available, Van Harten will be designing sewage systems that comply with Part 8 of the OBC and the conclusions of the HCS report. The designs will be accompanied with an engineering report that will be suitable for review by the Township of Mapleton building department and for construction by a licensed installer.

7.0 Closure

I trust that this report and conceptual design layouts have been completed within our terms of reference and will be helpful in your completion of the overall grading and drainage design of this subdivision. Please contact our office if you have any questions or require further information.

Van Harten Surveying Inc.



John Duffy, P. Eng.
Consulting Engineer

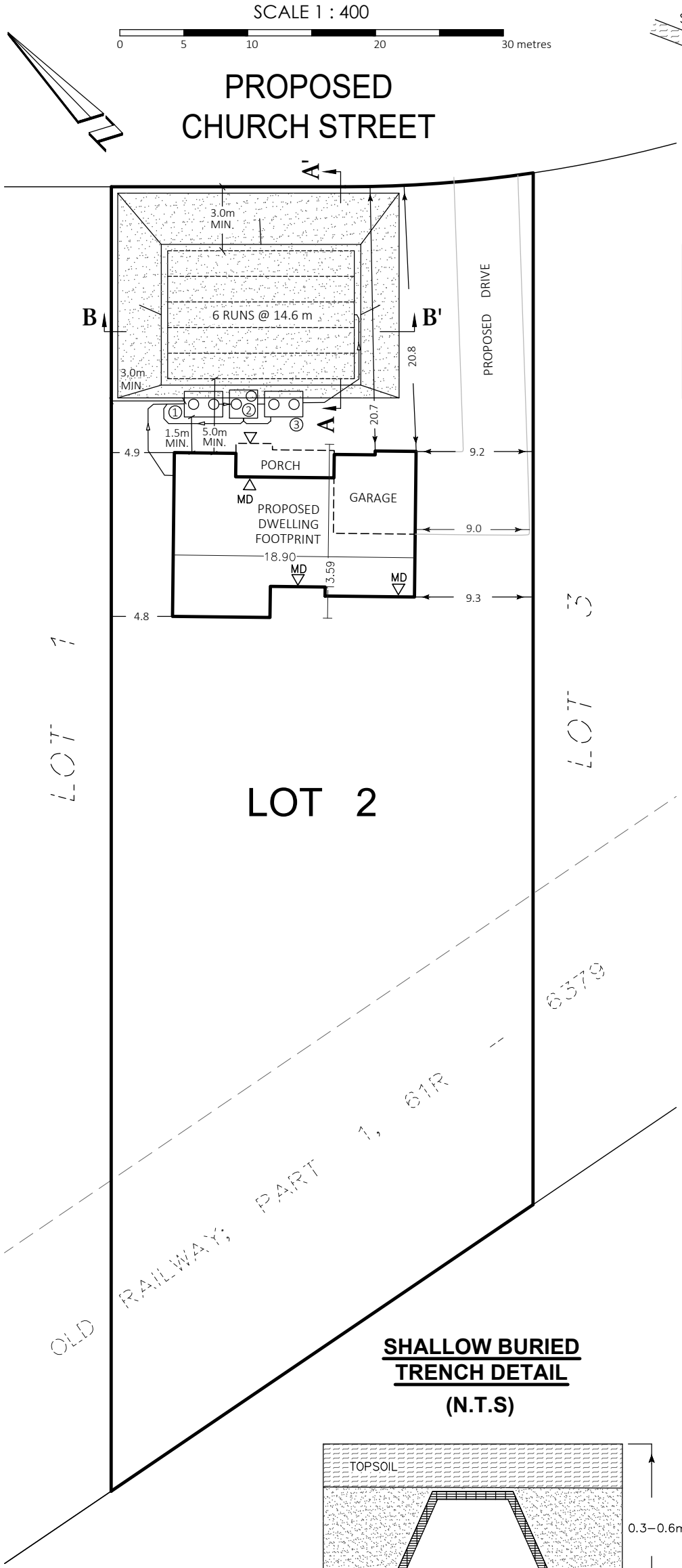
Encl. Conceptual Design Lot 2
Encl. Conceptual Design Lot 6
Encl. Conceptual Design Lot 8

ec Kevin Vanleeuwen, Exact Construction

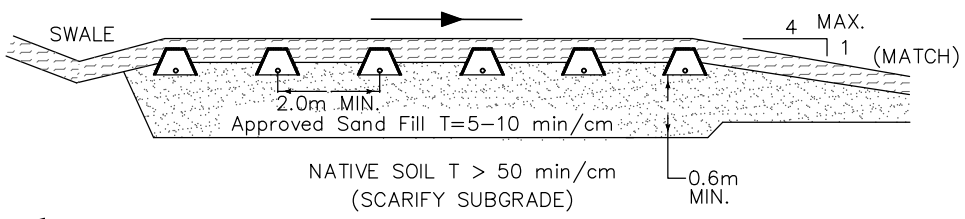
CONCEPTUAL DESIGN FOR: LOT 2, ALMA SUBDIVISION

SCALE 1 : 400

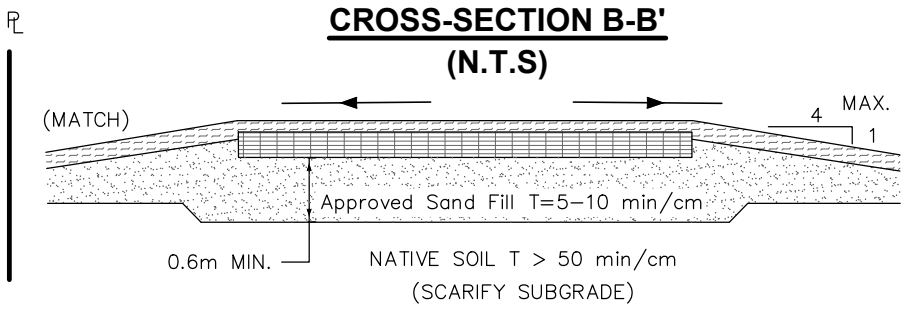
0 5 10 20 30 metres



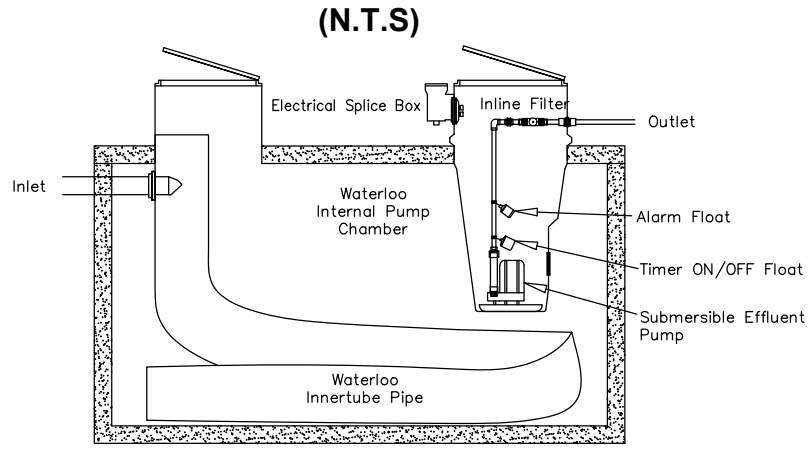
CROSS-SECTION A-A'
(N.T.S)



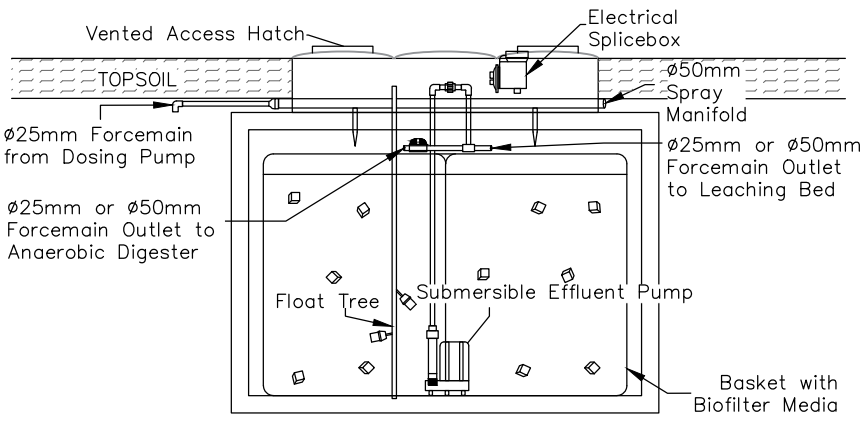
CROSS-SECTION B-B'
(N.T.S)



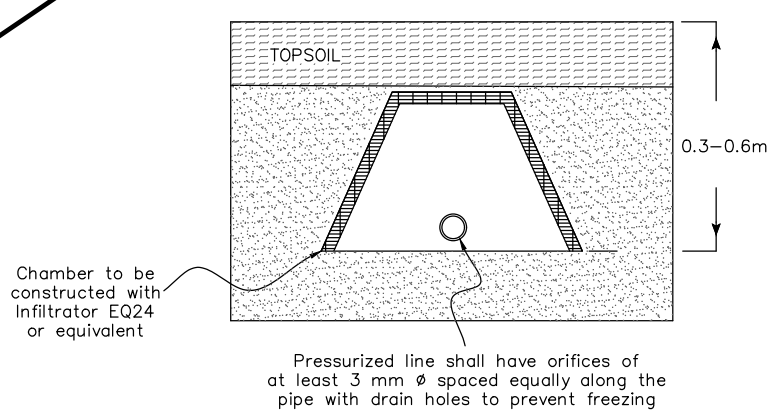
ANAEROBIC DIGESTER WITH INTERNAL PUMP CHAMBER DETAIL
(N.T.S)



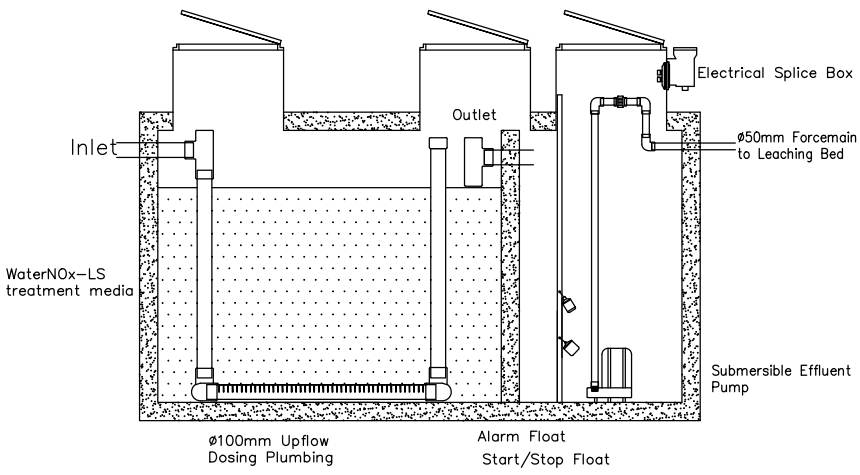
BASKETS IN CONCRETE TANK DETAIL
(N.T.S)



SHALLOW BURIED TRENCH DETAIL
(N.T.S)



WATERNOX-LS&D TANK DETAIL
(N.T.S)



SEWAGE SYSTEM DESIGN NOTES:

Q = 2,500 L/Day

T > 50 min/cm

Waterloo Biofilter Model AD-BA30

① Anaerobic Digester Complete with Internal Pump Chamber

② Biofilter Tank

③ WaterNOx-LS&D Tank

Sand Area = 352 m^2

Shallow Buried Trench = (6 runs @ 14.6 m) = 87.6 m

LEGEND:

- *AREA OF SAND*

Van Harten SURVEYING INC.
LAND SURVEYORS and ENGINEERS

Kitchener/Waterloo	Guelph	Orangeville
Ph: 519-742-8371	Ph: 519-821-2763	Ph: 519-940-4110

www.vanharten.com info@vanharten.com

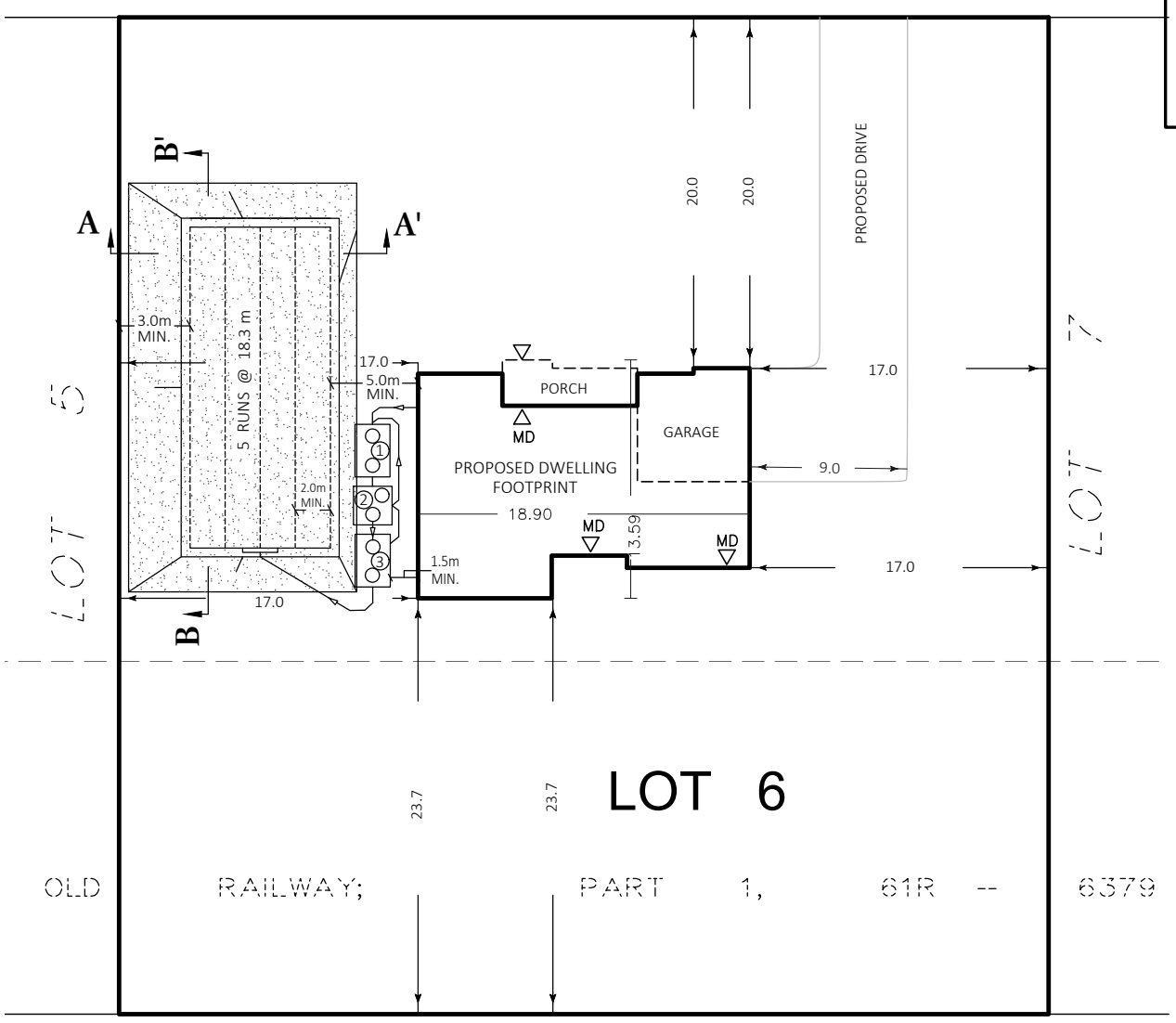
DRAWN BY: JRH/NCH	CHECKED BY: JMD	PROJECT No. 29069-20

Sep 13, 2022-1:51:08 PM
G:\PILKINGTON\CON 1 WGR\EXACT ALMA SUBDIVISION\ACAD\EXACT DRAFT PLAN SUB (7) UTM WITH SAMPLE HOUSE.dwg

CONCEPTUAL DESIGN FOR:
LOT 6, ALMA SUBDIVISION

SCALE 1 : 400

0 5 10 20 30 metres



SEWAGE SYSTEM DESIGN NOTES:

Q = 2,500 L/Day

T > 50 min/cm

Waterloo Biofilter Model AD-BA30

① Anaerobic Digester Complete with Internal Pump Chamber

② Biofilter Tank

③ WaterNOx-LS&D Tank

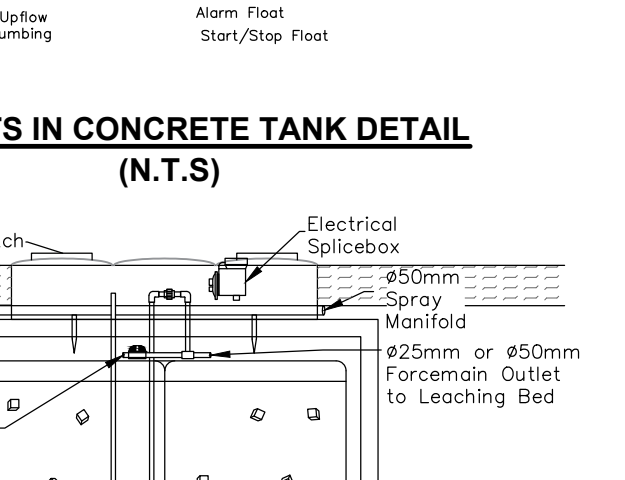
Sand Area = 303 m^2

Shallow Buried Trench = (5 runs @ 18.3 m) = 91.5 m

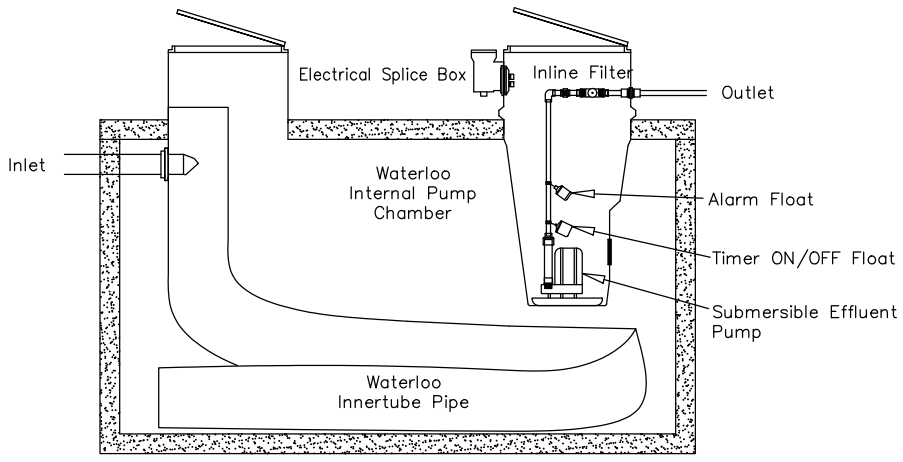
LEGEND:

- *AREA OF SAND*

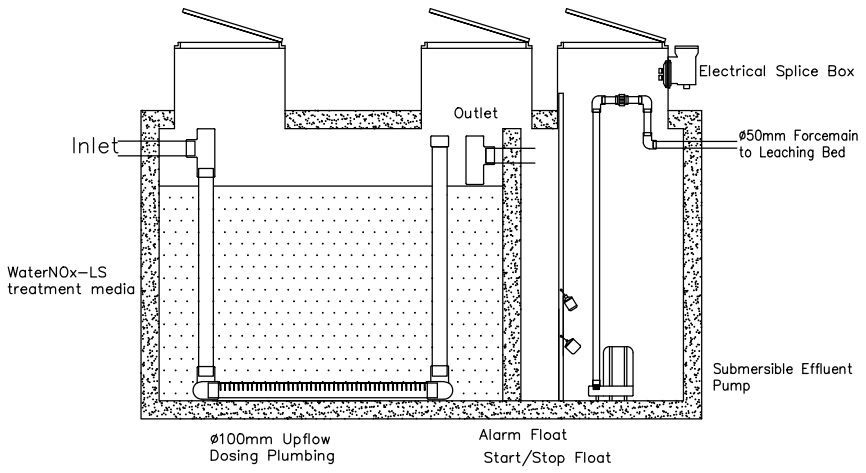
SHALLOW BURIED TRENCH DETAIL (N.T.S)



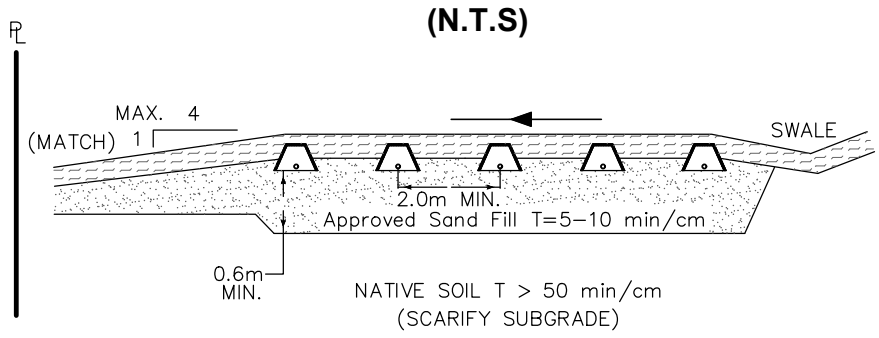
ANAEROBIC DIGESTER WITH INTERNAL PUMP CHAMBER DETAIL (N.T.S)



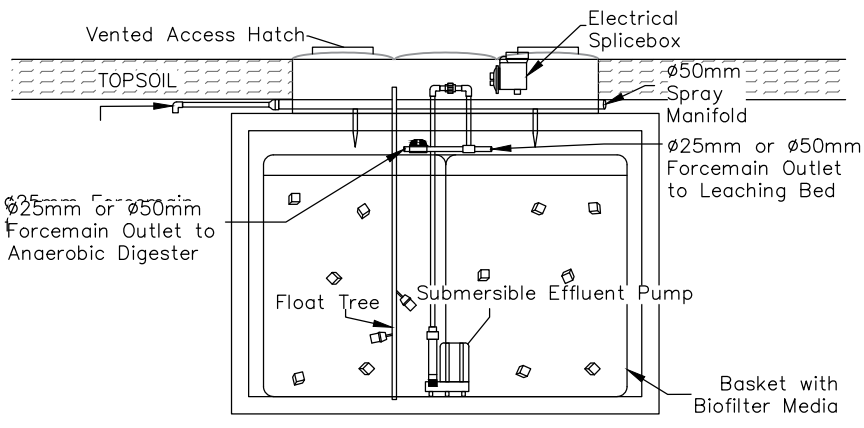
WATERNOX-LS&D TANK DETAIL (N.T.S)



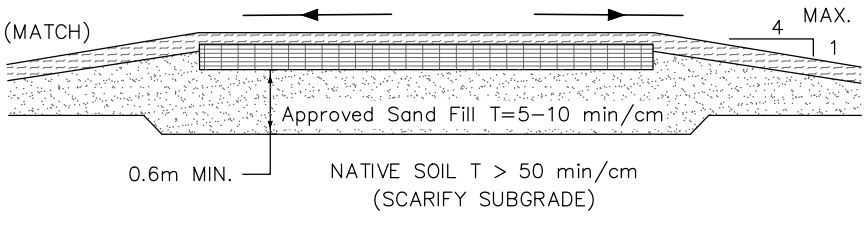
CROSS-SECTION A-A' (N.T.S)



BASKETS IN CONCRETE TANK DETAIL (N.T.S)



CROSS-SECTION B-B' (N.T.S)



Van Harten SURVEYING INC.
LAND SURVEYORS and ENGINEERS

Kitchener/Waterloo	Guelph	Orangeville
Ph: 519-742-8371	Ph: 519-821-2763	Ph: 519-940-4110

www.vanharten.com info@vanharten.com

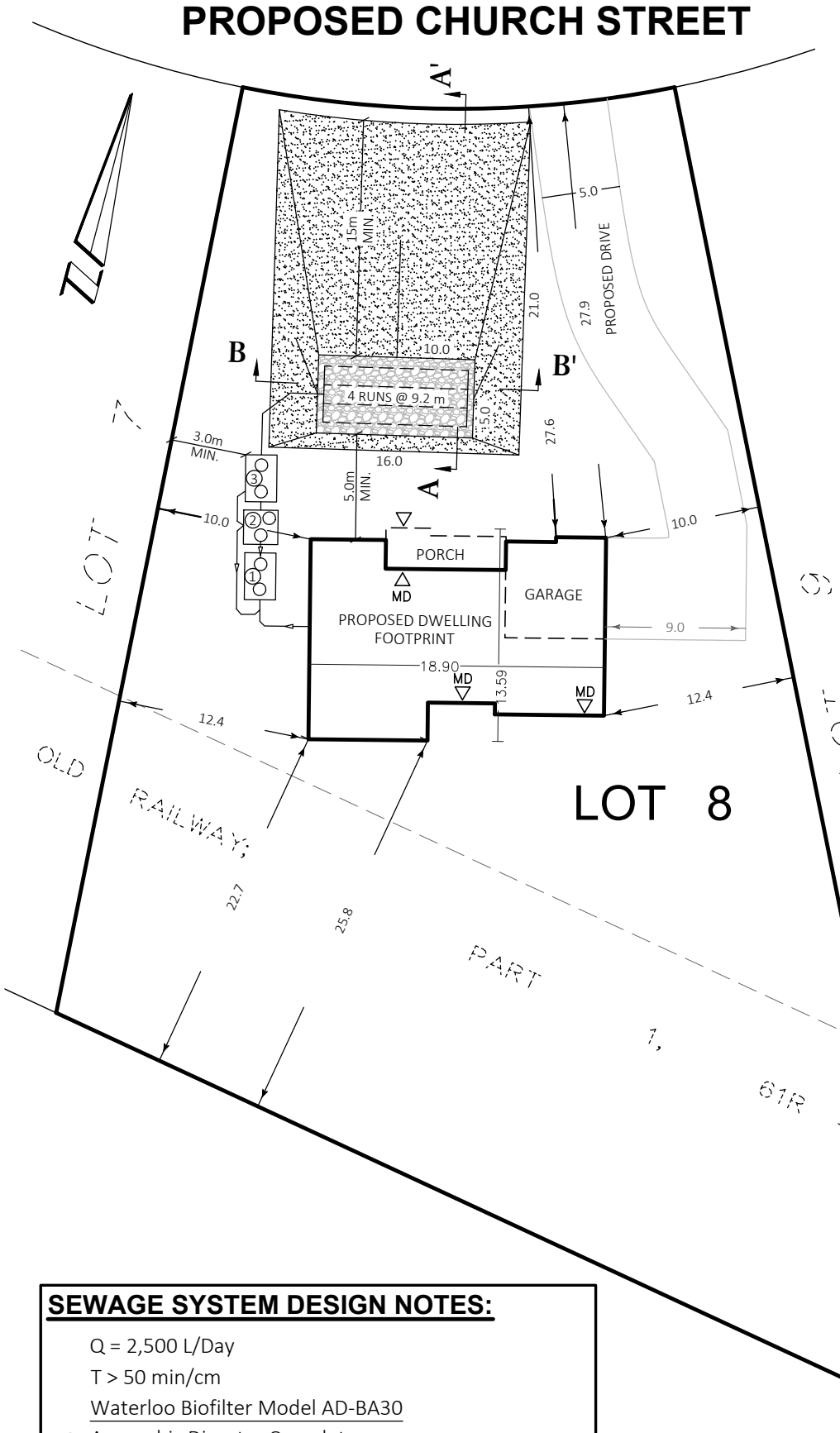
DRAWN BY: JRH/NCH	CHECKED BY: JMD	PROJECT No. 29069-20

Sep 13, 2022-1:51:08 PM
G:\PILKINGTON\CON 1 WGR\EXACT ALMA SUBDIVISION\ACAD\EXACT DRAFT PLAN SUB (7) UTM WITH SAMPLE HOUSE.dwg

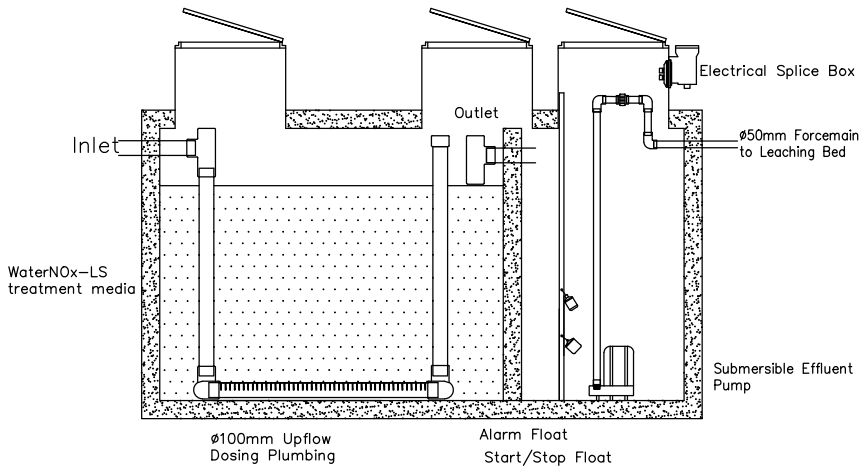
CONCEPTUAL DESIGN FOR: LOT 8, ALMA SUBDIVISION

SCALE 1 : 400

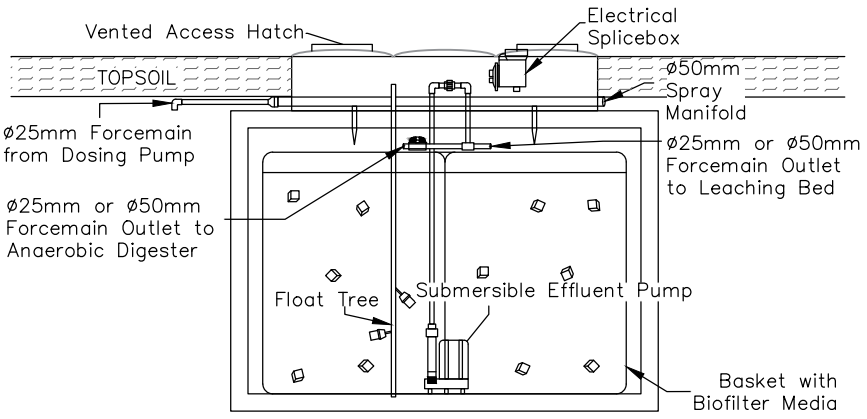
5 10 20 30 metres



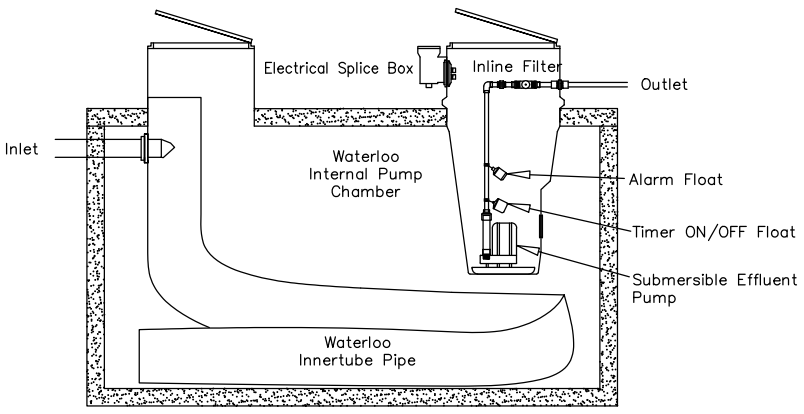
WATERNOX-LS&D TANK DETAIL
(N.T.S)



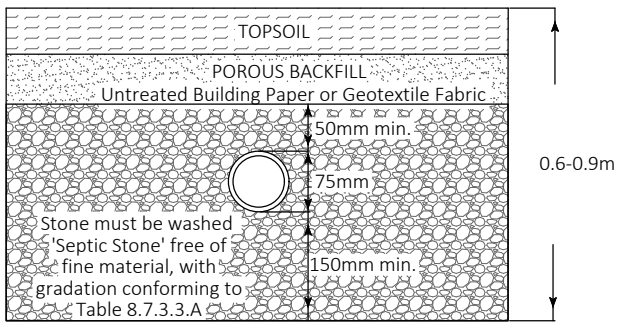
BASKETS IN CONCRETE TANK DETAIL
(N.T.S)



ANAEROBIC DIGESTER WITH INTERNAL PUMP CHAMBER DETAIL
(N.T.S)



DISTRIBUTION LAYER DETAIL
(N.T.S)



SEWAGE SYSTEM DESIGN NOTES:

Q = 2,500 L/Day

T > 50 min/cm

Waterloo Biofilter Model AD-BA30

① Anaerobic Digester Complete with Internal Pump Chamber

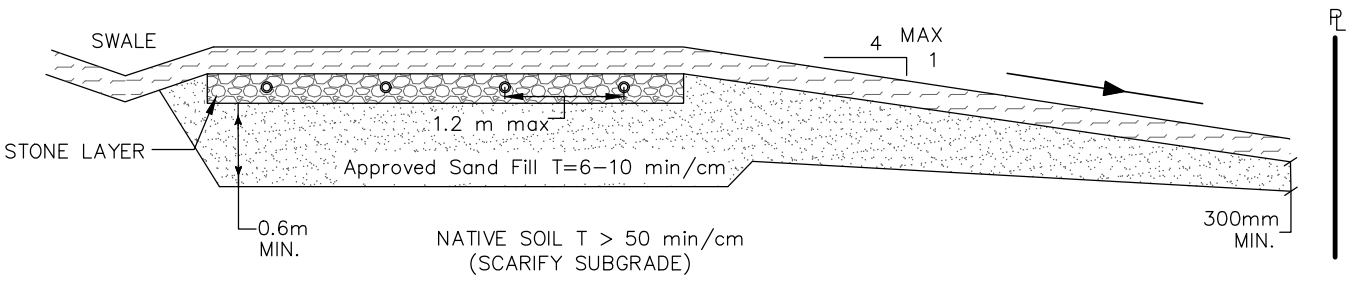
② Biofilter Tank

③ WaterNOx-LS&D Tank

Sand Area = 340 m^2

Distribution Pipe Length = (4 runs @ 9.2 m) = 36.8 m

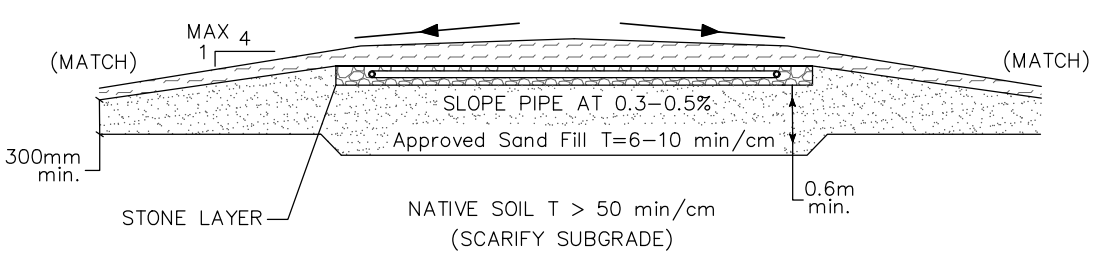
CROSS-SECTION A-A'
(N.T.S)



LEGEND:

- AREA OF SAND
- AREA OF STONE

CROSS-SECTION B-B'
(N.T.S)



Van Harten SURVEYING INC.
LAND SURVEYORS and ENGINEERS

Kitchener/Waterloo	Guelph	Orangeville
Ph: 519-742-8371	Ph: 519-821-2763	Ph: 519-940-4110

www.vanharten.com info@vanharten.com

DRAWN BY: JRH/NCH	CHECKED BY: JMD	PROJECT No. 29069-20

Sep 13, 2022-1:51:08 PM
G:\PILKINGTON\CON 1 WGR\EXACT ALMA SUBDIVISION\ACAD\EXACT DRAFT PLAN SUB (7) UTM WITH SAMPLE HOUSE.dwg

APPENDIX D

Preliminary Storm Sewer Design Calculations (Drainage Area Plan and Calculation Sheet)

ALMA SUBDIVISION
TOWNSHIP OF MAPLETON

WELLINGTON COUNTY ROAD No. 17
KNOWN AS PEEL STREET
ROAD ALLOWANCE BETWEEN TOWNSHIPS OF PEEL & PILKINGTON
PIN 71425-0057 (LT)

WELLINGTON ROAD No. 17

CHURCH STREET

ALEXANDER STREET

QUEEN STREET SOUTH

NAPIER STREET

LOT 1
CONCESSION 1
WEST OF GRAND RIVER

2
5.56 | 0.50

1
1.03 | 0.50

LEGEND

DRAINAGE AREA BOUNDARY

201
CATCHMENT NUMBER
0.11 | 80
RUNOFF COEFFICIENT "C"
CATCHMENT AREA IN HECTARES

30 0 20 40 80
1:2000 (m)

PRELIMINARY STORM SEWER DRAINAGE AREA PLAN

Figure No. 5

BluePlan ENGINEERING

120139
SEPTEMBER 2024
Scale: 1:2000 | NAD 1983 UTM Zone 17N

FILE:\\geiconsultants.com\data\Data_Storage\Working\exact Construction\2401042 - 120139 Alma Subdivision\5 Work In Progress\Drafting\Sheets\Figures\120139 - SWM Figures.dwg LAYOUT:Preliminary Storm Sewer
LAST SAVED BY:Eriarm3933, 9/16/2024 1:19:37 PM PLOTTED BY:Armstrong, Erin 9/16/2024 1:30:28 PM

Mount Forest Chicago Storm Parameters

A = 876.909
B = 7.781
C = 0.78

Intensity = $A / (t + B)^C$

Q = CiA (m^3/s)

STORM SEWER DESIGN

5 Year Design

Alma Subdivision - Preliminary Pipe Sizing

Location			Area (ha)	Runoff Coefficient	A x C	Cumulative A x C	Time of Conc. (min.)	Intensity (mm/hr)	Flow (m^3/s)	Proposed Sewer						
Street	From	To								Length (m)	Pipe Size (mm)	Type of Pipe	Grade %	Capacity (m^3/s)	Full Flow Velocity (m/s)	Time of Flow (min.)
Church Street	Catchment 1	Low Spot	1.03	0.5	0.52	0.52	10.00	92.89	**0.133**		375	0.013	2.00	0.258	2.33	-
Church Street	Catchment 2	Low Spot	5.56	0.5	2.78	2.78	10.00	92.89	**0.717**		675	0.013	1.81	1.175	3.28	-
SWM Block	Low Spot	Headwall	-	-	-	3.30	10.00	92.89	**0.850**		900	0.013	0.50	1.330	2.09	-

Minimum diameter = 300 mm
Minimum acceptable velocity = 0.75 m/s
Maximum acceptable velocity = 4.5 m/s

Date:	February 27, 2024	Project:	Alma Subdivision
Designed By:	SZ		
Checked By:	AEK	File:	120139

APPENDIX E

Pre-Development Conditions Stormwater Management Analysis

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:           C:\Users\rsingh\Desktop\My Jobs\120139\"
"                                                                      NEW SWM"
"                Output filename:                 120139 - Existing 2 year.out"
"                Licensee name:                                           gmbp"
"                Company                                                     "
"                Date & Time last used:               1/30/2024 at 12:13:17 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"     1440.000   Max. Storm length"
"     1440.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"      758.485   Coefficient A"
"        7.538   Constant B"
"        0.806   Exponent C"
"        0.375   Fraction R"
"     1440.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           83.116    mm/hr"
"             Total depth                 51.605    mm"
"            6   002hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 102"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          102   Presbyterian Church"
"        0.000   % Impervious"
"        0.080   Total Area"
"       40.000   Flow length"
"        2.000   Overland Slope"
"        0.080   Pervious Area"
"       40.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       40.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    0.002     0.000     0.000     0.000 c.m/sec"
"             Catchment 102          Pervious   Impervious Total Area "
"             Surface Area           0.080      0.000      0.080      hectare"
"             Time of concentration  22.117     2.839      22.117     minutes"
"             Time to Centroid       567.140    625.688    567.140    minutes"
"             Rainfall depth         51.605     51.605     51.605     mm"
"             Rainfall volume        41.28      0.00       41.28      c.m"
"             Rainfall losses        47.395     2.243      47.395     mm"
"             Runoff depth           4.210      49.362     4.210      mm"
"             Runoff volume          3.37       0.00       3.37       c.m"
"             Runoff coefficient     0.082      0.000      0.082      "
"             Maximum flow           0.002      0.000      0.002      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.002     0.002     0.000     0.000"
" 33          CATCHMENT 100"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          100   Site"
"        0.000   % Impervious"
"        7.880   Total Area"
"      300.000   Flow length"
"        2.000   Overland Slope"
"        7.880   Pervious Area"
"      300.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"      300.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.070     0.002     0.000     0.000 c.m/sec"
"             Catchment 100          Pervious   Impervious Total Area "
"             Surface Area           7.880      0.000      7.880      hectare"
"             Time of concentration  74.091     9.510      74.090     minutes"
"             Time to Centroid       613.303    636.249    613.303    minutes"
"             Rainfall depth         51.605     51.605     51.605     mm"
"             Rainfall volume        4066.46    0.00       4066.46    c.m"
"             Rainfall losses        47.384     2.124      47.384     mm"
"             Runoff depth           4.221      49.481     4.221      mm"
"             Runoff volume          332.62     0.00       332.63     c.m"
```

```
"             Runoff coefficient     0.082      0.000      0.082      "
"             Maximum flow           0.070      0.000      0.070      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.070     0.071     0.000     0.000"
" 33          CATCHMENT 101"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          101   Ex. Ditch"
"        0.000   % Impervious"
"        0.130   Total Area"
"       10.000   Flow length"
"        2.000   Overland Slope"
"        0.130   Pervious Area"
"       10.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       10.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.005     0.071     0.000     0.000 c.m/sec"
"             Catchment 101          Pervious   Impervious Total Area "
"             Surface Area           0.130      0.000      0.130      hectare"
"             Time of concentration  9.627      1.236      9.627      minutes"
"             Time to Centroid       555.974    622.927    555.974    minutes"
"             Rainfall depth         51.605     51.605     51.605     mm"
"             Rainfall volume        67.09      0.00       67.09      c.m"
"             Rainfall losses        47.430     2.503      47.430     mm"
"             Runoff depth           4.175      49.101     4.175      mm"
"             Runoff volume          5.43       0.00       5.43       c.m"
"             Runoff coefficient     0.081      0.000      0.081      "
"             Maximum flow           0.005      0.000      0.005      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.005     0.071     0.000     0.000"
" 38          START/RE-START TOTALS 101"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                      8.090    hectare"
"             Total Impervious area                     0.000    hectare"
"             Total % impervious                        0.000"
```

```
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:           C:\Users\rsingh\Desktop\My Jobs\120139\"
"                                                                      NEW SWM"
"                Output filename:                 120139 - Existing 5 year.out"
"                Licensee name:                                           gmbp"
"                Company                                                     "
"                Date & Time last used:               1/30/2024 at 12:25:39 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"     1440.000   Max. Storm length"
"     1440.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"      876.909   Coefficient A"
"        7.781   Constant B"
"        0.780   Exponent C"
"        0.375   Fraction R"
"     1440.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          101.955    mm/hr"
"             Total depth                 72.080    mm"
"            6   005hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 102"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          102   Presbyterian Church"
"        0.000   % Impervious"
"        0.080   Total Area"
"       40.000   Flow length"
"        2.000   Overland Slope"
"        0.080   Pervious Area"
"       40.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       40.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    0.007     0.000     0.000     0.000 c.m/sec"
"             Catchment 102          Pervious   Impervious Total Area "
"             Surface Area           0.080      0.000      0.080      hectare"
"             Time of concentration  15.274     2.616      15.274     minutes"
"             Time to Centroid       564.465    627.733    564.465    minutes"
"             Rainfall depth         72.080     72.080     72.080     mm"
"             Rainfall volume        57.66      0.00       57.66      c.m"
"             Rainfall losses        59.941     2.487      59.941     mm"
"             Runoff depth           12.139     69.594     12.139     mm"
"             Runoff volume          9.71       0.00       9.71       c.m"
"             Runoff coefficient     0.168      0.000      0.168      "
"             Maximum flow           0.007      0.000      0.007      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.007     0.007     0.000     0.000"
" 33          CATCHMENT 100"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          100   Site"
"        0.000   % Impervious"
"        7.880   Total Area"
"      300.000   Flow length"
"        2.000   Overland Slope"
"        7.880   Pervious Area"
"      300.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"      300.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.240     0.007     0.000     0.000 c.m/sec"
"             Catchment 100          Pervious   Impervious Total Area "
"             Surface Area           7.880      0.000      7.880      hectare"
"             Time of concentration  51.166     8.763      51.165     minutes"
"             Time to Centroid       602.313    637.297    602.313    minutes"
"             Rainfall depth         72.080     72.080     72.080     mm"
"             Rainfall volume        5679.94    0.01       5679.94    c.m"
"             Rainfall losses        59.924     2.212      59.924     mm"
"             Runoff depth           12.156     69.869     12.156     mm"
"             Runoff volume          957.92     0.01       957.93     c.m"
```

```
"             Runoff coefficient     0.169      0.000      0.169      "
"             Maximum flow           0.240      0.000      0.240      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.240     0.242     0.000     0.000"
" 33          CATCHMENT 101"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          101   Ex. Ditch"
"        0.000   % Impervious"
"        0.130   Total Area"
"       10.000   Flow length"
"        2.000   Overland Slope"
"        0.130   Pervious Area"
"       10.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       10.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.018     0.242     0.000     0.000 c.m/sec"
"             Catchment 101          Pervious   Impervious Total Area "
"             Surface Area           0.130      0.000      0.130      hectare"
"             Time of concentration  6.648      1.139      6.648      minutes"
"             Time to Centroid       555.309    625.608    555.309    minutes"
"             Rainfall depth         72.080     72.080     72.080     mm"
"             Rainfall volume        93.70      0.00       93.70      c.m"
"             Rainfall losses        60.166     3.103      60.166     mm"
"             Runoff depth           11.915     68.977     11.915     mm"
"             Runoff volume          15.49      0.00       15.49      c.m"
"             Runoff coefficient     0.165      0.000      0.165      "
"             Maximum flow           0.018      0.000      0.018      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.018     0.243     0.000     0.000"
" 38          START/RE-START TOTALS 101"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                      8.090    hectare"
"             Total Impervious area                     0.000    hectare"
"             Total % impervious                        0.000"
```

```
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:           C:\Users\rsingh\Desktop\My Jobs\120139\"
"                                                                      NEW SWM"
"                Output filename:                120139 - Existing 10 year.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:               1/30/2024 at 12:30:18 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"     1440.000   Max. Storm length"
"     1440.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"      997.497   Coefficient A"
"        8.438   Constant B"
"        0.775   Exponent C"
"        0.375   Fraction R"
"     1440.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          113.928    mm/hr"
"             Total depth                 85.001    mm"
"            6   010hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 102"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          102   Presbyterian Church"
"        0.000   % Impervious"
"        0.080   Total Area"
"       40.000   Flow length"
"        2.000   Overland Slope"
"        0.080   Pervious Area"
"       40.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       40.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    0.010     0.000     0.000     0.000 c.m/sec"
"             Catchment 102          Pervious   Impervious Total Area "
"             Surface Area           0.080      0.000      0.080      hectare"
"             Time of concentration  14.336     2.502      14.336     minutes"
"             Time to Centroid       563.828    627.249    563.828    minutes"
"             Rainfall depth         85.001     85.001     85.001     mm"
"             Rainfall volume        68.00      0.00       68.00      c.m"
"             Rainfall losses        67.173     2.617      67.173     mm"
"             Runoff depth           17.829     82.385     17.829     mm"
"             Runoff volume          14.26      0.00       14.26      c.m"
"             Runoff coefficient     0.210      0.000      0.210      "
"             Maximum flow           0.010      0.000      0.010      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.010     0.010     0.000     0.000"
" 33          CATCHMENT 100"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          100   Site"
"        0.000   % Impervious"
"        7.880   Total Area"
"      300.000   Flow length"
"        2.000   Overland Slope"
"        7.880   Pervious Area"
"      300.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"      300.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.361     0.010     0.000     0.000 c.m/sec"
"             Catchment 100          Pervious   Impervious Total Area "
"             Surface Area           7.880      0.000      7.880      hectare"
"             Time of concentration  48.025     8.383      48.024     minutes"
"             Time to Centroid       599.669    636.302    599.669    minutes"
"             Rainfall depth         85.001     85.001     85.001     mm"
"             Rainfall volume        6698.09    0.01       6698.10    c.m"
"             Rainfall losses        67.167     2.265      67.167     mm"
"             Runoff depth           17.835     82.736     17.835     mm"
"             Runoff volume          1405.37    0.01       1405.37    c.m"
```

```
"             Runoff coefficient     0.210      0.000      0.210      "
"             Maximum flow           0.361      0.000      0.361      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.361     0.364     0.000     0.000"
" 33          CATCHMENT 101"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          101   Ex. Ditch"
"        0.000   % Impervious"
"        0.130   Total Area"
"       10.000   Flow length"
"        2.000   Overland Slope"
"        0.130   Pervious Area"
"       10.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       10.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.025     0.364     0.000     0.000 c.m/sec"
"             Catchment 101          Pervious   Impervious Total Area "
"             Surface Area           0.130      0.000      0.130      hectare"
"             Time of concentration  6.240      1.089      6.240      minutes"
"             Time to Centroid       555.201    625.081    555.201    minutes"
"             Rainfall depth         85.001     85.001     85.001     mm"
"             Rainfall volume        110.50     0.00       110.50     c.m"
"             Rainfall losses        67.344     3.551      67.344     mm"
"             Runoff depth           17.657     81.451     17.657     mm"
"             Runoff volume          22.95      0.00       22.95      c.m"
"             Runoff coefficient     0.208      0.000      0.208      "
"             Maximum flow           0.025      0.000      0.025      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.025     0.366     0.000     0.000"
" 38          START/RE-START TOTALS 101"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                      8.090    hectare"
"             Total Impervious area                     0.000    hectare"
"             Total % impervious                        0.000"
```

```
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:           C:\Users\rsingh\Desktop\My Jobs\120139\"
"                                                                      NEW SWM"
"                Output filename:                120139 - Existing 25 year.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                1/30/2024 at 2:01:05 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"     1440.000   Max. Storm length"
"     1440.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     1145.741   Coefficient A"
"        9.035   Constant B"
"        0.769   Exponent C"
"        0.375   Fraction R"
"     1440.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          129.475    mm/hr"
"             Total depth                101.960    mm"
"            6   025hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 102"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          102   Presbyterian Church"
"        0.000   % Impervious"
"        0.080   Total Area"
"       40.000   Flow length"
"        2.000   Overland Slope"
"        0.080   Pervious Area"
"       40.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       40.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    0.014     0.000     0.000     0.000 c.m/sec"
"             Catchment 102          Pervious   Impervious Total Area "
"             Surface Area           0.080      0.000      0.080      hectare"
"             Time of concentration  13.444     2.378      13.444     minutes"
"             Time to Centroid       563.061    626.944    563.061    minutes"
"             Rainfall depth         101.960    101.960    101.960    mm"
"             Rainfall volume        81.57      0.00       81.57      c.m"
"             Rainfall losses        76.665     2.877      76.665     mm"
"             Runoff depth           25.295     99.082     25.295     mm"
"             Runoff volume          20.24      0.00       20.24      c.m"
"             Runoff coefficient     0.248      0.000      0.248      "
"             Maximum flow           0.014      0.000      0.014      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.014     0.014     0.000     0.000"
" 33          CATCHMENT 100"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          100   Site"
"        0.000   % Impervious"
"        7.880   Total Area"
"      300.000   Flow length"
"        2.000   Overland Slope"
"        7.880   Pervious Area"
"      300.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"      300.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.558     0.014     0.000     0.000 c.m/sec"
"             Catchment 100          Pervious   Impervious Total Area "
"             Surface Area           7.880      0.000      7.880      hectare"
"             Time of concentration  45.036     7.965      45.036     minutes"
"             Time to Centroid       596.249    635.557    596.249    minutes"
"             Rainfall depth         101.960    101.960    101.960    mm"
"             Rainfall volume        8034.40    0.01       8034.41    c.m"
"             Rainfall losses        76.551     2.379      76.550     mm"
"             Runoff depth           25.409     99.580     25.409     mm"
"             Runoff volume          2002.23    0.01       2002.23    c.m"
```

```
"             Runoff coefficient     0.249      0.000      0.249      "
"             Maximum flow           0.558      0.000      0.558      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.558     0.561     0.000     0.000"
" 33          CATCHMENT 101"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          101   Ex. Ditch"
"        0.000   % Impervious"
"        0.130   Total Area"
"       10.000   Flow length"
"        2.000   Overland Slope"
"        0.130   Pervious Area"
"       10.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       10.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.031     0.561     0.000     0.000 c.m/sec"
"             Catchment 101          Pervious   Impervious Total Area "
"             Surface Area           0.130      0.000      0.130      hectare"
"             Time of concentration  5.852      1.035      5.852      minutes"
"             Time to Centroid       555.207    624.849    555.207    minutes"
"             Rainfall depth         101.960    101.960    101.960    mm"
"             Rainfall volume        132.55     0.00       132.55     c.m"
"             Rainfall losses        76.742     4.137      76.742     mm"
"             Runoff depth           25.218     97.823     25.218     mm"
"             Runoff volume          32.78      0.00       32.78      c.m"
"             Runoff coefficient     0.247      0.000      0.247      "
"             Maximum flow           0.031      0.000      0.031      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.031     0.564     0.000     0.000"
" 38          START/RE-START TOTALS 101"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                      8.090    hectare"
"             Total Impervious area                     0.000    hectare"
"             Total % impervious                        0.000"
```

```
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:           C:\Users\rsingh\Desktop\My Jobs\120139\"
"                                                                      NEW SWM"
"                Output filename:               120139 - Existing 50 year.out"
"                Licensee name:                                           gmbp"
"                Company                                                     "
"                Date & Time last used:               1/30/2024 at 2:07:22 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"     1440.000   Max. Storm length"
"     1440.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     1273.113   Coefficient A"
"        9.492   Constant B"
"        0.770   Exponent C"
"        0.375   Fraction R"
"     1440.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          140.566    mm/hr"
"             Total depth                112.445    mm"
"            6   050hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 102"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          102   Presbyterian Church"
"        0.000   % Impervious"
"        0.080   Total Area"
"       40.000   Flow length"
"        2.000   Overland Slope"
"        0.080   Pervious Area"
"       40.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       40.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    0.016     0.000     0.000     0.000 c.m/sec"
"             Catchment 102          Pervious   Impervious Total Area "
"             Surface Area           0.080      0.000      0.080      hectare"
"             Time of concentration  12.942     2.301      12.942     minutes"
"             Time to Centroid       562.750    626.055    562.750    minutes"
"             Rainfall depth         112.445    112.445    112.445    mm"
"             Rainfall volume        89.96      0.00       89.96      c.m"
"             Rainfall losses        81.993     3.043      81.993     mm"
"             Runoff depth           30.452     109.402    30.452     mm"
"             Runoff volume          24.36      0.00       24.36      c.m"
"             Runoff coefficient     0.271      0.000      0.271      "
"             Maximum flow           0.016      0.000      0.016      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.016     0.016     0.000     0.000"
" 33          CATCHMENT 100"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          100   Site"
"        0.000   % Impervious"
"        7.880   Total Area"
"      300.000   Flow length"
"        2.000   Overland Slope"
"        7.880   Pervious Area"
"      300.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"      300.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.690     0.016     0.000     0.000 c.m/sec"
"             Catchment 100          Pervious   Impervious Total Area "
"             Surface Area           7.880      0.000      7.880      hectare"
"             Time of concentration  43.354     7.707      43.353     minutes"
"             Time to Centroid       594.507    634.321    594.507    minutes"
"             Rainfall depth         112.445    112.445    112.445    mm"
"             Rainfall volume        8860.70    0.01       8860.71    c.m"
"             Rainfall losses        81.856     2.484      81.856     mm"
"             Runoff depth           30.590     109.962    30.590     mm"
"             Runoff volume          2410.48    0.01       2410.49    c.m"
```

```
"             Runoff coefficient     0.272      0.000      0.272      "
"             Maximum flow           0.690      0.000      0.690      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.690     0.695     0.000     0.000"
" 33          CATCHMENT 101"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          101   Ex. Ditch"
"        0.000   % Impervious"
"        0.130   Total Area"
"       10.000   Flow length"
"        2.000   Overland Slope"
"        0.130   Pervious Area"
"       10.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       10.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.035     0.695     0.000     0.000 c.m/sec"
"             Catchment 101          Pervious   Impervious Total Area "
"             Surface Area           0.130      0.000      0.130      hectare"
"             Time of concentration  5.633      1.001      5.633      minutes"
"             Time to Centroid       555.222    624.029    555.222    minutes"
"             Rainfall depth         112.445    112.445    112.445    mm"
"             Rainfall volume        146.18     0.00       146.18     c.m"
"             Rainfall losses        82.103     4.514      82.103     mm"
"             Runoff depth           30.343     107.932    30.343     mm"
"             Runoff volume          39.45      0.00       39.45      c.m"
"             Runoff coefficient     0.270      0.000      0.270      "
"             Maximum flow           0.035      0.000      0.035      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.035     0.701     0.000     0.000"
" 38          START/RE-START TOTALS 101"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                      8.090    hectare"
"             Total Impervious area                     0.000    hectare"
"             Total % impervious                        0.000"
```

```
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:           C:\Users\rsingh\Desktop\My Jobs\120139\"
"                                                                      NEW SWM"
"                Output filename:               120139 - Existing 100 year.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                1/30/2024 at 2:09:04 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"     1440.000   Max. Storm length"
"     1440.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     1357.120   Coefficient A"
"        9.595   Constant B"
"        0.763   Exponent C"
"        0.375   Fraction R"
"     1440.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          152.190    mm/hr"
"             Total depth                126.124    mm"
"            6   100hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 102"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          102   Presbyterian Church"
"        0.000   % Impervious"
"        0.080   Total Area"
"       40.000   Flow length"
"        2.000   Overland Slope"
"        0.080   Pervious Area"
"       40.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       40.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    0.018     0.000     0.000     0.000 c.m/sec"
"             Catchment 102          Pervious   Impervious Total Area "
"             Surface Area           0.080      0.000      0.080      hectare"
"             Time of concentration  12.485     2.229      12.485     minutes"
"             Time to Centroid       563.027    626.695    563.027    minutes"
"             Rainfall depth         126.124    126.124    126.124    mm"
"             Rainfall volume        100.90     0.00       100.90     c.m"
"             Rainfall losses        89.816     3.173      89.816     mm"
"             Runoff depth           36.308     122.951    36.309     mm"
"             Runoff volume          29.05      0.00       29.05      c.m"
"             Runoff coefficient     0.288      0.000      0.288      "
"             Maximum flow           0.018      0.000      0.018      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.018     0.018     0.000     0.000"
" 33          CATCHMENT 100"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          100   Site"
"        0.000   % Impervious"
"        7.880   Total Area"
"      300.000   Flow length"
"        2.000   Overland Slope"
"        7.880   Pervious Area"
"      300.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"      300.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.822     0.018     0.000     0.000 c.m/sec"
"             Catchment 100          Pervious   Impervious Total Area "
"             Surface Area           7.880      0.000      7.880      hectare"
"             Time of concentration  41.823     7.466      41.822     minutes"
"             Time to Centroid       594.681    634.750    594.681    minutes"
"             Rainfall depth         126.124    126.124    126.124    mm"
"             Rainfall volume        9938.57    0.01       9938.58    c.m"
"             Rainfall losses        89.698     2.687      89.698     mm"
"             Runoff depth           36.426     123.437    36.426     mm"
"             Runoff volume          2870.40    0.01       2870.41    c.m"
```

```
"             Runoff coefficient     0.289      0.000      0.289      "
"             Maximum flow           0.822      0.000      0.822      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.822     0.827     0.000     0.000"
" 33          CATCHMENT 101"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          101   Ex. Ditch"
"        0.000   % Impervious"
"        0.130   Total Area"
"       10.000   Flow length"
"        2.000   Overland Slope"
"        0.130   Pervious Area"
"       10.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       10.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.040     0.827     0.000     0.000 c.m/sec"
"             Catchment 101          Pervious   Impervious Total Area "
"             Surface Area           0.130      0.000      0.130      hectare"
"             Time of concentration  5.434      0.970      5.434      minutes"
"             Time to Centroid       555.496    625.125    555.495    minutes"
"             Rainfall depth         126.124    126.124    126.124    mm"
"             Rainfall volume        163.96     0.00       163.96     c.m"
"             Rainfall losses        89.871     4.951      89.870     mm"
"             Runoff depth           36.254     121.173    36.254     mm"
"             Runoff volume          47.13      0.00       47.13      c.m"
"             Runoff coefficient     0.287      0.000      0.287      "
"             Maximum flow           0.040      0.000      0.040      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.040     0.834     0.000     0.000"
" 38          START/RE-START TOTALS 101"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                      8.090    hectare"
"             Total Impervious area                     0.000    hectare"
"             Total % impervious                        0.000"
```

```
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:           C:\Users\rsingh\Desktop\My Jobs\120139\"
"                                                                      NEW SWM"
"                Output filename:               120139 - Existing 100 year.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                1/30/2024 at 2:09:04 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"     1440.000   Max. Storm length"
"     1440.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     1357.120   Coefficient A"
"        9.595   Constant B"
"        0.763   Exponent C"
"        0.375   Fraction R"
"     1440.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          152.190    mm/hr"
"             Total depth                126.124    mm"
"            6   100hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 102"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          102   Presbyterian Church"
"        0.000   % Impervious"
"        0.080   Total Area"
"       40.000   Flow length"
"        2.000   Overland Slope"
"        0.080   Pervious Area"
"       40.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       40.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    0.018     0.000     0.000     0.000 c.m/sec"
"             Catchment 102          Pervious   Impervious Total Area "
"             Surface Area           0.080      0.000      0.080      hectare"
"             Time of concentration  12.485     2.229      12.485     minutes"
"             Time to Centroid       563.027    626.695    563.027    minutes"
"             Rainfall depth         126.124    126.124    126.124    mm"
"             Rainfall volume        100.90     0.00       100.90     c.m"
"             Rainfall losses        89.816     3.173      89.816     mm"
"             Runoff depth           36.308     122.951    36.309     mm"
"             Runoff volume          29.05      0.00       29.05      c.m"
"             Runoff coefficient     0.288      0.000      0.288      "
"             Maximum flow           0.018      0.000      0.018      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.018     0.018     0.000     0.000"
" 33          CATCHMENT 100"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          100   Site"
"        0.000   % Impervious"
"        7.880   Total Area"
"      300.000   Flow length"
"        2.000   Overland Slope"
"        7.880   Pervious Area"
"      300.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"      300.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.822     0.018     0.000     0.000 c.m/sec"
"             Catchment 100          Pervious   Impervious Total Area "
"             Surface Area           7.880      0.000      7.880      hectare"
"             Time of concentration  41.823     7.466      41.822     minutes"
"             Time to Centroid       594.681    634.750    594.681    minutes"
"             Rainfall depth         126.124    126.124    126.124    mm"
"             Rainfall volume        9938.57    0.01       9938.58    c.m"
"             Rainfall losses        89.698     2.687      89.698     mm"
"             Runoff depth           36.426     123.437    36.426     mm"
"             Runoff volume          2870.40    0.01       2870.41    c.m"
```

```
"             Runoff coefficient     0.289      0.000      0.289      "
"             Maximum flow           0.822      0.000      0.822      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.822     0.827     0.000     0.000"
" 33          CATCHMENT 101"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          101   Ex. Ditch"
"        0.000   % Impervious"
"        0.130   Total Area"
"       10.000   Flow length"
"        2.000   Overland Slope"
"        0.130   Pervious Area"
"       10.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       10.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.040     0.827     0.000     0.000 c.m/sec"
"             Catchment 101          Pervious   Impervious Total Area "
"             Surface Area           0.130      0.000      0.130      hectare"
"             Time of concentration  5.434      0.970      5.434      minutes"
"             Time to Centroid       555.496    625.125    555.495    minutes"
"             Rainfall depth         126.124    126.124    126.124    mm"
"             Rainfall volume        163.96     0.00       163.96     c.m"
"             Rainfall losses        89.871     4.951      89.870     mm"
"             Runoff depth           36.254     121.173    36.254     mm"
"             Runoff volume          47.13      0.00       47.13      c.m"
"             Runoff coefficient     0.287      0.000      0.287      "
"             Maximum flow           0.040      0.000      0.040      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.040     0.834     0.000     0.000"
" 38          START/RE-START TOTALS 101"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                      8.090    hectare"
"             Total Impervious area                     0.000    hectare"
"             Total % impervious                        0.000"
```

```
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:            C:\Users\szaga\Documents\MIDUSS\120139"
"                Output filename:                              120139_EX_Reg.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:               9/29/2023 at 11:48:57 AM"
" 31          TIME PARAMETERS"
"       60.000   Time Step"
"     2880.000   Max. Storm length"
"     5000.000   Max. Hydrograph"
" 32          STORM Historic"
"            5   Historic"
"     2880.000   Duration"
"       48.000   Rainfall intensity values"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.026     2.026     2.026     2.028"
"                  2.026     6.000     4.000     6.000    13.000"
"                 17.000    13.000    23.000    13.000    13.000"
"                 53.000    38.000    13.000"
"             Maximum intensity            53.000    mm/hr"
"             Total depth                 285.000    mm"
"            7   9999hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 102"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          102   Presbyterian Church"
"        0.000   % Impervious"
"        0.080   Total Area"
"       40.000   Flow length"
"        2.000   Overland Slope"
"        0.080   Pervious Area"
"       40.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       40.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
```

```
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.007     0.000     0.000     0.000 c.m/sec"
"             Catchment 102          Pervious   Impervious Total Area "
"             Surface Area           0.080      0.000      0.080      hectare"
"             Time of concentration  20.470     3.398      20.470     minutes"
"             Time to Centroid       2778.671   2240.650   2778.670   minutes"
"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        228.00     0.00       228.00     c.m"
"             Rainfall losses        207.046    39.000     207.046    mm"
"             Runoff depth           77.954     246.000    77.954     mm"
"             Runoff volume          62.36      0.00       62.36      c.m"
"             Runoff coefficient     0.274      0.000      0.274      "
"             Maximum flow           0.007      0.000      0.007      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.007     0.007     0.000     0.000"
" 33          CATCHMENT 100"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          100   Site"
"        0.000   % Impervious"
"        7.880   Total Area"
"      300.000   Flow length"
"        2.000   Overland Slope"
"        7.880   Pervious Area"
"      300.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"      300.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.575     0.007     0.000     0.000 c.m/sec"
"             Catchment 100          Pervious   Impervious Total Area "
"             Surface Area           7.880      0.000      7.880      hectare"
"             Time of concentration  68.574     11.385     68.574     minutes"
"             Time to Centroid       2824.284   2290.378   2824.283   minutes"
```

```
"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        2.2458     0.0000     2.2458     ha-m"
"             Rainfall losses        207.567    13.352     207.567    mm"
"             Runoff depth           77.433     271.648    77.433     mm"
"             Runoff volume          6101.70    0.02       6101.72    c.m"
"             Runoff coefficient     0.272      0.000      0.272      "
"             Maximum flow           0.575      0.000      0.575      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.575     0.581     0.000     0.000"
" 33          CATCHMENT 101"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          101   Ex. Ditch"
"        0.000   % Impervious"
"        0.130   Total Area"
"       10.000   Flow length"
"        2.000   Overland Slope"
"        0.130   Pervious Area"
"       10.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       10.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.012     0.581     0.000     0.000 c.m/sec"
"             Catchment 101          Pervious   Impervious Total Area "
"             Surface Area           0.130      0.000      0.130      hectare"
"             Time of concentration  8.910      1.479      8.910      minutes"
"             Time to Centroid       2761.635   2281.822   2761.634   minutes"
"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        370.50     0.00       370.50     c.m"
"             Rainfall losses        213.998    40.260     213.998    mm"
"             Runoff depth           71.002     244.740    71.002     mm"
"             Runoff volume          92.30      0.00       92.30      c.m"
"             Runoff coefficient     0.249      0.000      0.249      "
"             Maximum flow           0.012      0.000      0.012      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.012     0.590     0.000     0.000"
```

```
" 38          START/RE-START TOTALS 101"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                          8.090    hectare"
"             Total Impervious area                         0.000    hectare"
"             Total % impervious                            0.000"
" 19          EXIT"
```

APPENDIX F

Post-Development Conditions Stormwater Management Analysis

Alma Subdivision
Township of Mapleton
File No: 120139
Proposed Stormwater Management Pond

Active Storage Volume Calculations
Hybrid Wet pond/Wetland SWM Facility

Elevation (m)	Depth (m)	Pond Surface Area (m^2)	Perm. Pool (P.P) Volume (m^3)	Accum. P.P. Volume (m^3)	Pond Active Volume (m^3)	Accum. Active Volume (m^3)	
436.60	0.00	1,778.0	0.0	0.0			
436.70	0.10	1,885.0	183.2	183.2			
436.80	0.20	1,994.0	194.0	377.1			
436.90	0.00	2,106.0	205.0	582.1	0.0	0.0	Orifice No. 1
437.00	0.10	2,220.0			216.3	216.3	
437.10	0.20	2,336.0			227.8	444.1	
437.20	0.30	2,454.0			239.5	683.6	
437.30	0.40	2,575.0			251.5	935.1	Orifice No. 2
437.40	0.50	2,698.0			263.7	1,198.7	
437.50	0.60	2,824.0			276.1	1,474.8	
437.60	0.70	2,952.0			288.8	1,763.6	
437.70	0.80	3,084.0			301.8	2,065.4	
437.80	0.90	3,218.0			315.1	2,380.5	
437.90	1.00	3,353.0			328.6	2,709.1	
438.00	1.10	3,491.0			342.2	3,051.3	
438.10	1.20	3,631.0			356.1	3,407.4	Weir
438.20	1.30	3,778.0			370.5	3,777.8	
438.30	1.40	3,930.0			385.4	4,163.2	
438.40	1.50	4,117.0			402.4	4,565.6	Top of Pond
438.48	1.58	4,312.0			337.2	4,902.7	Overflow

Alma Subdivision
Township of Mapleton
File No: 120139
Proposed Stormwater Management Pond

Orifice No. 1			**Orifice No. 2**		
INV	436.90	m	INV	437.30	m
Q =	0.030	m^3/s	Q =	0.672	m^3/s
Cd =	0.600		Cd =	0.600	
H =	1.445	m	H =	0.8	m
2g =	19.620		2g =	19.620	
A =	0.010	m^2	A =	0.283	m^2
D =	0.110	m	D =	0.600	m

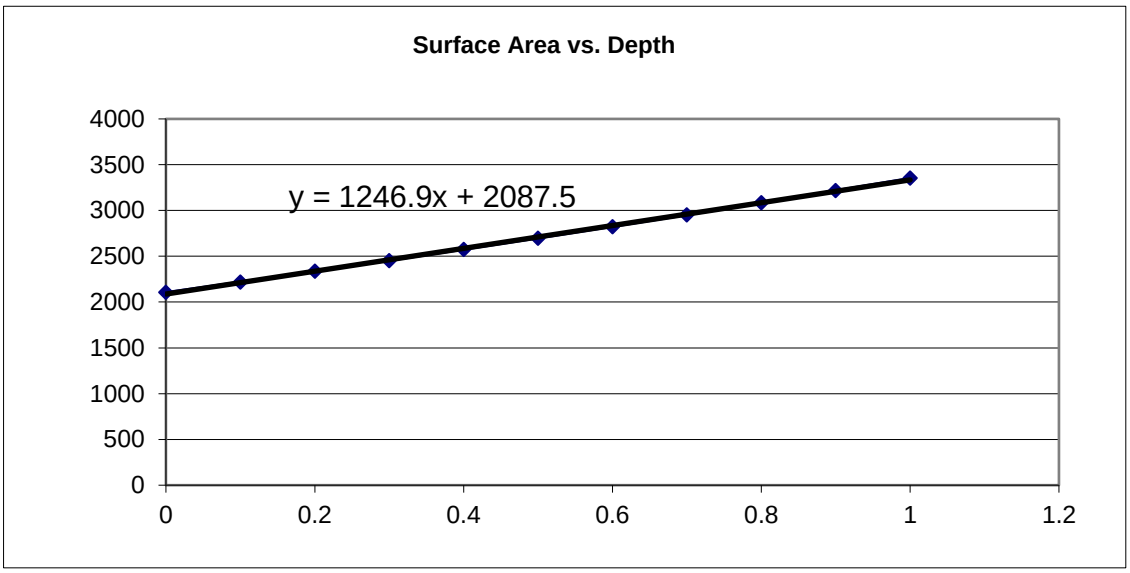
Overflow Weir

Elev	d1	h	H	2g	L	Q
m	m	m	m		m	m^3/s
438.10	1.20	1.20	0.00	19.62	10.00	0.00
438.20	1.30	1.20	0.10	19.62	10.00	0.44
438.30	1.40	1.20	0.20	19.62	10.00	1.26
438.40	1.50	1.20	0.30	19.62	10.00	2.35
438.48	1.58	1.20	0.38	19.62	10.00	3.39

Proposed Stormwater Management Pond
Stage-Storage-Discharge Table

Elevation (m)	Stage (m)	Storage (m^3)	Orifice No. 1 Control (m^3/s)	Orifice No. 2 Control (m^3/s)	Overflow Weir (m^3/s)	Actual Discharge (m^3/s)	
436.90	0.00	0.0	0.000	0.000	0.000	0.000	Orifice No. 1
437.00	0.10	216.3	0.005	0.000	0.000	0.005	
437.10	0.20	444.1	0.010	0.000	0.000	0.010	
437.20	0.30	683.6	0.013	0.000	0.000	0.013	
437.30	0.40	935.1	0.015	0.000	0.000	0.015	Orifice No. 2
437.40	0.50	1,198.7	0.017	0.030	0.000	0.047	
437.50	0.60	1,474.8	0.019	0.059	0.000	0.078	
437.60	0.70	1,763.6	0.020	0.119	0.000	0.139	
437.70	0.80	2,065.4	0.022	0.238	0.000	0.259	
437.80	0.90	2,380.5	0.023	0.336	0.000	0.359	
437.90	1.00	2,709.1	0.025	0.412	0.000	0.436	
438.00	1.10	3,051.3	0.026	0.475	0.000	0.501	
438.10	1.20	3,407.4	0.027	0.531	0.000	0.558	Weir
438.20	1.30	3,777.8	0.028	0.582	0.437	1.048	
438.30	1.40	4,163.2	0.029	0.629	1.259	1.917	
438.40	1.50	4,565.6	0.030	0.672	2.349	3.051	Top of Pond
438.48	1.58	4,902.7	0.031	0.705	3.387	4.123	Overflow

Alma Subdivision
Township of Mapleton
File No: 120139
Stormwater Management Facility Extended Detention Drawdown



Drain Down Calculations

$$t = \frac{0.66C_2h^{1.5} + 2C_3h^{0.5}}{2.75A_o}$$

Modelled extended detention volume :	721
Required extended detention volume ponding depth:	0.315

Extended Detention Orifice Sizing

Given: d = 0.110 m

A_o = 0.010 m

C_2 = 1246.9

C_3 = 2087.5

h = 0.315 - (0.110/2)

= 0.260 m

Solve for t

$$t = \frac{0.66C_2h^{1.5} + 2C_3h^{0.5}}{2.75A_o}$$

t = 85621

t = 1427

t = 24

Alma Subdivision
Township of Mapleton
File No: 120139

Stormwater Management Facility
Forebay

Forebay Length =	30.0	m	(Dist)
Forebay Top Width =	15.0	m	
Active Forebay Depth =	1.0	m	(d)
Active Forebay Bottom Width =	9.0	m	
Approximate Forebay Volume =	360	m^3	
Length Width Ratio =	2.0	:1	(r)
25 mm Storm Peak Flowrate =	0.013	m^3/s	(Q25mm)
5 Year Storm Inflow Rate =	0.884	m^3/s	(Q5)
Desired Forebay Velocity =	0.500	m/s	(Vf)
Desired Settling Velocity (recommended) =	0.0003	m/s	(Vs)

Settling Length

Dist = ((r x Q25mm)/Vs)^.5 =	9.3	m	25mm

Forebay length (30 m) exceeds the settling length (9.3 m).

Dispersion Length

Dist = (8 x Q5)/(d x Vf) =	14.1	m	5 Year

Forebay length (30 m) exceeds dispersion length (18.1 m).

Flow Velocity in Forebay

Cross-sectional Area =	12	m^2	
Cross-sectional Area (With Permanent Pool) =	16.95	m^2	A
Q5 =	0.884	m^3/s	
Velocity = Q5/A =	0.05	m/s	5 Year

The average flow velocity through the forebay meets the allowable velocity of 0.15 m/s.

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:           C:\Users\rsingh\Desktop\My Jobs\120139\"
"                                                                      NEW SWM"
"                Output filename:         120139 - Post 2 year Uncontrolled.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                  2/2/2024 at 9:57:46 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"     1440.000   Max. Storm length"
"     1440.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"      758.485   Coefficient A"
"        7.538   Constant B"
"        0.806   Exponent C"
"        0.375   Fraction R"
"     1440.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity            83.116    mm/hr"
"             Total depth                  51.605    mm"
"            6   002hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 203"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          203   Rear Yard Slope - Uncontrolled "
"        0.000   % Impervious"
"        0.530   Total Area"
"       10.000   Flow length"
"       33.000   Overland Slope"
"        0.530   Pervious Area"
"       10.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       10.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    0.021     0.000     0.000     0.000 c.m/sec"
"             Catchment 203          Pervious   Impervious Total Area "
"             Surface Area           0.530      0.000      0.530      hectare"
"             Time of concentration  9.627      1.236      9.627      minutes"
"             Time to Centroid       555.974    622.927    555.974    minutes"
"             Rainfall depth         51.605     51.605     51.605     mm"
"             Rainfall volume        273.51     0.00       273.51     c.m"
"             Rainfall losses        47.430     2.503      47.430     mm"
"             Runoff depth           4.175      49.101     4.175      mm"
"             Runoff volume          22.13      0.00       22.13      c.m"
"             Runoff coefficient     0.081      0.000      0.081      "
"             Maximum flow           0.021      0.000      0.021      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.021     0.021     0.000     0.000"
" 33          CATCHMENT 205"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          205   Presbyterian Church"
"        0.000   % Impervious"
"        0.080   Total Area"
"       40.000   Flow length"
"        2.000   Overland Slope"
"        0.080   Pervious Area"
"       40.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       40.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.002     0.021     0.000     0.000 c.m/sec"
"             Catchment 205          Pervious   Impervious Total Area "
"             Surface Area           0.080      0.000      0.080      hectare"
"             Time of concentration  22.117     2.839      22.117     minutes"
"             Time to Centroid       567.140    625.688    567.140    minutes"
"             Rainfall depth         51.605     51.605     51.605     mm"
"             Rainfall volume        41.28      0.00       41.28      c.m"
"             Rainfall losses        47.395     2.243      47.395     mm"
"             Runoff depth           4.210      49.362     4.210      mm"
"             Runoff volume          3.37       0.00       3.37       c.m"
```

```
"             Runoff coefficient     0.082      0.000      0.082      "
"             Maximum flow           0.002      0.000      0.002      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.002     0.022     0.000     0.000"
" 33          CATCHMENT 200"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          200   Site "
"       50.000   % Impervious"
"        6.330   Total Area"
"      150.000   Flow length"
"        2.000   Overland Slope"
"        3.165   Pervious Area"
"      150.000   Pervious length"
"        2.000   Pervious slope"
"        3.165   Impervious Area"
"      150.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.649     0.022     0.000     0.000 c.m/sec"
"             Catchment 200          Pervious   Impervious Total Area "
"             Surface Area           3.165      3.165      6.330      hectare"
"             Time of concentration  48.882     6.274      9.623      minutes"
"             Time to Centroid       590.936    631.190    628.027    minutes"
"             Rainfall depth         51.605     51.605     51.605     mm"
"             Rainfall volume        1633.29    1633.29    3266.59    c.m"
"             Rainfall losses        47.384     2.122      24.753     mm"
"             Runoff depth           4.221      49.483     26.852     mm"
"             Runoff volume          133.59     1566.12    1699.72    c.m"
"             Runoff coefficient     0.082      0.959      0.520      "
"             Maximum flow           0.041      0.640      0.649      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.649     0.670     0.000     0.000"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          201   Pond Block "
```

```
"       50.000   % Impervious"
"        0.660   Total Area"
"       20.000   Flow length"
"        2.000   Overland Slope"
"        0.330   Pervious Area"
"       20.000   Pervious length"
"        2.000   Pervious slope"
"        0.330   Impervious Area"
"       20.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.074     0.670     0.000     0.000 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           0.330      0.330      0.660      hectare"
"             Time of concentration  14.592     1.873      2.873      minutes"
"             Time to Centroid       560.529    623.824    618.849    minutes"
"             Rainfall depth         51.605     51.605     51.605     mm"
"             Rainfall volume        170.30     170.30     340.59     c.m"
"             Rainfall losses        47.384     2.127      24.755     mm"
"             Runoff depth           4.221      49.478     26.849     mm"
"             Runoff volume          13.93      163.28     177.21     c.m"
"             Runoff coefficient     0.082      0.959      0.520      "
"             Maximum flow           0.011      0.072      0.074      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.074     0.723     0.000     0.000"
" 33          CATCHMENT 204"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          204   Rear yard slope - Uncontrolled"
"        0.000   % Impervious"
"        0.170   Total Area"
"       10.000   Flow length"
"        2.000   Overland Slope"
"        0.170   Pervious Area"
"       10.000   Pervious length"
"       33.000   Pervious slope"
"        0.000   Impervious Area"
"       10.000   Impervious length"
"       33.000   Impervious slope"
```

```
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.010     0.723     0.000     0.000 c.m/sec"
"             Catchment 204          Pervious   Impervious Total Area "
"             Surface Area           0.170      0.000      0.170      hectare"
"             Time of concentration  4.152      0.533      4.152      minutes"
"             Time to Centroid       551.187    624.132    551.187    minutes"
"             Rainfall depth         51.605     51.605     51.605     mm"
"             Rainfall volume        87.73      0.00       87.73      c.m"
"             Rainfall losses        47.463     5.072      47.463     mm"
"             Runoff depth           4.142      46.533     4.142      mm"
"             Runoff volume          7.04       0.00       7.04       c.m"
"             Runoff coefficient     0.080      0.000      0.080      "
"             Maximum flow           0.010      0.000      0.010      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.010     0.733     0.000     0.000"
" 33          CATCHMENT 202"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          202   Ditch"
"        0.000   % Impervious"
"        0.320   Total Area"
"       10.000   Flow length"
"        2.000   Overland Slope"
"        0.320   Pervious Area"
"       10.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       10.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                  0.013     0.733     0.000     0.000 c.m/sec"
"             Catchment 202          Pervious   Impervious Total Area "
"             Surface Area           0.320      0.000      0.320      hectare"
"             Time of concentration  9.627      1.236      9.627      minutes"
"             Time to Centroid       555.974    622.926    555.974    minutes"
"             Rainfall depth         51.605     51.605     51.605     mm"
"             Rainfall volume        165.14     0.00       165.14     c.m"
"             Rainfall losses        47.430     2.503      47.430     mm"
"             Runoff depth           4.175      49.101     4.175      mm"
"             Runoff volume          13.36      0.00       13.36      c.m"
"             Runoff coefficient     0.081      0.000      0.081      "
"             Maximum flow           0.013      0.000      0.013      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                  0.013     0.746     0.000     0.000"
" 38          START/RE-START TOTALS 202"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                    8.090    hectare"
"             Total Impervious area                   3.495    hectare"
"             Total % impervious                     43.201"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:           C:\Users\rsingh\Desktop\My Jobs\120139\"
"                                                                      NEW SWM"
"                Output filename:         120139 - Post 5 year Uncontrolled.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                 2/2/2024 at 10:13:52 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"     1440.000   Max. Storm length"
"     1440.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"      876.909   Coefficient A"
"        7.781   Constant B"
"        0.780   Exponent C"
"        0.375   Fraction R"
"     1440.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           101.955    mm/hr"
"             Total depth                  72.080    mm"
"            6   005hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 203"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          203   Rear Yard Slope - Uncontrolled "
"        0.000   % Impervious"
"        0.530   Total Area"
"       10.000   Flow length"
"       33.000   Overland Slope"
"        0.530   Pervious Area"
"       10.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       10.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    0.074     0.000     0.000     0.000 c.m/sec"
"             Catchment 203          Pervious   Impervious Total Area "
"             Surface Area           0.530      0.000      0.530      hectare"
"             Time of concentration  6.648      1.139      6.648      minutes"
"             Time to Centroid       555.309    625.608    555.309    minutes"
"             Rainfall depth         72.080     72.080     72.080     mm"
"             Rainfall volume        382.03     0.00       382.03     c.m"
"             Rainfall losses        60.166     3.103      60.166     mm"
"             Runoff depth           11.915     68.977     11.915     mm"
"             Runoff volume          63.15      0.00       63.15      c.m"
"             Runoff coefficient     0.165      0.000      0.165      "
"             Maximum flow           0.074      0.000      0.074      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.074     0.074     0.000     0.000"
" 33          CATCHMENT 205"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          205   Presbyterian Church"
"        0.000   % Impervious"
"        0.080   Total Area"
"       40.000   Flow length"
"        2.000   Overland Slope"
"        0.080   Pervious Area"
"       40.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       40.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.007     0.074     0.000     0.000 c.m/sec"
"             Catchment 205          Pervious   Impervious Total Area "
"             Surface Area           0.080      0.000      0.080      hectare"
"             Time of concentration  15.274     2.616      15.274     minutes"
"             Time to Centroid       564.465    627.733    564.465    minutes"
"             Rainfall depth         72.080     72.080     72.080     mm"
"             Rainfall volume        57.66      0.00       57.66      c.m"
"             Rainfall losses        59.941     2.487      59.941     mm"
"             Runoff depth           12.139     69.594     12.139     mm"
"             Runoff volume          9.71       0.00       9.71       c.m"
```

```
"             Runoff coefficient     0.168      0.000      0.168      "
"             Maximum flow           0.007      0.000      0.007      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.007     0.078     0.000     0.000"
" 33          CATCHMENT 200"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          200   Site "
"       50.000   % Impervious"
"        6.330   Total Area"
"      150.000   Flow length"
"        2.000   Overland Slope"
"        3.165   Pervious Area"
"      150.000   Pervious length"
"        2.000   Pervious slope"
"        3.165   Impervious Area"
"      150.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.792     0.078     0.000     0.000 c.m/sec"
"             Catchment 200          Pervious   Impervious Total Area "
"             Surface Area           3.165      3.165      6.330      hectare"
"             Time of concentration  33.757     5.782      9.927      minutes"
"             Time to Centroid       583.954    632.632    625.420    minutes"
"             Rainfall depth         72.080     72.080     72.080     mm"
"             Rainfall volume        2281.35    2281.35    4562.69    c.m"
"             Rainfall losses        59.924     2.189      31.057     mm"
"             Runoff depth           12.157     69.891     41.024     mm"
"             Runoff volume          384.75     2212.05    2596.81    c.m"
"             Runoff coefficient     0.169      0.970      0.569      "
"             Maximum flow           0.138      0.748      0.792      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.792     0.870     0.000     0.000"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          201   Pond Block "
```

```
"       50.000   % Impervious"
"        0.660   Total Area"
"       20.000   Flow length"
"        2.000   Overland Slope"
"        0.330   Pervious Area"
"       20.000   Pervious length"
"        2.000   Pervious slope"
"        0.330   Impervious Area"
"       20.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.099     0.870     0.000     0.000 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           0.330      0.330      0.660      hectare"
"             Time of concentration  10.077     1.726      2.957      minutes"
"             Time to Centroid       558.902    626.076    616.169    minutes"
"             Rainfall depth         72.080     72.080     72.080     mm"
"             Rainfall volume        237.87     237.87     475.73     c.m"
"             Rainfall losses        60.034     2.435      31.235     mm"
"             Runoff depth           12.047     69.645     40.846     mm"
"             Runoff volume          39.75      229.83     269.58     c.m"
"             Runoff coefficient     0.167      0.966      0.567      "
"             Maximum flow           0.032      0.088      0.099      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.099     0.958     0.000     0.000"
" 33          CATCHMENT 204"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          204   Rear yard slope - Uncontrolled"
"        0.000   % Impervious"
"        0.170   Total Area"
"       10.000   Flow length"
"        2.000   Overland Slope"
"        0.170   Pervious Area"
"       10.000   Pervious length"
"       33.000   Pervious slope"
"        0.000   Impervious Area"
"       10.000   Impervious length"
"       33.000   Impervious slope"
```

```
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.025     0.958     0.000     0.000 c.m/sec"
"             Catchment 204          Pervious   Impervious Total Area "
"             Surface Area           0.170      0.000      0.170      hectare"
"             Time of concentration  2.867      0.491      2.867      minutes"
"             Time to Centroid       551.252    626.425    551.252    minutes"
"             Rainfall depth         72.080     72.080     72.080     mm"
"             Rainfall volume        122.54     0.00       122.54     c.m"
"             Rainfall losses        60.122     6.427      60.122     mm"
"             Runoff depth           11.958     65.654     11.958     mm"
"             Runoff volume          20.33      0.00       20.33      c.m"
"             Runoff coefficient     0.166      0.000      0.166      "
"             Maximum flow           0.025      0.000      0.025      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.025     0.983     0.000     0.000"
" 33          CATCHMENT 202"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          202   Ditch"
"        0.000   % Impervious"
"        0.320   Total Area"
"       10.000   Flow length"
"        2.000   Overland Slope"
"        0.320   Pervious Area"
"       10.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       10.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                  0.045     0.983     0.000     0.000 c.m/sec"
"             Catchment 202          Pervious   Impervious Total Area "
"             Surface Area           0.320      0.000      0.320      hectare"
"             Time of concentration  6.648      1.139      6.648      minutes"
"             Time to Centroid       555.309    625.608    555.309    minutes"
"             Rainfall depth         72.080     72.080     72.080     mm"
"             Rainfall volume        230.66     0.00       230.66     c.m"
"             Rainfall losses        60.166     3.103      60.166     mm"
"             Runoff depth           11.915     68.977     11.915     mm"
"             Runoff volume          38.13      0.00       38.13      c.m"
"             Runoff coefficient     0.165      0.000      0.165      "
"             Maximum flow           0.045      0.000      0.045      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                  0.045     1.027     0.000     0.000"
" 38          START/RE-START TOTALS 202"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                    8.090    hectare"
"             Total Impervious area                   3.495    hectare"
"             Total % impervious                     43.201"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:           C:\Users\rsingh\Desktop\My Jobs\120139\"
"                                                                      NEW SWM"
"                Output filename:       120139 - Post 10 year Uncontrolled.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                 2/2/2024 at 10:16:18 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"     1440.000   Max. Storm length"
"     1440.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"      997.497   Coefficient A"
"        8.438   Constant B"
"        0.775   Exponent C"
"        0.375   Fraction R"
"     1440.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          113.928    mm/hr"
"             Total depth                 85.001    mm"
"            6   010hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 203"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          203   Rear Yard Slope - Uncontrolled "
"        0.000   % Impervious"
"        0.530   Total Area"
"       10.000   Flow length"
"       33.000   Overland Slope"
"        0.530   Pervious Area"
"       10.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       10.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    0.101     0.000     0.000     0.000 c.m/sec"
"             Catchment 203          Pervious   Impervious Total Area "
"             Surface Area           0.530      0.000      0.530      hectare"
"             Time of concentration  6.240      1.089      6.240      minutes"
"             Time to Centroid       555.201    625.081    555.201    minutes"
"             Rainfall depth         85.001     85.001     85.001     mm"
"             Rainfall volume        450.51     0.00       450.51     c.m"
"             Rainfall losses        67.344     3.550      67.344     mm"
"             Runoff depth           17.657     81.451     17.657     mm"
"             Runoff volume          93.58      0.00       93.58      c.m"
"             Runoff coefficient     0.208      0.000      0.208      "
"             Maximum flow           0.101      0.000      0.101      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.101     0.101     0.000     0.000"
" 33          CATCHMENT 205"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          205   Presbyterian Church"
"        0.000   % Impervious"
"        0.080   Total Area"
"       40.000   Flow length"
"        2.000   Overland Slope"
"        0.080   Pervious Area"
"       40.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       40.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.010     0.101     0.000     0.000 c.m/sec"
"             Catchment 205          Pervious   Impervious Total Area "
"             Surface Area           0.080      0.000      0.080      hectare"
"             Time of concentration  14.336     2.502      14.336     minutes"
"             Time to Centroid       563.828    627.249    563.828    minutes"
"             Rainfall depth         85.001     85.001     85.001     mm"
"             Rainfall volume        68.00      0.00       68.00      c.m"
"             Rainfall losses        67.173     2.617      67.173     mm"
"             Runoff depth           17.829     82.385     17.829     mm"
"             Runoff volume          14.26      0.00       14.26      c.m"
```

```
"             Runoff coefficient     0.210      0.000      0.210      "
"             Maximum flow           0.010      0.000      0.010      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.010     0.108     0.000     0.000"
" 33          CATCHMENT 200"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          200   Site "
"       50.000   % Impervious"
"        6.330   Total Area"
"      150.000   Flow length"
"        2.000   Overland Slope"
"        3.165   Pervious Area"
"      150.000   Pervious length"
"        2.000   Pervious slope"
"        3.165   Impervious Area"
"      150.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.902     0.108     0.000     0.000 c.m/sec"
"             Catchment 200          Pervious   Impervious Total Area "
"             Surface Area           3.165      3.165      6.330      hectare"
"             Time of concentration  31.684     5.530      10.162     minutes"
"             Time to Centroid       582.266    631.816    623.042    minutes"
"             Rainfall depth         85.001     85.001     85.001     mm"
"             Rainfall volume        2690.29    2690.29    5380.58    c.m"
"             Rainfall losses        67.184     2.198      34.691     mm"
"             Runoff depth           17.817     82.803     50.310     mm"
"             Runoff volume          563.91     2620.73    3184.63    c.m"
"             Runoff coefficient     0.210      0.974      0.592      "
"             Maximum flow           0.209      0.834      0.902      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.902     1.010     0.000     0.000"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          201   Pond Block "
```

```
"       50.000   % Impervious"
"        0.660   Total Area"
"       20.000   Flow length"
"        2.000   Overland Slope"
"        0.330   Pervious Area"
"       20.000   Pervious length"
"        2.000   Pervious slope"
"        0.330   Impervious Area"
"       20.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.118     1.010     0.000     0.000 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           0.330      0.330      0.660      hectare"
"             Time of concentration  9.458      1.651      3.034      minutes"
"             Time to Centroid       558.572    625.766    613.859    minutes"
"             Rainfall depth         85.001     85.001     85.001     mm"
"             Rainfall volume        280.50     280.50     561.01     c.m"
"             Rainfall losses        67.269     2.669      34.969     mm"
"             Runoff depth           17.732     82.332     50.032     mm"
"             Runoff volume          58.52      271.70     330.21     c.m"
"             Runoff coefficient     0.209      0.969      0.589      "
"             Maximum flow           0.048      0.099      0.118      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.118     1.121     0.000     0.000"
" 33          CATCHMENT 204"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          204   Rear yard slope - Uncontrolled"
"        0.000   % Impervious"
"        0.170   Total Area"
"       10.000   Flow length"
"        2.000   Overland Slope"
"        0.170   Pervious Area"
"       10.000   Pervious length"
"       33.000   Pervious slope"
"        0.000   Impervious Area"
"       10.000   Impervious length"
"       33.000   Impervious slope"
```

```
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.033     1.121     0.000     0.000 c.m/sec"
"             Catchment 204          Pervious   Impervious Total Area "
"             Surface Area           0.170      0.000      0.170      hectare"
"             Time of concentration  2.691      0.470      2.691      minutes"
"             Time to Centroid       551.290    626.923    551.290    minutes"
"             Rainfall depth         85.001     85.001     85.001     mm"
"             Rainfall volume        144.50     0.00       144.50     c.m"
"             Rainfall losses        67.499     7.308      67.499     mm"
"             Runoff depth           17.502     77.694     17.502     mm"
"             Runoff volume          29.75      0.00       29.75      c.m"
"             Runoff coefficient     0.206      0.000      0.206      "
"             Maximum flow           0.033      0.000      0.033      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.033     1.151     0.000     0.000"
" 33          CATCHMENT 202"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          202   Ditch"
"        0.000   % Impervious"
"        0.320   Total Area"
"       10.000   Flow length"
"        2.000   Overland Slope"
"        0.320   Pervious Area"
"       10.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       10.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                  0.061     1.151     0.000     0.000 c.m/sec"
"             Catchment 202          Pervious   Impervious Total Area "
"             Surface Area           0.320      0.000      0.320      hectare"
"             Time of concentration  6.240      1.089      6.240      minutes"
"             Time to Centroid       555.201    625.081    555.201    minutes"
"             Rainfall depth         85.001     85.001     85.001     mm"
"             Rainfall volume        272.00     0.00       272.00     c.m"
"             Rainfall losses        67.344     3.551      67.344     mm"
"             Runoff depth           17.657     81.451     17.657     mm"
"             Runoff volume          56.50      0.00       56.50      c.m"
"             Runoff coefficient     0.208      0.000      0.208      "
"             Maximum flow           0.061      0.000      0.061      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                  0.061     1.212     0.000     0.000"
" 38          START/RE-START TOTALS 202"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                    8.090    hectare"
"             Total Impervious area                   3.495    hectare"
"             Total % impervious                     43.201"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:           C:\Users\rsingh\Desktop\My Jobs\120139\"
"                                                                      NEW SWM"
"                Output filename:       120139 - Post 25 year Uncontrolled.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                 2/2/2024 at 10:18:41 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"     1440.000   Max. Storm length"
"     1440.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     1145.741   Coefficient A"
"        9.035   Constant B"
"        0.769   Exponent C"
"        0.375   Fraction R"
"     1440.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          129.475    mm/hr"
"             Total depth                101.960    mm"
"            6   025hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 203"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          203   Rear Yard Slope - Uncontrolled "
"        0.000   % Impervious"
"        0.530   Total Area"
"       10.000   Flow length"
"       33.000   Overland Slope"
"        0.530   Pervious Area"
"       10.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       10.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    0.127     0.000     0.000     0.000 c.m/sec"
"             Catchment 203          Pervious   Impervious Total Area "
"             Surface Area           0.530      0.000      0.530      hectare"
"             Time of concentration  5.852      1.035      5.852      minutes"
"             Time to Centroid       555.207    624.849    555.207    minutes"
"             Rainfall depth         101.960    101.960    101.960    mm"
"             Rainfall volume        540.39     0.00       540.39     c.m"
"             Rainfall losses        76.742     4.137      76.742     mm"
"             Runoff depth           25.218     97.823     25.218     mm"
"             Runoff volume          133.65     0.00       133.65     c.m"
"             Runoff coefficient     0.247      0.000      0.247      "
"             Maximum flow           0.127      0.000      0.127      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.127     0.127     0.000     0.000"
" 33          CATCHMENT 205"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          205   Presbyterian Church"
"        0.000   % Impervious"
"        0.080   Total Area"
"       40.000   Flow length"
"        2.000   Overland Slope"
"        0.080   Pervious Area"
"       40.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       40.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.014     0.127     0.000     0.000 c.m/sec"
"             Catchment 205          Pervious   Impervious Total Area "
"             Surface Area           0.080      0.000      0.080      hectare"
"             Time of concentration  13.444     2.378      13.444     minutes"
"             Time to Centroid       563.061    626.944    563.061    minutes"
"             Rainfall depth         101.960    101.960    101.960    mm"
"             Rainfall volume        81.57      0.00       81.57      c.m"
"             Rainfall losses        76.665     2.877      76.665     mm"
"             Runoff depth           25.295     99.082     25.295     mm"
"             Runoff volume          20.24      0.00       20.24      c.m"
```

```
"             Runoff coefficient     0.248      0.000      0.248      "
"             Maximum flow           0.014      0.000      0.014      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.014     0.138     0.000     0.000"
" 33          CATCHMENT 200"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          200   Site "
"       50.000   % Impervious"
"        6.330   Total Area"
"      150.000   Flow length"
"        2.000   Overland Slope"
"        3.165   Pervious Area"
"      150.000   Pervious length"
"        2.000   Pervious slope"
"        3.165   Impervious Area"
"      150.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     1.058     0.138     0.000     0.000 c.m/sec"
"             Catchment 200          Pervious   Impervious Total Area "
"             Surface Area           3.165      3.165      6.330      hectare"
"             Time of concentration  29.712     5.255      10.224     minutes"
"             Time to Centroid       580.162    631.317    620.922    minutes"
"             Rainfall depth         101.960    101.960    101.960    mm"
"             Rainfall volume        3227.02    3227.02    6454.04    c.m"
"             Rainfall losses        76.551     2.325      39.438     mm"
"             Runoff depth           25.409     99.634     62.522     mm"
"             Runoff volume          804.19     3153.42    3957.61    c.m"
"             Runoff coefficient     0.249      0.977      0.613      "
"             Maximum flow           0.314      0.972      1.058      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     1.058     1.196     0.000     0.000"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          201   Pond Block "
```

```
"       50.000   % Impervious"
"        0.660   Total Area"
"       20.000   Flow length"
"        2.000   Overland Slope"
"        0.330   Pervious Area"
"       20.000   Pervious length"
"        2.000   Pervious slope"
"        0.330   Impervious Area"
"       20.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.150     1.196     0.000     0.000 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           0.330      0.330      0.660      hectare"
"             Time of concentration  8.870      1.569      3.056      minutes"
"             Time to Centroid       558.222    625.501    611.790    minutes"
"             Rainfall depth         101.960    101.960    101.960    mm"
"             Rainfall volume        336.47     336.47     672.93     c.m"
"             Rainfall losses        76.630     2.996      39.813     mm"
"             Runoff depth           25.330     98.964     62.147     mm"
"             Runoff volume          83.59      326.58     410.17     c.m"
"             Runoff coefficient     0.248      0.971      0.610      "
"             Maximum flow           0.069      0.112      0.150      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.150     1.337     0.000     0.000"
" 33          CATCHMENT 204"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          204   Rear yard slope - Uncontrolled"
"        0.000   % Impervious"
"        0.170   Total Area"
"       10.000   Flow length"
"        2.000   Overland Slope"
"        0.170   Pervious Area"
"       10.000   Pervious length"
"       33.000   Pervious slope"
"        0.000   Impervious Area"
"       10.000   Impervious length"
"       33.000   Impervious slope"
```

```
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.046     1.337     0.000     0.000 c.m/sec"
"             Catchment 204          Pervious   Impervious Total Area "
"             Surface Area           0.170      0.000      0.170      hectare"
"             Time of concentration  2.524      0.446      2.524      minutes"
"             Time to Centroid       551.437    627.547    551.437    minutes"
"             Rainfall depth         101.960    101.960    101.960    mm"
"             Rainfall volume        173.33     0.00       173.33     c.m"
"             Rainfall losses        77.082     8.496      77.082     mm"
"             Runoff depth           24.877     93.464     24.877     mm"
"             Runoff volume          42.29      0.00       42.29      c.m"
"             Runoff coefficient     0.244      0.000      0.244      "
"             Maximum flow           0.046      0.000      0.046      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.046     1.372     0.000     0.000"
" 33          CATCHMENT 202"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          202   Ditch"
"        0.000   % Impervious"
"        0.320   Total Area"
"       10.000   Flow length"
"        2.000   Overland Slope"
"        0.320   Pervious Area"
"       10.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       10.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                  0.076     1.372     0.000     0.000 c.m/sec"
"             Catchment 202          Pervious   Impervious Total Area "
"             Surface Area           0.320      0.000      0.320      hectare"
"             Time of concentration  5.852      1.035      5.852      minutes"
"             Time to Centroid       555.207    624.849    555.207    minutes"
"             Rainfall depth         101.960    101.960    101.960    mm"
"             Rainfall volume        326.27     0.00       326.27     c.m"
"             Rainfall losses        76.742     4.137      76.742     mm"
"             Runoff depth           25.218     97.823     25.218     mm"
"             Runoff volume          80.70      0.00       80.70      c.m"
"             Runoff coefficient     0.247      0.000      0.247      "
"             Maximum flow           0.076      0.000      0.076      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                  0.076     1.448     0.000     0.000"
" 38          START/RE-START TOTALS 202"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                    8.090    hectare"
"             Total Impervious area                   3.495    hectare"
"             Total % impervious                     43.201"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:           C:\Users\rsingh\Desktop\My Jobs\120139\"
"                                                                      NEW SWM"
"                Output filename:       120139 - Post 50 year Uncontrolled.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                 2/2/2024 at 10:28:30 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"     1440.000   Max. Storm length"
"     1440.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     1273.113   Coefficient A"
"        9.492   Constant B"
"        0.770   Exponent C"
"        0.375   Fraction R"
"     1440.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          140.566    mm/hr"
"             Total depth                112.445    mm"
"            6   050hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 203"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          203   Rear Yard Slope - Uncontrolled "
"        0.000   % Impervious"
"        0.530   Total Area"
"       10.000   Flow length"
"       33.000   Overland Slope"
"        0.530   Pervious Area"
"       10.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       10.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    0.145     0.000     0.000     0.000 c.m/sec"
"             Catchment 203          Pervious   Impervious Total Area "
"             Surface Area           0.530      0.000      0.530      hectare"
"             Time of concentration  5.633      1.001      5.633      minutes"
"             Time to Centroid       555.222    624.029    555.222    minutes"
"             Rainfall depth         112.445    112.445    112.445    mm"
"             Rainfall volume        595.96     0.00       595.96     c.m"
"             Rainfall losses        82.103     4.514      82.103     mm"
"             Runoff depth           30.343     107.932    30.343     mm"
"             Runoff volume          160.82     0.00       160.82     c.m"
"             Runoff coefficient     0.270      0.000      0.270      "
"             Maximum flow           0.145      0.000      0.145      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.145     0.145     0.000     0.000"
" 33          CATCHMENT 205"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          205   Presbyterian Church"
"        0.000   % Impervious"
"        0.080   Total Area"
"       40.000   Flow length"
"        2.000   Overland Slope"
"        0.080   Pervious Area"
"       40.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       40.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.016     0.145     0.000     0.000 c.m/sec"
"             Catchment 205          Pervious   Impervious Total Area "
"             Surface Area           0.080      0.000      0.080      hectare"
"             Time of concentration  12.942     2.301      12.942     minutes"
"             Time to Centroid       562.750    626.055    562.750    minutes"
"             Rainfall depth         112.445    112.445    112.445    mm"
"             Rainfall volume        89.96      0.00       89.96      c.m"
"             Rainfall losses        81.993     3.043      81.993     mm"
"             Runoff depth           30.452     109.402    30.452     mm"
"             Runoff volume          24.36      0.00       24.36      c.m"
```

```
"             Runoff coefficient     0.271      0.000      0.271      "
"             Maximum flow           0.016      0.000      0.016      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.016     0.159     0.000     0.000"
" 33          CATCHMENT 200"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          200   Site "
"       50.000   % Impervious"
"        6.330   Total Area"
"      150.000   Flow length"
"        2.000   Overland Slope"
"        3.165   Pervious Area"
"      150.000   Pervious length"
"        2.000   Pervious slope"
"        3.165   Impervious Area"
"      150.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     1.176     0.159     0.000     0.000 c.m/sec"
"             Catchment 200          Pervious   Impervious Total Area "
"             Surface Area           3.165      3.165      6.330      hectare"
"             Time of concentration  28.603     5.085      10.196     minutes"
"             Time to Centroid       579.105    630.239    619.125    minutes"
"             Rainfall depth         112.445    112.445    112.445    mm"
"             Rainfall volume        3558.90    3558.90    7117.80    c.m"
"             Rainfall losses        81.897     2.443      42.170     mm"
"             Runoff depth           30.549     110.002    70.276     mm"
"             Runoff volume          966.87     3481.58    4448.45    c.m"
"             Runoff coefficient     0.272      0.978      0.625      "
"             Maximum flow           0.380      1.070      1.176      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     1.176     1.336     0.000     0.000"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          201   Pond Block "
```

```
"       50.000   % Impervious"
"        0.660   Total Area"
"       20.000   Flow length"
"        2.000   Overland Slope"
"        0.330   Pervious Area"
"       20.000   Pervious length"
"        2.000   Pervious slope"
"        0.330   Impervious Area"
"       20.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.174     1.336     0.000     0.000 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           0.330      0.330      0.660      hectare"
"             Time of concentration  8.538      1.518      3.049      minutes"
"             Time to Centroid       558.176    624.537    610.062    minutes"
"             Rainfall depth         112.445    112.445    112.445    mm"
"             Rainfall volume        371.07     371.07     742.14     c.m"
"             Rainfall losses        81.969     3.206      42.587     mm"
"             Runoff depth           30.477     109.240    69.858     mm"
"             Runoff volume          100.57     360.49     461.06     c.m"
"             Runoff coefficient     0.271      0.971      0.621      "
"             Maximum flow           0.082      0.122      0.174      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.174     1.497     0.000     0.000"
" 33          CATCHMENT 204"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          204   Rear yard slope - Uncontrolled"
"        0.000   % Impervious"
"        0.170   Total Area"
"       10.000   Flow length"
"        2.000   Overland Slope"
"        0.170   Pervious Area"
"       10.000   Pervious length"
"       33.000   Pervious slope"
"        0.000   Impervious Area"
"       10.000   Impervious length"
"       33.000   Impervious slope"
```

```
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.054     1.497     0.000     0.000 c.m/sec"
"             Catchment 204          Pervious   Impervious Total Area "
"             Surface Area           0.170      0.000      0.170      hectare"
"             Time of concentration  2.429      0.432      2.429      minutes"
"             Time to Centroid       551.645    626.990    551.645    minutes"
"             Rainfall depth         112.445    112.445    112.445    mm"
"             Rainfall volume        191.16     0.00       191.16     c.m"
"             Rainfall losses        82.326     9.387      82.326     mm"
"             Runoff depth           30.120     103.059    30.120     mm"
"             Runoff volume          51.20      0.00       51.20      c.m"
"             Runoff coefficient     0.268      0.000      0.268      "
"             Maximum flow           0.054      0.000      0.054      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.054     1.535     0.000     0.000"
" 33          CATCHMENT 202"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          202   Ditch"
"        0.000   % Impervious"
"        0.320   Total Area"
"       10.000   Flow length"
"        2.000   Overland Slope"
"        0.320   Pervious Area"
"       10.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       10.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    0.087     1.535     0.000     0.000 c.m/sec"
"              Catchment 202          Pervious   Impervious Total Area "
"              Surface Area           0.320      0.000      0.320      hectare"
"              Time of concentration  5.633      1.001      5.633      minutes"
"              Time to Centroid       555.222    624.029    555.221    minutes"
"              Rainfall depth         112.445    112.445    112.445    mm"
"              Rainfall volume        359.83     0.00       359.83     c.m"
"              Rainfall losses        82.103     4.514      82.103     mm"
"              Runoff depth           30.343     107.932    30.343     mm"
"              Runoff volume          97.10      0.00       97.10      c.m"
"              Runoff coefficient     0.270      0.000      0.270      "
"              Maximum flow           0.087      0.000      0.087      c.m/sec"
" 40           HYDROGRAPH Add Runoff "
"             4   Add Runoff "
"                    0.087     1.623     0.000     0.000"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:           C:\Users\rsingh\Desktop\My Jobs\120139\"
"                                                                      NEW SWM"
"                Output filename:      120139 - Post 100 year Uncontrolled.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                 2/2/2024 at 11:11:04 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"     1440.000   Max. Storm length"
"     1440.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     1357.120   Coefficient A"
"        9.595   Constant B"
"        0.763   Exponent C"
"        0.375   Fraction R"
"     1440.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          152.190    mm/hr"
"             Total depth                126.124    mm"
"            6   100hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 203"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          203   Rear Yard Slope - Uncontrolled "
"        0.000   % Impervious"
"        0.530   Total Area"
"       10.000   Flow length"
"       33.000   Overland Slope"
"        0.530   Pervious Area"
"       10.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       10.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    0.164     0.000     0.000     0.000 c.m/sec"
"             Catchment 203          Pervious   Impervious Total Area "
"             Surface Area           0.530      0.000      0.530      hectare"
"             Time of concentration  5.434      0.970      5.434      minutes"
"             Time to Centroid       555.495    625.125    555.495    minutes"
"             Rainfall depth         126.124    126.124    126.124    mm"
"             Rainfall volume        668.46     0.00       668.46     c.m"
"             Rainfall losses        89.871     4.951      89.870     mm"
"             Runoff depth           36.254     121.173    36.254     mm"
"             Runoff volume          192.14     0.00       192.14     c.m"
"             Runoff coefficient     0.287      0.000      0.287      "
"             Maximum flow           0.164      0.000      0.164      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.164     0.164     0.000     0.000"
" 33          CATCHMENT 205"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          205   Presbyterian Church"
"        0.000   % Impervious"
"        0.080   Total Area"
"       40.000   Flow length"
"        2.000   Overland Slope"
"        0.080   Pervious Area"
"       40.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       40.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.018     0.164     0.000     0.000 c.m/sec"
"             Catchment 205          Pervious   Impervious Total Area "
"             Surface Area           0.080      0.000      0.080      hectare"
"             Time of concentration  12.485     2.229      12.485     minutes"
"             Time to Centroid       563.027    626.695    563.027    minutes"
"             Rainfall depth         126.124    126.124    126.124    mm"
"             Rainfall volume        100.90     0.00       100.90     c.m"
"             Rainfall losses        89.816     3.173      89.816     mm"
"             Runoff depth           36.308     122.951    36.309     mm"
"             Runoff volume          29.05      0.00       29.05      c.m"
```

```
"             Runoff coefficient     0.288      0.000      0.288      "
"             Maximum flow           0.018      0.000      0.018      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.018     0.181     0.000     0.000"
" 33          CATCHMENT 200"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          200   Site "
"       50.000   % Impervious"
"        6.330   Total Area"
"      150.000   Flow length"
"        2.000   Overland Slope"
"        3.165   Pervious Area"
"      150.000   Pervious length"
"        2.000   Pervious slope"
"        3.165   Impervious Area"
"      150.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     1.295     0.181     0.000     0.000 c.m/sec"
"             Catchment 200          Pervious   Impervious Total Area "
"             Surface Area           3.165      3.165      6.330      hectare"
"             Time of concentration  27.593     4.926      10.084     minutes"
"             Time to Centroid       579.332    630.701    619.010    minutes"
"             Rainfall depth         126.124    126.124    126.124    mm"
"             Rainfall volume        3991.83    3991.83    7983.66    c.m"
"             Rainfall losses        89.702     2.509      46.105     mm"
"             Runoff depth           36.422     123.615    80.019     mm"
"             Runoff volume          1152.77    3912.43    5065.20    c.m"
"             Runoff coefficient     0.289      0.980      0.634      "
"             Maximum flow           0.446      1.171      1.295      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     1.295     1.476     0.000     0.000"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          201   Pond Block "
```

```
"       50.000   % Impervious"
"        0.660   Total Area"
"       20.000   Flow length"
"        2.000   Overland Slope"
"        0.330   Pervious Area"
"       20.000   Pervious length"
"        2.000   Pervious slope"
"        0.330   Impervious Area"
"       20.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.189     1.476     0.000     0.000 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           0.330      0.330      0.660      hectare"
"             Time of concentration  8.237      1.470      3.017      minutes"
"             Time to Centroid       558.543    625.315    610.049    minutes"
"             Rainfall depth         126.124    126.124    126.124    mm"
"             Rainfall volume        416.21     416.21     832.42     c.m"
"             Rainfall losses        89.766     3.452      46.609     mm"
"             Runoff depth           36.358     122.673    79.515     mm"
"             Runoff volume          119.98     404.82     524.80     c.m"
"             Runoff coefficient     0.288      0.973      0.630      "
"             Maximum flow           0.104      0.132      0.189      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.189     1.666     0.000     0.000"
" 33          CATCHMENT 204"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          204   Rear yard slope - Uncontrolled"
"        0.000   % Impervious"
"        0.170   Total Area"
"       10.000   Flow length"
"        2.000   Overland Slope"
"        0.170   Pervious Area"
"       10.000   Pervious length"
"       33.000   Pervious slope"
"        0.000   Impervious Area"
"       10.000   Impervious length"
"       33.000   Impervious slope"
```

```
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.062     1.666     0.000     0.000 c.m/sec"
"             Catchment 204          Pervious   Impervious Total Area "
"             Surface Area           0.170      0.000      0.170      hectare"
"             Time of concentration  2.344      0.418      2.344      minutes"
"             Time to Centroid       551.946    628.104    551.946    minutes"
"             Rainfall depth         126.124    126.124    126.124    mm"
"             Rainfall volume        214.41     0.00       214.41     c.m"
"             Rainfall losses        90.171     10.418     90.171     mm"
"             Runoff depth           35.953     115.707    35.954     mm"
"             Runoff volume          61.12      0.00       61.12      c.m"
"             Runoff coefficient     0.285      0.000      0.285      "
"             Maximum flow           0.062      0.000      0.062      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.062     1.708     0.000     0.000"
" 33          CATCHMENT 202"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          202   Ditch"
"        0.000   % Impervious"
"        0.320   Total Area"
"       10.000   Flow length"
"        2.000   Overland Slope"
"        0.320   Pervious Area"
"       10.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       10.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    0.099     1.708     0.000     0.000 c.m/sec"
"             Catchment 202          Pervious   Impervious Total Area "
"             Surface Area           0.320      0.000      0.320      hectare"
"             Time of concentration  5.434      0.970      5.434      minutes"
"             Time to Centroid       555.495    625.125    555.495    minutes"
"             Rainfall depth         126.124    126.124    126.124    mm"
"             Rainfall volume        403.60     0.00       403.60     c.m"
"             Rainfall losses        89.871     4.951      89.870     mm"
"             Runoff depth           36.254     121.173    36.254     mm"
"             Runoff volume          116.01     0.00       116.01     c.m"
"             Runoff coefficient     0.287      0.000      0.287      "
"             Maximum flow           0.099      0.000      0.099      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.099     1.807     0.000     0.000"
" 38          START/RE-START TOTALS 202"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                      8.090    hectare"
"             Total Impervious area                     3.495    hectare"
"             Total % impervious                       43.201"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:            C:\Users\szaga\Documents\MIDUSS\120139"
"                Output filename:                        120139_Post_Reg-UN.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                9/29/2023 at 1:04:45 PM"
" 31          TIME PARAMETERS"
"       60.000   Time Step"
"     2880.000   Max. Storm length"
"     5000.000   Max. Hydrograph"
" 32          STORM Historic"
"            5   Historic"
"     2880.000   Duration"
"       48.000   Rainfall intensity values"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.026     2.026     2.026     2.028"
"                  2.026     6.000     4.000     6.000    13.000"
"                 17.000    13.000    23.000    13.000    13.000"
"                 53.000    38.000    13.000"
"             Maximum intensity            53.000    mm/hr"
"             Total depth                 285.000    mm"
"            7   9999hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 203"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          203   Rear Yard Slope - Uncontrolled "
"        0.000   % Impervious"
"        0.530   Total Area"
"       10.000   Flow length"
"       33.000   Overland Slope"
"        0.530   Pervious Area"
"       10.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       10.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
```

```
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.047     0.000     0.000     0.000 c.m/sec"
"             Catchment 203          Pervious   Impervious Total Area "
"             Surface Area           0.530      0.000      0.530      hectare"
"             Time of concentration  8.910      1.479      8.910      minutes"
"             Time to Centroid       2761.635   2281.822   2761.634   minutes"
"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        1510.50    0.00       1510.50    c.m"
"             Rainfall losses        213.998    40.260     213.998    mm"
"             Runoff depth           71.002     244.740    71.002     mm"
"             Runoff volume          376.31     0.00       376.31     c.m"
"             Runoff coefficient     0.249      0.000      0.249      "
"             Maximum flow           0.047      0.000      0.047      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.047     0.047     0.000     0.000"
" 33          CATCHMENT 205"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          205   Presbyterian Church"
"        0.000   % Impervious"
"        0.080   Total Area"
"       40.000   Flow length"
"        2.000   Overland Slope"
"        0.080   Pervious Area"
"       40.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       40.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.007     0.047     0.000     0.000 c.m/sec"
"             Catchment 205          Pervious   Impervious Total Area "
"             Surface Area           0.080      0.000      0.080      hectare"
"             Time of concentration  20.470     3.398      20.470     minutes"
"             Time to Centroid       2778.671   2240.650   2778.670   minutes"
```

```
"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        228.00     0.00       228.00     c.m"
"             Rainfall losses        207.046    39.000     207.046    mm"
"             Runoff depth           77.954     246.000    77.954     mm"
"             Runoff volume          62.36      0.00       62.36      c.m"
"             Runoff coefficient     0.274      0.000      0.274      "
"             Maximum flow           0.007      0.000      0.007      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.007     0.053     0.000     0.000"
" 33          CATCHMENT 200"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          200   Site "
"       50.000   % Impervious"
"        6.330   Total Area"
"      150.000   Flow length"
"        2.000   Overland Slope"
"        3.165   Pervious Area"
"      150.000   Pervious length"
"        2.000   Pervious slope"
"        3.165   Impervious Area"
"      150.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.549     0.053     0.000     0.000 c.m/sec"
"             Catchment 200          Pervious   Impervious Total Area "
"             Surface Area           3.165      3.165      6.330      hectare"
"             Time of concentration  45.242     7.511      15.948     minutes"
"             Time to Centroid       2800.591   2249.031   2372.360   minutes"
"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        0.9020     0.9020     1.8040     ha-m"
"             Rainfall losses        209.112    21.494     115.303    mm"
"             Runoff depth           75.888     263.506    169.697    mm"
"             Runoff volume          0.2402     0.8340     1.0742     ha-m"
"             Runoff coefficient     0.266      0.925      0.595      "
"             Maximum flow           0.263      0.400      0.549      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.549     0.602     0.000     0.000"
```

```
" 33          CATCHMENT 201"
"             1   Triangular SCS"
"             1   Equal length"
"             2   Horton equation"
"           201   Pond Block "
"        50.000   % Impervious"
"         0.660   Total Area"
"        20.000   Flow length"
"         2.000   Overland Slope"
"         0.330   Pervious Area"
"        20.000   Pervious length"
"         2.000   Pervious slope"
"         0.330   Impervious Area"
"        20.000   Impervious length"
"         2.000   Impervious slope"
"         0.250   Pervious Manning 'n'"
"        75.000   Pervious Max.infiltration"
"        12.500   Pervious Min.infiltration"
"         0.250   Pervious Lag constant (hours)"
"         5.000   Pervious Depression storage"
"         0.015   Impervious Manning 'n'"
"         0.000   Impervious Max.infiltration"
"         0.000   Impervious Min.infiltration"
"         0.050   Impervious Lag constant (hours)"
"         1.500   Impervious Depression storage"
"                      0.070     0.602     0.000     0.000 c.m/sec"
"              Catchment 201          Pervious   Impervious Total Area "
"              Surface Area           0.330      0.330      0.660      hectare"
"              Time of concentration  13.505     2.242      4.903      minutes"
"              Time to Centroid       2770.029   2266.892   2385.771   minutes"
"              Rainfall depth         285.000    285.000    285.000    mm"
"              Rainfall volume        940.50     940.50     1881.00    c.m"
"              Rainfall losses        209.394    40.613     125.003    mm"
"              Runoff depth           75.606     244.387    159.997    mm"
"              Runoff volume          249.50     806.48     1055.98    c.m"
"              Runoff coefficient     0.265      0.857      0.561      "
"              Maximum flow           0.028      0.042      0.070      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"             4   Add Runoff "
"                      0.070     0.672     0.000     0.000"
" 33          CATCHMENT 204"
"             1   Triangular SCS"
"             1   Equal length"
"             2   Horton equation"
"           204   Rear yard slope - Uncontrolled"
"         0.000   % Impervious"
"         0.170   Total Area"
"        10.000   Flow length"
"         2.000   Overland Slope"
"         0.170   Pervious Area"
```

```
"       10.000   Pervious length"
"       33.000   Pervious slope"
"        0.000   Impervious Area"
"       10.000   Impervious length"
"       33.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.016     0.672     0.000     0.000 c.m/sec"
"             Catchment 204          Pervious   Impervious Total Area "
"             Surface Area           0.170      0.000      0.170      hectare"
"             Time of concentration  3.843      0.638      3.843      minutes"
"             Time to Centroid       2754.335   2273.618   2754.333   minutes"
"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        484.50     0.00       484.50     c.m"
"             Rainfall losses        218.261    34.309     218.261    mm"
"             Runoff depth           66.739     250.691    66.739     mm"
"             Runoff volume          113.46     0.00       113.46     c.m"
"             Runoff coefficient     0.234      0.000      0.234      "
"             Maximum flow           0.016      0.000      0.016      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.016     0.688     0.000     0.000"
" 33          CATCHMENT 202"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          202   Ditch"
"        0.000   % Impervious"
"        0.320   Total Area"
"       10.000   Flow length"
"        2.000   Overland Slope"
"        0.320   Pervious Area"
"       10.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       10.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
```

```
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.029     0.688     0.000     0.000 c.m/sec"
"             Catchment 202          Pervious   Impervious Total Area "
"             Surface Area           0.320      0.000      0.320      hectare"
"             Time of concentration  8.910      1.479      8.910      minutes"
"             Time to Centroid       2761.635   2281.822   2761.633   minutes"
"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        912.00     0.00       912.00     c.m"
"             Rainfall losses        213.998    40.260     213.998    mm"
"             Runoff depth           71.002     244.740    71.002     mm"
"             Runoff volume          227.21     0.00       227.21     c.m"
"             Runoff coefficient     0.249      0.000      0.249      "
"             Maximum flow           0.029      0.000      0.029      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.029     0.717     0.000     0.000"
" 38          START/RE-START TOTALS 202"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                     8.090    hectare"
"             Total Impervious area                    3.495    hectare"
"             Total % impervious                      43.201"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:            C:\Users\szaga\Documents\MIDUSS\120139"
"                Output filename:                       120139_Post_0025mm.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:               9/29/2023 at 11:57:00 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      240.000   Max. Storm length"
"     3600.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     1581.200   Coefficient A"
"       13.000   Constant B"
"        1.000   Exponent C"
"        0.400   Fraction R"
"      240.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity            84.723    mm/hr"
"             Total depth                  24.999    mm"
"            8   00025hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 203"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          203   Rear Yard Slope - Uncontrolled "
"        0.000   % Impervious"
"        0.530   Total Area"
"       10.000   Flow length"
"       33.000   Overland Slope"
"        0.530   Pervious Area"
"       10.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       10.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.000     0.000     0.000     0.000 c.m/sec"
```

```
"             Catchment 203          Pervious   Impervious Total Area "
"             Surface Area           0.530      0.000      0.530      hectare"
"             Time of concentration      ---    1.226      1.226      minutes"
"             Time to Centroid       0.000      109.362    109.362    minutes"
"             Rainfall depth         24.999     24.999     24.999     mm"
"             Rainfall volume        132.50     0.00       132.50     c.m"
"             Rainfall losses        24.999     2.010      24.999     mm"
"             Runoff depth           0.000      22.989     0.000      mm"
"             Runoff volume          0.00       0.00       0.00       c.m"
"             Runoff coefficient     0.000      0.000      0.000      "
"             Maximum flow           0.000      0.000      0.000      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.000     0.000     0.000     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.000     0.000     0.000     0.000"
" 40          HYDROGRAPH   Combine    1000"
"            6   Combine "
"         1000   Node #"
"                Total from Site "
"             Maximum flow                  0.000    c.m/sec"
"             Hydrograph volume             0.000    c.m"
"                     0.000     0.000     0.000     0.000"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.000     0.000     0.000     0.000"
" 33          CATCHMENT 205"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          205   Presbyterian Church"
"        0.000   % Impervious"
"        0.080   Total Area"
"       40.000   Flow length"
"        2.000   Overland Slope"
"        0.080   Pervious Area"
"       40.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       40.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
```

```
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.000     0.000     0.000     0.000 c.m/sec"
"             Catchment 205          Pervious   Impervious Total Area "
"             Surface Area           0.080      0.000      0.080      hectare"
"             Time of concentration      ---    2.817      2.817      minutes"
"             Time to Centroid       0.000      111.623    111.623    minutes"
"             Rainfall depth         24.999     24.999     24.999     mm"
"             Rainfall volume        20.00      0.00       20.00      c.m"
"             Rainfall losses        24.999     2.050      24.999     mm"
"             Runoff depth           0.000      22.949     0.000      mm"
"             Runoff volume          0.00       0.00       0.00       c.m"
"             Runoff coefficient     0.000      0.000      0.000      "
"             Maximum flow           0.000      0.000      0.000      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.000     0.000     0.000     0.000"
" 33          CATCHMENT 200"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          200   Site "
"       50.000   % Impervious"
"        6.330   Total Area"
"      150.000   Flow length"
"        2.000   Overland Slope"
"        3.165   Pervious Area"
"      150.000   Pervious length"
"        2.000   Pervious slope"
"        3.165   Impervious Area"
"      150.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.615     0.000     0.000     0.000 c.m/sec"
"             Catchment 200          Pervious   Impervious Total Area "
"             Surface Area           3.165      3.165      6.330      hectare"
"             Time of concentration      ---    6.226      6.226      minutes"
"             Time to Centroid       0.000      116.340    116.340    minutes"
"             Rainfall depth         24.999     24.999     24.999     mm"
"             Rainfall volume        791.23     791.23     1582.45    c.m"
"             Rainfall losses        24.999     1.639      13.319     mm"
```

```
"             Runoff depth           0.000      23.360     11.680     mm"
"             Runoff volume          0.00       739.35     739.35     c.m"
"             Runoff coefficient     0.000      0.934      0.467      "
"             Maximum flow           0.000      0.615      0.615      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.615     0.615     0.000     0.000"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          201   Pond Block "
"       50.000   % Impervious"
"        0.660   Total Area"
"       20.000   Flow length"
"        2.000   Overland Slope"
"        0.330   Pervious Area"
"       20.000   Pervious length"
"        2.000   Pervious slope"
"        0.330   Impervious Area"
"       20.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.068     0.615     0.000     0.000 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           0.330      0.330      0.660      hectare"
"             Time of concentration      ---    1.859      1.859      minutes"
"             Time to Centroid       0.000      110.186    110.186    minutes"
"             Rainfall depth         24.999     24.999     24.999     mm"
"             Rainfall volume        82.50      82.50      164.99     c.m"
"             Rainfall losses        24.999     1.779      13.389     mm"
"             Runoff depth           0.000      23.220     11.610     mm"
"             Runoff volume          0.00       76.63      76.63      c.m"
"             Runoff coefficient     0.000      0.929      0.464      "
"             Maximum flow           0.000      0.068      0.068      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.068     0.662     0.000     0.000"
" 54          POND DESIGN"
"        0.662   Current peak flow    c.m/sec"
"        0.933   Target outflow    c.m/sec"
```

```
"        816.0   Hydrograph volume    c.m"
"          17.   Number of stages"
"        0.000   Minimum water level    metre"
"        3.000   Maximum water level    metre"
"        0.000   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                436.900     0.000     0.000"
"                437.000   0.00500   216.300"
"                437.100   0.01000   444.100"
"                437.200   0.01300   683.600"
"                437.300   0.01500   935.100"
"                437.400   0.04700  1198.700"
"                437.500   0.07800  1474.800"
"                437.600    0.1390  1763.600"
"                437.700    0.2590  2065.400"
"                437.800    0.3590  2380.500"
"                437.900    0.4360  2709.100"
"                438.000    0.5010  3051.300"
"                438.100    0.5580  3407.400"
"                438.200     1.048  3777.800"
"                438.300     1.917  4163.200"
"                438.400     3.051  4565.600"
"                438.480     4.123  4902.700"
"             Peak outflow                  0.013    c.m/sec"
"             Maximum level               437.215    metre"
"             Maximum storage             721.156    c.m"
"             Centroidal lag               14.382   hours"
"                  0.068     0.662     0.013     0.000 c.m/sec"
" 40          HYDROGRAPH Next link "
"            5   Next link "
"                     0.068     0.013     0.013     0.000"
" 33          CATCHMENT 204"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          204   Rear yard slope - Uncontrolled"
"        0.000   % Impervious"
"        0.170   Total Area"
"       10.000   Flow length"
"        2.000   Overland Slope"
"        0.170   Pervious Area"
"       10.000   Pervious length"
"       33.000   Pervious slope"
"        0.000   Impervious Area"
"       10.000   Impervious length"
"       33.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
```

```
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.000     0.013     0.013     0.000 c.m/sec"
"             Catchment 204          Pervious   Impervious Total Area "
"             Surface Area           0.170      0.000      0.170      hectare"
"             Time of concentration      ---    0.529      0.529      minutes"
"             Time to Centroid       0.000      108.700    108.700    minutes"
"             Rainfall depth         24.999     24.999     24.999     mm"
"             Rainfall volume        42.50      0.00       42.50      c.m"
"             Rainfall losses        24.999     4.064      24.999     mm"
"             Runoff depth           0.000      20.935     0.000      mm"
"             Runoff volume          0.00       0.00       0.00       c.m"
"             Runoff coefficient     0.000      0.000      0.000      "
"             Maximum flow           0.000      0.000      0.000      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.000     0.013     0.013     0.000"
" 33          CATCHMENT 202"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          202   Ditch"
"        0.000   % Impervious"
"        0.320   Total Area"
"       10.000   Flow length"
"        2.000   Overland Slope"
"        0.320   Pervious Area"
"       10.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       10.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.000     0.013     0.013     0.000 c.m/sec"
"             Catchment 202          Pervious   Impervious Total Area "
"             Surface Area           0.320      0.000      0.320      hectare"
```

```
"             Time of concentration      ---    1.226      1.226      minutes"
"             Time to Centroid       0.000      109.362    109.362    minutes"
"             Rainfall depth         24.999     24.999     24.999     mm"
"             Rainfall volume        80.00      0.00       80.00      c.m"
"             Rainfall losses        24.999     2.010      24.999     mm"
"             Runoff depth           0.000      22.989     0.000      mm"
"             Runoff volume          0.00       0.00       0.00       c.m"
"             Runoff coefficient     0.000      0.000      0.000      "
"             Maximum flow           0.000      0.000      0.000      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.000     0.013     0.013     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.000     0.013     0.013     0.000"
" 40          HYDROGRAPH   Combine    1000"
"            6   Combine "
"         1000   Node #"
"                Total from Site "
"             Maximum flow                  0.013    c.m/sec"
"             Hydrograph volume           808.778    c.m"
"                    0.000     0.013     0.013     0.013"
" 40          HYDROGRAPH   Confluence    1000"
"            7   Confluence "
"         1000   Node #"
"                Total from Site "
"             Maximum flow                  0.013    c.m/sec"
"             Hydrograph volume           808.778    c.m"
"                    0.000     0.013     0.013     0.000"
" 38          START/RE-START TOTALS 1000"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                      8.090    hectare"
"             Total Impervious area                     3.495    hectare"
"             Total % impervious                       43.201"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:           C:\Users\rsingh\Desktop\My Jobs\120139\"
"                                                                      NEW SWM"
"                Output filename:          120139 - Post 2 year Controlled.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                1/30/2024 at 2:22:21 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"     1440.000   Max. Storm length"
"     1440.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"      758.485   Coefficient A"
"        7.538   Constant B"
"        0.806   Exponent C"
"        0.375   Fraction R"
"     1440.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           83.116    mm/hr"
"             Total depth                 51.605    mm"
"            6   002hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 203"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          203   Rear Yard Slope - Uncontrolled "
"        0.000   % Impervious"
"        0.530   Total Area"
"       10.000   Flow length"
"       33.000   Overland Slope"
"        0.530   Pervious Area"
"       10.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       10.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    0.021     0.000     0.000     0.000 c.m/sec"
"             Catchment 203          Pervious   Impervious Total Area "
"             Surface Area           0.530      0.000      0.530      hectare"
"             Time of concentration  9.627      1.236      9.627      minutes"
"             Time to Centroid       555.974    622.927    555.974    minutes"
"             Rainfall depth         51.605     51.605     51.605     mm"
"             Rainfall volume        273.51     0.00       273.51     c.m"
"             Rainfall losses        47.430     2.503      47.430     mm"
"             Runoff depth           4.175      49.101     4.175      mm"
"             Runoff volume          22.13      0.00       22.13      c.m"
"             Runoff coefficient     0.081      0.000      0.081      "
"             Maximum flow           0.021      0.000      0.021      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.021     0.021     0.000     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.021     0.021     0.021     0.000"
" 40          HYDROGRAPH   Combine    1000"
"            6   Combine "
"         1000   Node #"
"                Total from Site "
"             Maximum flow                 0.021    c.m/sec"
"             Hydrograph volume           22.126    c.m"
"                    0.021     0.021     0.021     0.021"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.021     0.000     0.021     0.021"
" 33          CATCHMENT 205"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          205   Presbyterian Church"
"        0.000   % Impervious"
"        0.080   Total Area"
"       40.000   Flow length"
"        2.000   Overland Slope"
"        0.080   Pervious Area"
"       40.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       40.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
```

```
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.002     0.000     0.021     0.021 c.m/sec"
"             Catchment 205          Pervious   Impervious Total Area "
"             Surface Area           0.080      0.000      0.080      hectare"
"             Time of concentration  22.117     2.839      22.117     minutes"
"             Time to Centroid       567.140    625.688    567.140    minutes"
"             Rainfall depth         51.605     51.605     51.605     mm"
"             Rainfall volume        41.28      0.00       41.28      c.m"
"             Rainfall losses        47.395     2.243      47.395     mm"
"             Runoff depth           4.210      49.362     4.210      mm"
"             Runoff volume          3.37       0.00       3.37       c.m"
"             Runoff coefficient     0.082      0.000      0.082      "
"             Maximum flow           0.002      0.000      0.002      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.002     0.002     0.021     0.021"
" 33          CATCHMENT 200"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          200   Site "
"       50.000   % Impervious"
"        6.330   Total Area"
"      150.000   Flow length"
"        2.000   Overland Slope"
"        3.165   Pervious Area"
"      150.000   Pervious length"
"        2.000   Pervious slope"
"        3.165   Impervious Area"
"      150.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.649     0.002     0.021     0.021 c.m/sec"
"             Catchment 200          Pervious   Impervious Total Area "
"             Surface Area           3.165      3.165      6.330      hectare"
"             Time of concentration  48.882     6.274      9.623      minutes"
"             Time to Centroid       590.936    631.190    628.027    minutes"
"             Rainfall depth         51.605     51.605     51.605     mm"
"             Rainfall volume        1633.29    1633.29    3266.59    c.m"
```

```
"             Rainfall losses        47.384     2.122      24.753     mm"
"             Runoff depth           4.221      49.483     26.852     mm"
"             Runoff volume          133.59     1566.12    1699.72    c.m"
"             Runoff coefficient     0.082      0.959      0.520      "
"             Maximum flow           0.041      0.640      0.649      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.649     0.650     0.021     0.021"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          201   Pond Block "
"       50.000   % Impervious"
"        0.660   Total Area"
"       20.000   Flow length"
"        2.000   Overland Slope"
"        0.330   Pervious Area"
"       20.000   Pervious length"
"        2.000   Pervious slope"
"        0.330   Impervious Area"
"       20.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.074     0.650     0.021     0.021 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           0.330      0.330      0.660      hectare"
"             Time of concentration  14.592     1.873      2.873      minutes"
"             Time to Centroid       560.529    623.824    618.849    minutes"
"             Rainfall depth         51.605     51.605     51.605     mm"
"             Rainfall volume        170.30     170.30     340.59     c.m"
"             Rainfall losses        47.384     2.127      24.755     mm"
"             Runoff depth           4.221      49.478     26.849     mm"
"             Runoff volume          13.93      163.28     177.21     c.m"
"             Runoff coefficient     0.082      0.959      0.520      "
"             Maximum flow           0.011      0.072      0.074      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.074     0.703     0.021     0.021"
" 54          POND DESIGN"
"        0.703   Current peak flow    c.m/sec"
```

```
"        0.933   Target outflow    c.m/sec"
"       1880.3   Hydrograph volume    c.m"
"         17.    Number of stages"
"        0.000   Minimum water level    metre"
"        3.000   Maximum water level    metre"
"        0.000   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                436.900     0.000     0.000"
"                437.000   0.00500   216.300"
"                437.100   0.01000   444.100"
"                437.200   0.01300   683.600"
"                437.300   0.01500   935.100"
"                437.400   0.04700  1198.700"
"                437.500   0.07800  1474.800"
"                437.600    0.1390  1763.600"
"                437.700    0.2590  2065.400"
"                437.800    0.3590  2380.500"
"                437.900    0.4360  2709.100"
"                438.000    0.5010  3051.300"
"                438.100    0.5580  3407.400"
"                438.200     1.048  3777.800"
"                438.300     1.917  4163.200"
"                438.400     3.051  4565.600"
"                438.480     4.123  4902.700"
"             Peak outflow                  0.047    c.m/sec"
"             Maximum level               437.400    metre"
"             Maximum storage            1197.740    c.m"
"             Centroidal lag               21.657   hours"
"                  0.074     0.703     0.047     0.021 c.m/sec"
" 40          HYDROGRAPH Next link "
"            5   Next link "
"                     0.074     0.047     0.047     0.021"
" 33          CATCHMENT 204"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          204   Rear yard slope - Uncontrolled"
"        0.000   % Impervious"
"        0.170   Total Area"
"       10.000   Flow length"
"        2.000   Overland Slope"
"        0.170   Pervious Area"
"       10.000   Pervious length"
"       33.000   Pervious slope"
"        0.000   Impervious Area"
"       10.000   Impervious length"
"       33.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
```

```
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.010     0.047     0.047     0.021 c.m/sec"
"             Catchment 204          Pervious   Impervious Total Area "
"             Surface Area           0.170      0.000      0.170      hectare"
"             Time of concentration  4.152      0.533      4.152      minutes"
"             Time to Centroid       551.187    624.132    551.187    minutes"
"             Rainfall depth         51.605     51.605     51.605     mm"
"             Rainfall volume        87.73      0.00       87.73      c.m"
"             Rainfall losses        47.463     5.072      47.463     mm"
"             Runoff depth           4.142      46.533     4.142      mm"
"             Runoff volume          7.04       0.00       7.04       c.m"
"             Runoff coefficient     0.080      0.000      0.080      "
"             Maximum flow           0.010      0.000      0.010      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.010     0.047     0.047     0.021"
" 33          CATCHMENT 202"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          202   Ditch"
"        0.000   % Impervious"
"        0.320   Total Area"
"       10.000   Flow length"
"        2.000   Overland Slope"
"        0.320   Pervious Area"
"       10.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       10.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.013     0.047     0.047     0.021 c.m/sec"
"             Catchment 202          Pervious   Impervious Total Area "
```

```
"             Surface Area           0.320      0.000      0.320      hectare"
"             Time of concentration  9.627      1.236      9.627      minutes"
"             Time to Centroid       555.974    622.926    555.974    minutes"
"             Rainfall depth         51.605     51.605     51.605     mm"
"             Rainfall volume        165.14     0.00       165.14     c.m"
"             Rainfall losses        47.430     2.503      47.430     mm"
"             Runoff depth           4.175      49.101     4.175      mm"
"             Runoff volume          13.36      0.00       13.36      c.m"
"             Runoff coefficient     0.081      0.000      0.081      "
"             Maximum flow           0.013      0.000      0.013      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.013     0.047     0.047     0.021"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.013     0.047     0.047     0.021"
" 40          HYDROGRAPH   Combine    1000"
"            6   Combine "
"         1000   Node #"
"                Total from Site "
"             Maximum flow                  0.056    c.m/sec"
"             Hydrograph volume          1231.384    c.m"
"                    0.013     0.047     0.047     0.056"
" 40          HYDROGRAPH   Confluence    1000"
"            7   Confluence "
"         1000   Node #"
"                Total from Site "
"             Maximum flow                  0.056    c.m/sec"
"             Hydrograph volume          1231.384    c.m"
"                    0.013     0.056     0.047     0.000"
" 38          START/RE-START TOTALS 1000"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                      8.090    hectare"
"             Total Impervious area                     3.495    hectare"
"             Total % impervious                       43.201"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:           C:\Users\rsingh\Desktop\My Jobs\120139\"
"                                                                      NEW SWM"
"                Output filename:          120139 - Post 5 year Controlled.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                  2/2/2024 at 9:44:22 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"     1440.000   Max. Storm length"
"     1440.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"      876.909   Coefficient A"
"        7.781   Constant B"
"        0.780   Exponent C"
"        0.375   Fraction R"
"     1440.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          101.955    mm/hr"
"             Total depth                 72.080    mm"
"            6   005hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 203"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          203   Rear Yard Slope - Uncontrolled "
"        0.000   % Impervious"
"        0.530   Total Area"
"       10.000   Flow length"
"       33.000   Overland Slope"
"        0.530   Pervious Area"
"       10.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       10.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    0.074     0.000     0.000     0.000 c.m/sec"
"             Catchment 203          Pervious   Impervious Total Area "
"             Surface Area           0.530      0.000      0.530      hectare"
"             Time of concentration  6.648      1.139      6.648      minutes"
"             Time to Centroid       555.309    625.608    555.309    minutes"
"             Rainfall depth         72.080     72.080     72.080     mm"
"             Rainfall volume        382.03     0.00       382.03     c.m"
"             Rainfall losses        60.166     3.103      60.166     mm"
"             Runoff depth           11.915     68.977     11.915     mm"
"             Runoff volume          63.15      0.00       63.15      c.m"
"             Runoff coefficient     0.165      0.000      0.165      "
"             Maximum flow           0.074      0.000      0.074      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.074     0.074     0.000     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.074     0.074     0.074     0.000"
" 40          HYDROGRAPH   Combine    1000"
"            6   Combine "
"         1000   Node #"
"                Total from Site "
"             Maximum flow                 0.074    c.m/sec"
"             Hydrograph volume           63.147    c.m"
"                    0.074     0.074     0.074     0.074"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.074     0.000     0.074     0.074"
" 33          CATCHMENT 205"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          205   Presbyterian Church"
"        0.000   % Impervious"
"        0.080   Total Area"
"       40.000   Flow length"
"        2.000   Overland Slope"
"        0.080   Pervious Area"
"       40.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       40.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
```

```
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.007     0.000     0.074     0.074 c.m/sec"
"             Catchment 205          Pervious   Impervious Total Area "
"             Surface Area           0.080      0.000      0.080      hectare"
"             Time of concentration  15.274     2.616      15.274     minutes"
"             Time to Centroid       564.465    627.733    564.465    minutes"
"             Rainfall depth         72.080     72.080     72.080     mm"
"             Rainfall volume        57.66      0.00       57.66      c.m"
"             Rainfall losses        59.941     2.487      59.941     mm"
"             Runoff depth           12.139     69.594     12.139     mm"
"             Runoff volume          9.71       0.00       9.71       c.m"
"             Runoff coefficient     0.168      0.000      0.168      "
"             Maximum flow           0.007      0.000      0.007      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.007     0.007     0.074     0.074"
" 33          CATCHMENT 200"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          200   Site "
"       50.000   % Impervious"
"        6.330   Total Area"
"      150.000   Flow length"
"        2.000   Overland Slope"
"        3.165   Pervious Area"
"      150.000   Pervious length"
"        2.000   Pervious slope"
"        3.165   Impervious Area"
"      150.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.792     0.007     0.074     0.074 c.m/sec"
"             Catchment 200          Pervious   Impervious Total Area "
"             Surface Area           3.165      3.165      6.330      hectare"
"             Time of concentration  33.757     5.782      9.927      minutes"
"             Time to Centroid       583.954    632.632    625.420    minutes"
"             Rainfall depth         72.080     72.080     72.080     mm"
"             Rainfall volume        2281.35    2281.35    4562.69    c.m"
```

```
"             Rainfall losses        59.924     2.189      31.057     mm"
"             Runoff depth           12.157     69.891     41.024     mm"
"             Runoff volume          384.75     2212.05    2596.81    c.m"
"             Runoff coefficient     0.169      0.970      0.569      "
"             Maximum flow           0.138      0.748      0.792      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.792     0.796     0.074     0.074"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          201   Pond Block "
"       50.000   % Impervious"
"        0.660   Total Area"
"       20.000   Flow length"
"        2.000   Overland Slope"
"        0.330   Pervious Area"
"       20.000   Pervious length"
"        2.000   Pervious slope"
"        0.330   Impervious Area"
"       20.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.099     0.796     0.074     0.074 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           0.330      0.330      0.660      hectare"
"             Time of concentration  10.077     1.726      2.957      minutes"
"             Time to Centroid       558.902    626.076    616.169    minutes"
"             Rainfall depth         72.080     72.080     72.080     mm"
"             Rainfall volume        237.87     237.87     475.73     c.m"
"             Rainfall losses        60.034     2.435      31.235     mm"
"             Runoff depth           12.047     69.645     40.846     mm"
"             Runoff volume          39.75      229.83     269.58     c.m"
"             Runoff coefficient     0.167      0.966      0.567      "
"             Maximum flow           0.032      0.088      0.099      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.099     0.884     0.074     0.074"
" 54          POND DESIGN"
"        0.884   Current peak flow    c.m/sec"
```

```
"        0.933   Target outflow    c.m/sec"
"       2876.1   Hydrograph volume    c.m"
"         17.    Number of stages"
"        0.000   Minimum water level    metre"
"        3.000   Maximum water level    metre"
"        0.000   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                436.900     0.000     0.000"
"                437.000   0.00500   216.300"
"                437.100   0.01000   444.100"
"                437.200   0.01300   683.600"
"                437.300   0.01500   935.100"
"                437.400   0.04700  1198.700"
"                437.500   0.07800  1474.800"
"                437.600    0.1390  1763.600"
"                437.700    0.2590  2065.400"
"                437.800    0.3590  2380.500"
"                437.900    0.4360  2709.100"
"                438.000    0.5010  3051.300"
"                438.100    0.5580  3407.400"
"                438.200     1.048  3777.800"
"                438.300     1.917  4163.200"
"                438.400     3.051  4565.600"
"                438.480     4.123  4902.700"
"             Peak outflow                  0.118    c.m/sec"
"             Maximum level               437.565    metre"
"             Maximum storage            1662.830    c.m"
"             Centroidal lag               19.381   hours"
"                  0.099     0.884     0.118     0.074 c.m/sec"
" 40          HYDROGRAPH Next link "
"            5   Next link "
"                     0.099     0.118     0.118     0.074"
" 33          CATCHMENT 204"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          204   Rear yard slope - Uncontrolled"
"        0.000   % Impervious"
"        0.170   Total Area"
"       10.000   Flow length"
"        2.000   Overland Slope"
"        0.170   Pervious Area"
"       10.000   Pervious length"
"       33.000   Pervious slope"
"        0.000   Impervious Area"
"       10.000   Impervious length"
"       33.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
```

```
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.025     0.118     0.118     0.074 c.m/sec"
"             Catchment 204          Pervious   Impervious Total Area "
"             Surface Area           0.170      0.000      0.170      hectare"
"             Time of concentration  2.867      0.491      2.867      minutes"
"             Time to Centroid       551.252    626.425    551.252    minutes"
"             Rainfall depth         72.080     72.080     72.080     mm"
"             Rainfall volume        122.54     0.00       122.54     c.m"
"             Rainfall losses        60.122     6.427      60.122     mm"
"             Runoff depth           11.958     65.654     11.958     mm"
"             Runoff volume          20.33      0.00       20.33      c.m"
"             Runoff coefficient     0.166      0.000      0.166      "
"             Maximum flow           0.025      0.000      0.025      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.025     0.118     0.118     0.074"
" 33          CATCHMENT 202"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          202   Ditch"
"        0.000   % Impervious"
"        0.320   Total Area"
"       10.000   Flow length"
"        2.000   Overland Slope"
"        0.320   Pervious Area"
"       10.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       10.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.045     0.118     0.118     0.074 c.m/sec"
"             Catchment 202          Pervious   Impervious Total Area "
```

```
"             Surface Area           0.320      0.000      0.320      hectare"
"             Time of concentration  6.648      1.139      6.648      minutes"
"             Time to Centroid       555.309    625.608    555.309    minutes"
"             Rainfall depth         72.080     72.080     72.080     mm"
"             Rainfall volume        230.66     0.00       230.66     c.m"
"             Rainfall losses        60.166     3.103      60.166     mm"
"             Runoff depth           11.915     68.977     11.915     mm"
"             Runoff volume          38.13      0.00       38.13      c.m"
"             Runoff coefficient     0.165      0.000      0.165      "
"             Maximum flow           0.045      0.000      0.045      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.045     0.118     0.118     0.074"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.045     0.118     0.118     0.074"
" 40          HYDROGRAPH   Combine    1000"
"            6   Combine "
"         1000   Node #"
"                Total from Site "
"             Maximum flow                  0.162    c.m/sec"
"             Hydrograph volume          2190.186    c.m"
"                    0.045     0.118     0.118     0.162"
" 40          HYDROGRAPH   Confluence    1000"
"            7   Confluence "
"         1000   Node #"
"                Total from Site "
"             Maximum flow                  0.162    c.m/sec"
"             Hydrograph volume          2190.186    c.m"
"                    0.045     0.162     0.118     0.000"
" 38          START/RE-START TOTALS 1000"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                      8.090    hectare"
"             Total Impervious area                     3.495    hectare"
"             Total % impervious                       43.201"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:           C:\Users\rsingh\Desktop\My Jobs\120139\"
"                                                                      NEW SWM"
"                Output filename:          120139 - Post 10 year Controlled.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                  2/2/2024 at 9:46:55 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"     1440.000   Max. Storm length"
"     1440.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"      997.497   Coefficient A"
"        8.438   Constant B"
"        0.775   Exponent C"
"        0.375   Fraction R"
"     1440.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          113.928    mm/hr"
"             Total depth                 85.001    mm"
"            6   010hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 203"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          203   Rear Yard Slope - Uncontrolled "
"        0.000   % Impervious"
"        0.530   Total Area"
"       10.000   Flow length"
"       33.000   Overland Slope"
"        0.530   Pervious Area"
"       10.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       10.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    0.101     0.000     0.000     0.000 c.m/sec"
"             Catchment 203          Pervious   Impervious Total Area "
"             Surface Area           0.530      0.000      0.530      hectare"
"             Time of concentration  6.240      1.089      6.240      minutes"
"             Time to Centroid       555.201    625.081    555.201    minutes"
"             Rainfall depth         85.001     85.001     85.001     mm"
"             Rainfall volume        450.51     0.00       450.51     c.m"
"             Rainfall losses        67.344     3.550      67.344     mm"
"             Runoff depth           17.657     81.451     17.657     mm"
"             Runoff volume          93.58      0.00       93.58      c.m"
"             Runoff coefficient     0.208      0.000      0.208      "
"             Maximum flow           0.101      0.000      0.101      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.101     0.101     0.000     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.101     0.101     0.101     0.000"
" 40          HYDROGRAPH   Combine    1000"
"            6   Combine "
"         1000   Node #"
"                Total from Site "
"             Maximum flow                 0.101    c.m/sec"
"             Hydrograph volume           93.584    c.m"
"                    0.101     0.101     0.101     0.101"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.101     0.000     0.101     0.101"
" 33          CATCHMENT 205"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          205   Presbyterian Church"
"        0.000   % Impervious"
"        0.080   Total Area"
"       40.000   Flow length"
"        2.000   Overland Slope"
"        0.080   Pervious Area"
"       40.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       40.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
```

```
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.010     0.000     0.101     0.101 c.m/sec"
"             Catchment 205          Pervious   Impervious Total Area "
"             Surface Area           0.080      0.000      0.080      hectare"
"             Time of concentration  14.336     2.502      14.336     minutes"
"             Time to Centroid       563.828    627.249    563.828    minutes"
"             Rainfall depth         85.001     85.001     85.001     mm"
"             Rainfall volume        68.00      0.00       68.00      c.m"
"             Rainfall losses        67.173     2.617      67.173     mm"
"             Runoff depth           17.829     82.385     17.829     mm"
"             Runoff volume          14.26      0.00       14.26      c.m"
"             Runoff coefficient     0.210      0.000      0.210      "
"             Maximum flow           0.010      0.000      0.010      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.010     0.010     0.101     0.101"
" 33          CATCHMENT 200"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          200   Site "
"       50.000   % Impervious"
"        6.330   Total Area"
"      150.000   Flow length"
"        2.000   Overland Slope"
"        3.165   Pervious Area"
"      150.000   Pervious length"
"        2.000   Pervious slope"
"        3.165   Impervious Area"
"      150.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.902     0.010     0.101     0.101 c.m/sec"
"             Catchment 200          Pervious   Impervious Total Area "
"             Surface Area           3.165      3.165      6.330      hectare"
"             Time of concentration  31.684     5.530      10.162     minutes"
"             Time to Centroid       582.266    631.816    623.042    minutes"
"             Rainfall depth         85.001     85.001     85.001     mm"
"             Rainfall volume        2690.29    2690.29    5380.58    c.m"
```

```
"             Rainfall losses        67.184     2.198      34.691     mm"
"             Runoff depth           17.817     82.803     50.310     mm"
"             Runoff volume          563.91     2620.73    3184.63    c.m"
"             Runoff coefficient     0.210      0.974      0.592      "
"             Maximum flow           0.209      0.834      0.902      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.902     0.909     0.101     0.101"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          201   Pond Block "
"       50.000   % Impervious"
"        0.660   Total Area"
"       20.000   Flow length"
"        2.000   Overland Slope"
"        0.330   Pervious Area"
"       20.000   Pervious length"
"        2.000   Pervious slope"
"        0.330   Impervious Area"
"       20.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.118     0.909     0.101     0.101 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           0.330      0.330      0.660      hectare"
"             Time of concentration  9.458      1.651      3.034      minutes"
"             Time to Centroid       558.572    625.766    613.859    minutes"
"             Rainfall depth         85.001     85.001     85.001     mm"
"             Rainfall volume        280.50     280.50     561.01     c.m"
"             Rainfall losses        67.269     2.669      34.969     mm"
"             Runoff depth           17.732     82.332     50.032     mm"
"             Runoff volume          58.52      271.70     330.21     c.m"
"             Runoff coefficient     0.209      0.969      0.589      "
"             Maximum flow           0.048      0.099      0.118      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.118     1.020     0.101     0.101"
" 54          POND DESIGN"
"        1.020   Current peak flow    c.m/sec"
```

```
"        0.933   Target outflow    c.m/sec"
"       3529.1   Hydrograph volume    c.m"
"         17.    Number of stages"
"        0.000   Minimum water level    metre"
"        3.000   Maximum water level    metre"
"        0.000   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                436.900     0.000     0.000"
"                437.000   0.00500   216.300"
"                437.100   0.01000   444.100"
"                437.200   0.01300   683.600"
"                437.300   0.01500   935.100"
"                437.400   0.04700  1198.700"
"                437.500   0.07800  1474.800"
"                437.600    0.1390  1763.600"
"                437.700    0.2590  2065.400"
"                437.800    0.3590  2380.500"
"                437.900    0.4360  2709.100"
"                438.000    0.5010  3051.300"
"                438.100    0.5580  3407.400"
"                438.200     1.048  3777.800"
"                438.300     1.917  4163.200"
"                438.400     3.051  4565.600"
"                438.480     4.123  4902.700"
"             Peak outflow                  0.204    c.m/sec"
"             Maximum level               437.654    metre"
"             Maximum storage            1926.347    c.m"
"             Centroidal lag               18.247   hours"
"                  0.118     1.020     0.204     0.101 c.m/sec"
" 40          HYDROGRAPH Next link "
"            5   Next link "
"                     0.118     0.204     0.204     0.101"
" 33          CATCHMENT 204"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          204   Rear yard slope - Uncontrolled"
"        0.000   % Impervious"
"        0.170   Total Area"
"       10.000   Flow length"
"        2.000   Overland Slope"
"        0.170   Pervious Area"
"       10.000   Pervious length"
"       33.000   Pervious slope"
"        0.000   Impervious Area"
"       10.000   Impervious length"
"       33.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
```

```
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.033     0.204     0.204     0.101 c.m/sec"
"             Catchment 204          Pervious   Impervious Total Area "
"             Surface Area           0.170      0.000      0.170      hectare"
"             Time of concentration  2.691      0.470      2.691      minutes"
"             Time to Centroid       551.290    626.923    551.290    minutes"
"             Rainfall depth         85.001     85.001     85.001     mm"
"             Rainfall volume        144.50     0.00       144.50     c.m"
"             Rainfall losses        67.499     7.308      67.499     mm"
"             Runoff depth           17.502     77.694     17.502     mm"
"             Runoff volume          29.75      0.00       29.75      c.m"
"             Runoff coefficient     0.206      0.000      0.206      "
"             Maximum flow           0.033      0.000      0.033      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.033     0.204     0.204     0.101"
" 33          CATCHMENT 202"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          202   Ditch"
"        0.000   % Impervious"
"        0.320   Total Area"
"       10.000   Flow length"
"        2.000   Overland Slope"
"        0.320   Pervious Area"
"       10.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       10.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.061     0.204     0.204     0.101 c.m/sec"
"             Catchment 202          Pervious   Impervious Total Area "
```

```
"             Surface Area           0.320      0.000      0.320      hectare"
"             Time of concentration  6.240      1.089      6.240      minutes"
"             Time to Centroid       555.201    625.081    555.201    minutes"
"             Rainfall depth         85.001     85.001     85.001     mm"
"             Rainfall volume        272.00     0.00       272.00     c.m"
"             Rainfall losses        67.344     3.551      67.344     mm"
"             Runoff depth           17.657     81.451     17.657     mm"
"             Runoff volume          56.50      0.00       56.50      c.m"
"             Runoff coefficient     0.208      0.000      0.208      "
"             Maximum flow           0.061      0.000      0.061      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.061     0.204     0.204     0.101"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.061     0.204     0.204     0.101"
" 40          HYDROGRAPH   Combine    1000"
"            6   Combine "
"         1000   Node #"
"                Total from Site "
"             Maximum flow                  0.233    c.m/sec"
"             Hydrograph volume          2857.645    c.m"
"                    0.061     0.204     0.204     0.233"
" 40          HYDROGRAPH   Confluence    1000"
"            7   Confluence "
"         1000   Node #"
"                Total from Site "
"             Maximum flow                  0.233    c.m/sec"
"             Hydrograph volume          2857.645    c.m"
"                    0.061     0.233     0.204     0.000"
" 38          START/RE-START TOTALS 1000"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                      8.090    hectare"
"             Total Impervious area                     3.495    hectare"
"             Total % impervious                       43.201"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:           C:\Users\rsingh\Desktop\My Jobs\120139\"
"                                                                      NEW SWM"
"                Output filename:          120139 - Post 25 year Controlled.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                  2/2/2024 at 9:50:15 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"     1440.000   Max. Storm length"
"     1440.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     1145.741   Coefficient A"
"        9.035   Constant B"
"        0.769   Exponent C"
"        0.375   Fraction R"
"     1440.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           129.475    mm/hr"
"             Total depth                 101.960    mm"
"            6   025hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 203"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          203   Rear Yard Slope - Uncontrolled "
"        0.000   % Impervious"
"        0.530   Total Area"
"       10.000   Flow length"
"       33.000   Overland Slope"
"        0.530   Pervious Area"
"       10.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       10.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    0.127     0.000     0.000     0.000 c.m/sec"
"             Catchment 203          Pervious   Impervious Total Area "
"             Surface Area           0.530      0.000      0.530      hectare"
"             Time of concentration  5.852      1.035      5.852      minutes"
"             Time to Centroid       555.207    624.849    555.207    minutes"
"             Rainfall depth         101.960    101.960    101.960    mm"
"             Rainfall volume        540.39     0.00       540.39     c.m"
"             Rainfall losses        76.742     4.137      76.742     mm"
"             Runoff depth           25.218     97.823     25.218     mm"
"             Runoff volume          133.65     0.00       133.65     c.m"
"             Runoff coefficient     0.247      0.000      0.247      "
"             Maximum flow           0.127      0.000      0.127      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.127     0.127     0.000     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.127     0.127     0.127     0.000"
" 40          HYDROGRAPH   Combine    1000"
"            6   Combine "
"         1000   Node #"
"                Total from Site "
"             Maximum flow                 0.127    c.m/sec"
"             Hydrograph volume          133.654    c.m"
"                    0.127     0.127     0.127     0.127"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.127     0.000     0.127     0.127"
" 33          CATCHMENT 205"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          205   Presbyterian Church"
"        0.000   % Impervious"
"        0.080   Total Area"
"       40.000   Flow length"
"        2.000   Overland Slope"
"        0.080   Pervious Area"
"       40.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       40.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
```

```
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.014     0.000     0.127     0.127 c.m/sec"
"             Catchment 205          Pervious   Impervious Total Area "
"             Surface Area           0.080      0.000      0.080      hectare"
"             Time of concentration  13.444     2.378      13.444     minutes"
"             Time to Centroid       563.061    626.944    563.061    minutes"
"             Rainfall depth         101.960    101.960    101.960    mm"
"             Rainfall volume        81.57      0.00       81.57      c.m"
"             Rainfall losses        76.665     2.877      76.665     mm"
"             Runoff depth           25.295     99.082     25.295     mm"
"             Runoff volume          20.24      0.00       20.24      c.m"
"             Runoff coefficient     0.248      0.000      0.248      "
"             Maximum flow           0.014      0.000      0.014      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.014     0.014     0.127     0.127"
" 33          CATCHMENT 200"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          200   Site "
"       50.000   % Impervious"
"        6.330   Total Area"
"      150.000   Flow length"
"        2.000   Overland Slope"
"        3.165   Pervious Area"
"      150.000   Pervious length"
"        2.000   Pervious slope"
"        3.165   Impervious Area"
"      150.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     1.058     0.014     0.127     0.127 c.m/sec"
"             Catchment 200          Pervious   Impervious Total Area "
"             Surface Area           3.165      3.165      6.330      hectare"
"             Time of concentration  29.712     5.255      10.224     minutes"
"             Time to Centroid       580.162    631.317    620.922    minutes"
"             Rainfall depth         101.960    101.960    101.960    mm"
"             Rainfall volume        3227.02    3227.02    6454.04    c.m"
```

```
"             Rainfall losses        76.551     2.325      39.438     mm"
"             Runoff depth           25.409     99.634     62.522     mm"
"             Runoff volume          804.19     3153.42    3957.61    c.m"
"             Runoff coefficient     0.249      0.977      0.613      "
"             Maximum flow           0.314      0.972      1.058      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     1.058     1.069     0.127     0.127"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          201   Pond Block "
"       50.000   % Impervious"
"        0.660   Total Area"
"       20.000   Flow length"
"        2.000   Overland Slope"
"        0.330   Pervious Area"
"       20.000   Pervious length"
"        2.000   Pervious slope"
"        0.330   Impervious Area"
"       20.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.150     1.069     0.127     0.127 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           0.330      0.330      0.660      hectare"
"             Time of concentration  8.870      1.569      3.056      minutes"
"             Time to Centroid       558.222    625.501    611.790    minutes"
"             Rainfall depth         101.960    101.960    101.960    mm"
"             Rainfall volume        336.47     336.47     672.93     c.m"
"             Rainfall losses        76.630     2.996      39.813     mm"
"             Runoff depth           25.330     98.964     62.147     mm"
"             Runoff volume          83.59      326.58     410.17     c.m"
"             Runoff coefficient     0.248      0.971      0.610      "
"             Maximum flow           0.069      0.112      0.150      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.150     1.211     0.127     0.127"
" 54          POND DESIGN"
"        1.211   Current peak flow    c.m/sec"
```

```
"        0.933   Target outflow    c.m/sec"
"       4388.0   Hydrograph volume    c.m"
"          17.   Number of stages"
"        0.000   Minimum water level    metre"
"        3.000   Maximum water level    metre"
"        0.000   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                436.900     0.000     0.000"
"                437.000   0.00500   216.300"
"                437.100   0.01000   444.100"
"                437.200   0.01300   683.600"
"                437.300   0.01500   935.100"
"                437.400   0.04700  1198.700"
"                437.500   0.07800  1474.800"
"                437.600    0.1390  1763.600"
"                437.700    0.2590  2065.400"
"                437.800    0.3590  2380.500"
"                437.900    0.4360  2709.100"
"                438.000    0.5010  3051.300"
"                438.100    0.5580  3407.400"
"                438.200     1.048  3777.800"
"                438.300     1.917  4163.200"
"                438.400     3.051  4565.600"
"                438.480     4.123  4902.700"
"             Peak outflow                  0.314    c.m/sec"
"             Maximum level               437.755    metre"
"             Maximum storage            2239.066    c.m"
"             Centroidal lag               17.154   hours"
"                  0.150     1.211     0.314     0.127 c.m/sec"
" 40          HYDROGRAPH Next link "
"            5   Next link "
"                     0.150     0.314     0.314     0.127"
" 33          CATCHMENT 204"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          204   Rear yard slope - Uncontrolled"
"        0.000   % Impervious"
"        0.170   Total Area"
"       10.000   Flow length"
"        2.000   Overland Slope"
"        0.170   Pervious Area"
"       10.000   Pervious length"
"       33.000   Pervious slope"
"        0.000   Impervious Area"
"       10.000   Impervious length"
"       33.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
```

```
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.046     0.314     0.314     0.127 c.m/sec"
"             Catchment 204          Pervious   Impervious Total Area "
"             Surface Area           0.170      0.000      0.170      hectare"
"             Time of concentration  2.524      0.446      2.524      minutes"
"             Time to Centroid       551.437    627.547    551.437    minutes"
"             Rainfall depth         101.960    101.960    101.960    mm"
"             Rainfall volume        173.33     0.00       173.33     c.m"
"             Rainfall losses        77.082     8.496      77.082     mm"
"             Runoff depth           24.877     93.464     24.877     mm"
"             Runoff volume          42.29      0.00       42.29      c.m"
"             Runoff coefficient     0.244      0.000      0.244      "
"             Maximum flow           0.046      0.000      0.046      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.046     0.315     0.314     0.127"
" 33          CATCHMENT 202"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          202   Ditch"
"        0.000   % Impervious"
"        0.320   Total Area"
"       10.000   Flow length"
"        2.000   Overland Slope"
"        0.320   Pervious Area"
"       10.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       10.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.076     0.315     0.314     0.127 c.m/sec"
"             Catchment 202          Pervious   Impervious Total Area "
```

```
"             Surface Area           0.320      0.000      0.320      hectare"
"             Time of concentration  5.852      1.035      5.852      minutes"
"             Time to Centroid       555.207    624.849    555.207    minutes"
"             Rainfall depth         101.960    101.960    101.960    mm"
"             Rainfall volume        326.27     0.00       326.27     c.m"
"             Rainfall losses        76.742     4.137      76.742     mm"
"             Runoff depth           25.218     97.823     25.218     mm"
"             Runoff volume          80.70      0.00       80.70      c.m"
"             Runoff coefficient     0.247      0.000      0.247      "
"             Maximum flow           0.076      0.000      0.076      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                   0.076     0.318     0.314     0.127"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                   0.076     0.318     0.318     0.127"
" 40          HYDROGRAPH   Combine    1000"
"            6   Combine "
"         1000   Node #"
"                Total from Site "
"             Maximum flow                  0.325    c.m/sec"
"             Hydrograph volume          3748.878    c.m"
"                   0.076     0.318     0.318     0.325"
" 40          HYDROGRAPH   Confluence    1000"
"            7   Confluence "
"         1000   Node #"
"                Total from Site "
"             Maximum flow                  0.325    c.m/sec"
"             Hydrograph volume          3748.878    c.m"
"                   0.076     0.325     0.318     0.000"
" 38          START/RE-START TOTALS 1000"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                      8.090    hectare"
"             Total Impervious area                     3.495    hectare"
"             Total % impervious                       43.201"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:           C:\Users\rsingh\Desktop\My Jobs\120139\"
"                                                                      NEW SWM"
"                Output filename:          120139 - Post 50 year Controlled.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                  2/2/2024 at 9:56:18 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"     1440.000   Max. Storm length"
"     1440.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     1273.113   Coefficient A"
"        9.492   Constant B"
"        0.770   Exponent C"
"        0.375   Fraction R"
"     1440.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           140.566    mm/hr"
"             Total depth                 112.445    mm"
"            6   050hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 203"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          203   Rear Yard Slope - Uncontrolled "
"        0.000   % Impervious"
"        0.530   Total Area"
"       10.000   Flow length"
"       33.000   Overland Slope"
"        0.530   Pervious Area"
"       10.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       10.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    0.145     0.000     0.000     0.000 c.m/sec"
"             Catchment 203          Pervious   Impervious Total Area "
"             Surface Area           0.530      0.000      0.530      hectare"
"             Time of concentration  5.633      1.001      5.633      minutes"
"             Time to Centroid       555.222    624.029    555.222    minutes"
"             Rainfall depth         112.445    112.445    112.445    mm"
"             Rainfall volume        595.96     0.00       595.96     c.m"
"             Rainfall losses        82.103     4.514      82.103     mm"
"             Runoff depth           30.343     107.932    30.343     mm"
"             Runoff volume          160.82     0.00       160.82     c.m"
"             Runoff coefficient     0.270      0.000      0.270      "
"             Maximum flow           0.145      0.000      0.145      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.145     0.145     0.000     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.145     0.145     0.145     0.000"
" 40          HYDROGRAPH   Combine    1000"
"            6   Combine "
"         1000   Node #"
"                Total from Site "
"             Maximum flow                 0.145    c.m/sec"
"             Hydrograph volume          160.818    c.m"
"                    0.145     0.145     0.145     0.145"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.145     0.000     0.145     0.145"
" 33          CATCHMENT 205"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          205   Presbyterian Church"
"        0.000   % Impervious"
"        0.080   Total Area"
"       40.000   Flow length"
"        2.000   Overland Slope"
"        0.080   Pervious Area"
"       40.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       40.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
```

```
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.016     0.000     0.145     0.145 c.m/sec"
"             Catchment 205          Pervious   Impervious Total Area "
"             Surface Area           0.080      0.000      0.080      hectare"
"             Time of concentration  12.942     2.301      12.942     minutes"
"             Time to Centroid       562.750    626.055    562.750    minutes"
"             Rainfall depth         112.445    112.445    112.445    mm"
"             Rainfall volume        89.96      0.00       89.96      c.m"
"             Rainfall losses        81.993     3.043      81.993     mm"
"             Runoff depth           30.452     109.402    30.452     mm"
"             Runoff volume          24.36      0.00       24.36      c.m"
"             Runoff coefficient     0.271      0.000      0.271      "
"             Maximum flow           0.016      0.000      0.016      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.016     0.016     0.145     0.145"
" 33          CATCHMENT 200"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          200   Site "
"       50.000   % Impervious"
"        6.330   Total Area"
"      150.000   Flow length"
"        2.000   Overland Slope"
"        3.165   Pervious Area"
"      150.000   Pervious length"
"        2.000   Pervious slope"
"        3.165   Impervious Area"
"      150.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     1.176     0.016     0.145     0.145 c.m/sec"
"             Catchment 200          Pervious   Impervious Total Area "
"             Surface Area           3.165      3.165      6.330      hectare"
"             Time of concentration  28.603     5.085      10.196     minutes"
"             Time to Centroid       579.105    630.239    619.125    minutes"
"             Rainfall depth         112.445    112.445    112.445    mm"
"             Rainfall volume        3558.90    3558.90    7117.80    c.m"
```

```
"             Rainfall losses        81.897     2.443      42.170     mm"
"             Runoff depth           30.549     110.002    70.276     mm"
"             Runoff volume          966.87     3481.58    4448.45    c.m"
"             Runoff coefficient     0.272      0.978      0.625      "
"             Maximum flow           0.380      1.070      1.176      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     1.176     1.191     0.145     0.145"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          201   Pond Block "
"       50.000   % Impervious"
"        0.660   Total Area"
"       20.000   Flow length"
"        2.000   Overland Slope"
"        0.330   Pervious Area"
"       20.000   Pervious length"
"        2.000   Pervious slope"
"        0.330   Impervious Area"
"       20.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.174     1.191     0.145     0.145 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           0.330      0.330      0.660      hectare"
"             Time of concentration  8.538      1.518      3.049      minutes"
"             Time to Centroid       558.176    624.537    610.062    minutes"
"             Rainfall depth         112.445    112.445    112.445    mm"
"             Rainfall volume        371.07     371.07     742.14     c.m"
"             Rainfall losses        81.969     3.206      42.587     mm"
"             Runoff depth           30.477     109.240    69.858     mm"
"             Runoff volume          100.57     360.49     461.06     c.m"
"             Runoff coefficient     0.271      0.971      0.621      "
"             Maximum flow           0.082      0.122      0.174      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.174     1.352     0.145     0.145"
" 54          POND DESIGN"
"        1.352   Current peak flow    c.m/sec"
```

```
"        0.933   Target outflow    c.m/sec"
"       4933.9   Hydrograph volume    c.m"
"         17.    Number of stages"
"        0.000   Minimum water level    metre"
"        3.000   Maximum water level    metre"
"        0.000   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                436.900     0.000     0.000"
"                437.000   0.00500   216.300"
"                437.100   0.01000   444.100"
"                437.200   0.01300   683.600"
"                437.300   0.01500   935.100"
"                437.400   0.04700  1198.700"
"                437.500   0.07800  1474.800"
"                437.600    0.1390  1763.600"
"                437.700    0.2590  2065.400"
"                437.800    0.3590  2380.500"
"                437.900    0.4360  2709.100"
"                438.000    0.5010  3051.300"
"                438.100    0.5580  3407.400"
"                438.200     1.048  3777.800"
"                438.300     1.917  4163.200"
"                438.400     3.051  4565.600"
"                438.480     4.123  4902.700"
"             Peak outflow                  0.377    c.m/sec"
"             Maximum level               437.824    metre"
"             Maximum storage            2459.053    c.m"
"             Centroidal lag               16.593   hours"
"                  0.174     1.352     0.377     0.145 c.m/sec"
" 40          HYDROGRAPH Next link "
"            5   Next link "
"                     0.174     0.377     0.377     0.145"
" 33          CATCHMENT 204"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          204   Rear yard slope - Uncontrolled"
"        0.000   % Impervious"
"        0.170   Total Area"
"       10.000   Flow length"
"        2.000   Overland Slope"
"        0.170   Pervious Area"
"       10.000   Pervious length"
"       33.000   Pervious slope"
"        0.000   Impervious Area"
"       10.000   Impervious length"
"       33.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
```

```
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.054     0.377     0.377     0.145 c.m/sec"
"             Catchment 204          Pervious   Impervious Total Area "
"             Surface Area           0.170      0.000      0.170      hectare"
"             Time of concentration  2.429      0.432      2.429      minutes"
"             Time to Centroid       551.645    626.990    551.645    minutes"
"             Rainfall depth         112.445    112.445    112.445    mm"
"             Rainfall volume        191.16     0.00       191.16     c.m"
"             Rainfall losses        82.326     9.387      82.326     mm"
"             Runoff depth           30.120     103.059    30.120     mm"
"             Runoff volume          51.20      0.00       51.20      c.m"
"             Runoff coefficient     0.268      0.000      0.268      "
"             Maximum flow           0.054      0.000      0.054      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.054     0.379     0.377     0.145"
" 33          CATCHMENT 202"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          202   Ditch"
"        0.000   % Impervious"
"        0.320   Total Area"
"       10.000   Flow length"
"        2.000   Overland Slope"
"        0.320   Pervious Area"
"       10.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       10.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.087     0.379     0.377     0.145 c.m/sec"
"             Catchment 202          Pervious   Impervious Total Area "
```

```
"             Surface Area           0.320      0.000      0.320      hectare"
"             Time of concentration  5.633      1.001      5.633      minutes"
"             Time to Centroid       555.222    624.029    555.221    minutes"
"             Rainfall depth         112.445    112.445    112.445    mm"
"             Rainfall volume        359.83     0.00       359.83     c.m"
"             Rainfall losses        82.103     4.514      82.103     mm"
"             Runoff depth           30.343     107.932    30.343     mm"
"             Runoff volume          97.10      0.00       97.10      c.m"
"             Runoff coefficient     0.270      0.000      0.270      "
"             Maximum flow           0.087      0.000      0.087      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                   0.087     0.385     0.377     0.145"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                   0.087     0.385     0.385     0.145"
" 40          HYDROGRAPH   Combine    1000"
"            6   Combine "
"         1000   Node #"
"                Total from Site "
"             Maximum flow                  0.397    c.m/sec"
"             Hydrograph volume          4329.553    c.m"
"                   0.087     0.385     0.385     0.397"
" 40          HYDROGRAPH   Confluence    1000"
"            7   Confluence "
"         1000   Node #"
"                Total from Site "
"             Maximum flow                  0.397    c.m/sec"
"             Hydrograph volume          4329.553    c.m"
"                   0.087     0.397     0.385     0.000"
" 38          START/RE-START TOTALS 1000"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                      8.090    hectare"
"             Total Impervious area                     3.495    hectare"
"             Total % impervious                       43.201"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:           C:\Users\rsingh\Desktop\My Jobs\120139\"
"                                                                      NEW SWM"
"                Output filename:         120139 - Post 100 year Controlled.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                 1/30/2024 at 3:04:22 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"     1440.000   Max. Storm length"
"     1440.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     1357.120   Coefficient A"
"        9.595   Constant B"
"        0.763   Exponent C"
"        0.375   Fraction R"
"     1440.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           152.190    mm/hr"
"             Total depth                 126.124    mm"
"            6   100hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 203"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          203   Rear Yard Slope - Uncontrolled "
"        0.000   % Impervious"
"        0.530   Total Area"
"       10.000   Flow length"
"       33.000   Overland Slope"
"        0.530   Pervious Area"
"       10.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       10.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    0.164     0.000     0.000     0.000 c.m/sec"
"             Catchment 203          Pervious   Impervious Total Area "
"             Surface Area           0.530      0.000      0.530      hectare"
"             Time of concentration  5.434      0.970      5.434      minutes"
"             Time to Centroid       555.495    625.125    555.495    minutes"
"             Rainfall depth         126.124    126.124    126.124    mm"
"             Rainfall volume        668.46     0.00       668.46     c.m"
"             Rainfall losses        89.871     4.951      89.870     mm"
"             Runoff depth           36.254     121.173    36.254     mm"
"             Runoff volume          192.14     0.00       192.14     c.m"
"             Runoff coefficient     0.287      0.000      0.287      "
"             Maximum flow           0.164      0.000      0.164      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.164     0.164     0.000     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.164     0.164     0.164     0.000"
" 40          HYDROGRAPH   Combine    1000"
"            6   Combine "
"         1000   Node #"
"                Total from Site "
"             Maximum flow                 0.164    c.m/sec"
"             Hydrograph volume          192.144    c.m"
"                    0.164     0.164     0.164     0.164"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.164     0.000     0.164     0.164"
" 33          CATCHMENT 205"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          205   Presbyterian Church"
"        0.000   % Impervious"
"        0.080   Total Area"
"       40.000   Flow length"
"        2.000   Overland Slope"
"        0.080   Pervious Area"
"       40.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       40.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
```

```
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.018     0.000     0.164     0.164 c.m/sec"
"             Catchment 205          Pervious   Impervious Total Area "
"             Surface Area           0.080      0.000      0.080      hectare"
"             Time of concentration  12.485     2.229      12.485     minutes"
"             Time to Centroid       563.027    626.695    563.027    minutes"
"             Rainfall depth         126.124    126.124    126.124    mm"
"             Rainfall volume        100.90     0.00       100.90     c.m"
"             Rainfall losses        89.816     3.173      89.816     mm"
"             Runoff depth           36.308     122.951    36.309     mm"
"             Runoff volume          29.05      0.00       29.05      c.m"
"             Runoff coefficient     0.288      0.000      0.288      "
"             Maximum flow           0.018      0.000      0.018      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.018     0.018     0.164     0.164"
" 33          CATCHMENT 200"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          200   Site "
"       50.000   % Impervious"
"        6.330   Total Area"
"      150.000   Flow length"
"        2.000   Overland Slope"
"        3.165   Pervious Area"
"      150.000   Pervious length"
"        2.000   Pervious slope"
"        3.165   Impervious Area"
"      150.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     1.295     0.018     0.164     0.164 c.m/sec"
"             Catchment 200          Pervious   Impervious Total Area "
"             Surface Area           3.165      3.165      6.330      hectare"
"             Time of concentration  27.593     4.926      10.084     minutes"
"             Time to Centroid       579.332    630.701    619.010    minutes"
"             Rainfall depth         126.124    126.124    126.124    mm"
"             Rainfall volume        3991.83    3991.83    7983.66    c.m"
```

```
"             Rainfall losses        89.702     2.509      46.105     mm"
"             Runoff depth           36.422     123.615    80.019     mm"
"             Runoff volume          1152.77    3912.43    5065.20    c.m"
"             Runoff coefficient     0.289      0.980      0.634      "
"             Maximum flow           0.446      1.171      1.295      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     1.295     1.313     0.164     0.164"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          201   Pond Block "
"       50.000   % Impervious"
"        0.660   Total Area"
"       20.000   Flow length"
"        2.000   Overland Slope"
"        0.330   Pervious Area"
"       20.000   Pervious length"
"        2.000   Pervious slope"
"        0.330   Impervious Area"
"       20.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.189     1.313     0.164     0.164 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           0.330      0.330      0.660      hectare"
"             Time of concentration  8.237      1.470      3.017      minutes"
"             Time to Centroid       558.543    625.315    610.049    minutes"
"             Rainfall depth         126.124    126.124    126.124    mm"
"             Rainfall volume        416.21     416.21     832.42     c.m"
"             Rainfall losses        89.766     3.452      46.609     mm"
"             Runoff depth           36.358     122.673    79.515     mm"
"             Runoff volume          119.98     404.82     524.80     c.m"
"             Runoff coefficient     0.288      0.973      0.630      "
"             Maximum flow           0.104      0.132      0.189      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.189     1.502     0.164     0.164"
" 54          POND DESIGN"
"        1.502   Current peak flow    c.m/sec"
```

```
"        0.933   Target outflow    c.m/sec"
"       5619.0   Hydrograph volume    c.m"
"         17.    Number of stages"
"        0.000   Minimum water level    metre"
"        3.000   Maximum water level    metre"
"        0.000   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                436.900     0.000     0.000"
"                437.000   0.00500   216.300"
"                437.100   0.01000   444.100"
"                437.200   0.01300   683.600"
"                437.300   0.01500   935.100"
"                437.400   0.04700  1198.700"
"                437.500   0.07800  1474.800"
"                437.600    0.1390  1763.600"
"                437.700    0.2590  2065.400"
"                437.800    0.3590  2380.500"
"                437.900    0.4360  2709.100"
"                438.000    0.5010  3051.300"
"                438.100    0.5580  3407.400"
"                438.200     1.048  3777.800"
"                438.300     1.917  4163.200"
"                438.400     3.051  4565.600"
"                438.480     4.123  4902.700"
"             Peak outflow                  0.437    c.m/sec"
"             Maximum level               437.902    metre"
"             Maximum storage            2716.704    c.m"
"             Centroidal lag               16.089   hours"
"                  0.189     1.502     0.437     0.164 c.m/sec"
" 40          HYDROGRAPH Next link "
"            5   Next link "
"                     0.189     0.437     0.437     0.164"
" 33          CATCHMENT 204"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          204   Rear yard slope - Uncontrolled"
"        0.000   % Impervious"
"        0.170   Total Area"
"       10.000   Flow length"
"        2.000   Overland Slope"
"        0.170   Pervious Area"
"       10.000   Pervious length"
"       33.000   Pervious slope"
"        0.000   Impervious Area"
"       10.000   Impervious length"
"       33.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
```

```
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.062     0.437     0.437     0.164 c.m/sec"
"             Catchment 204          Pervious   Impervious Total Area "
"             Surface Area           0.170      0.000      0.170      hectare"
"             Time of concentration  2.344      0.418      2.344      minutes"
"             Time to Centroid       551.946    628.104    551.946    minutes"
"             Rainfall depth         126.124    126.124    126.124    mm"
"             Rainfall volume        214.41     0.00       214.41     c.m"
"             Rainfall losses        90.171     10.418     90.171     mm"
"             Runoff depth           35.953     115.707    35.954     mm"
"             Runoff volume          61.12      0.00       61.12      c.m"
"             Runoff coefficient     0.285      0.000      0.285      "
"             Maximum flow           0.062      0.000      0.062      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.062     0.440     0.437     0.164"
" 33          CATCHMENT 202"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          202   Ditch"
"        0.000   % Impervious"
"        0.320   Total Area"
"       10.000   Flow length"
"        2.000   Overland Slope"
"        0.320   Pervious Area"
"       10.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       10.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.099     0.440     0.437     0.164 c.m/sec"
"             Catchment 202          Pervious   Impervious Total Area "
```

```
"             Surface Area           0.320      0.000      0.320      hectare"
"             Time of concentration  5.434      0.970      5.434      minutes"
"             Time to Centroid       555.495    625.125    555.495    minutes"
"             Rainfall depth         126.124    126.124    126.124    mm"
"             Rainfall volume        403.60     0.00       403.60     c.m"
"             Rainfall losses        89.871     4.951      89.870     mm"
"             Runoff depth           36.254     121.173    36.254     mm"
"             Runoff volume          116.01     0.00       116.01     c.m"
"             Runoff coefficient     0.287      0.000      0.287      "
"             Maximum flow           0.099      0.000      0.099      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.099     0.448     0.437     0.164"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.099     0.448     0.448     0.164"
" 40          HYDROGRAPH   Combine    1000"
"            6   Combine "
"         1000   Node #"
"                Total from Site "
"             Maximum flow                  0.463    c.m/sec"
"             Hydrograph volume          5051.960    c.m"
"                    0.099     0.448     0.448     0.463"
" 40          HYDROGRAPH   Confluence    1000"
"            7   Confluence "
"         1000   Node #"
"                Total from Site "
"             Maximum flow                  0.463    c.m/sec"
"             Hydrograph volume          5051.960    c.m"
"                    0.099     0.463     0.448     0.000"
" 38          START/RE-START TOTALS 1000"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                      8.090    hectare"
"             Total Impervious area                     3.495    hectare"
"             Total % impervious                       43.201"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:            C:\Users\szaga\Documents\MIDUSS\120139"
"                Output filename:                           120139_Post_Reg.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:               9/29/2023 at 12:34:40 PM"
" 31          TIME PARAMETERS"
"       60.000   Time Step"
"     2880.000   Max. Storm length"
"     5000.000   Max. Hydrograph"
" 32          STORM Historic"
"            5   Historic"
"     2880.000   Duration"
"       48.000   Rainfall intensity values"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.026     2.026     2.026     2.028"
"                  2.026     6.000     4.000     6.000    13.000"
"                 17.000    13.000    23.000    13.000    13.000"
"                 53.000    38.000    13.000"
"             Maximum intensity            53.000    mm/hr"
"             Total depth                 285.000    mm"
"            7   9999hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 203"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          203   Rear Yard Slope - Uncontrolled "
"        0.000   % Impervious"
"        0.530   Total Area"
"       10.000   Flow length"
"       33.000   Overland Slope"
"        0.530   Pervious Area"
"       10.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       10.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
```

```
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.047     0.000     0.000     0.000 c.m/sec"
"             Catchment 203          Pervious   Impervious Total Area "
"             Surface Area           0.530      0.000      0.530      hectare"
"             Time of concentration  8.910      1.479      8.910      minutes"
"             Time to Centroid       2761.635   2281.822   2761.634   minutes"
"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        1510.50    0.00       1510.50    c.m"
"             Rainfall losses        213.998    40.260     213.998    mm"
"             Runoff depth           71.002     244.740    71.002     mm"
"             Runoff volume          376.31     0.00       376.31     c.m"
"             Runoff coefficient     0.249      0.000      0.249      "
"             Maximum flow           0.047      0.000      0.047      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.047     0.047     0.000     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.047     0.047     0.047     0.000"
" 40          HYDROGRAPH   Combine    1000"
"            6   Combine "
"         1000   Node #"
"                Total from Site "
"             Maximum flow                  0.047    c.m/sec"
"             Hydrograph volume           376.313    c.m"
"                     0.047     0.047     0.047     0.047"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.047     0.000     0.047     0.047"
" 33          CATCHMENT 205"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          205   Presbyterian Church"
"        0.000   % Impervious"
"        0.080   Total Area"
"       40.000   Flow length"
"        2.000   Overland Slope"
"        0.080   Pervious Area"
"       40.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       40.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
```

```
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.007     0.000     0.047     0.047 c.m/sec"
"             Catchment 205          Pervious   Impervious Total Area "
"             Surface Area           0.080      0.000      0.080      hectare"
"             Time of concentration  20.470     3.398      20.470     minutes"
"             Time to Centroid       2778.671   2240.650   2778.670   minutes"
"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        228.00     0.00       228.00     c.m"
"             Rainfall losses        207.046    39.000     207.046    mm"
"             Runoff depth           77.954     246.000    77.954     mm"
"             Runoff volume          62.36      0.00       62.36      c.m"
"             Runoff coefficient     0.274      0.000      0.274      "
"             Maximum flow           0.007      0.000      0.007      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.007     0.007     0.047     0.047"
" 33          CATCHMENT 200"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          200   Site "
"       50.000   % Impervious"
"        6.330   Total Area"
"      150.000   Flow length"
"        2.000   Overland Slope"
"        3.165   Pervious Area"
"      150.000   Pervious length"
"        2.000   Pervious slope"
"        3.165   Impervious Area"
"      150.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.549     0.007     0.047     0.047 c.m/sec"
"             Catchment 200          Pervious   Impervious Total Area "
```

```
"             Surface Area           3.165      3.165      6.330      hectare"
"             Time of concentration  45.242     7.511      15.948     minutes"
"             Time to Centroid       2800.591   2249.031   2372.360   minutes"
"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        0.9020     0.9020     1.8040     ha-m"
"             Rainfall losses        209.112    21.494     115.303    mm"
"             Runoff depth           75.888     263.506    169.697    mm"
"             Runoff volume          0.2402     0.8340     1.0742     ha-m"
"             Runoff coefficient     0.266      0.925      0.595      "
"             Maximum flow           0.263      0.400      0.549      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.549     0.556     0.047     0.047"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          201   Pond Block "
"       50.000   % Impervious"
"        0.660   Total Area"
"       20.000   Flow length"
"        2.000   Overland Slope"
"        0.330   Pervious Area"
"       20.000   Pervious length"
"        2.000   Pervious slope"
"        0.330   Impervious Area"
"       20.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.070     0.556     0.047     0.047 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           0.330      0.330      0.660      hectare"
"             Time of concentration  13.505     2.242      4.903      minutes"
"             Time to Centroid       2770.029   2266.892   2385.771   minutes"
"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        940.50     940.50     1881.00    c.m"
"             Rainfall losses        209.394    40.613     125.003    mm"
"             Runoff depth           75.606     244.387    159.997    mm"
"             Runoff volume          249.50     806.48     1055.98    c.m"
"             Runoff coefficient     0.265      0.857      0.561      "
"             Maximum flow           0.028      0.042      0.070      c.m/sec"
```

```
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.070     0.624     0.047     0.047"
" 54          POND DESIGN"
"        0.624   Current peak flow    c.m/sec"
"        0.933   Target outflow    c.m/sec"
"      11860.2   Hydrograph volume    c.m"
"         17.   Number of stages"
"        0.000   Minimum water level    metre"
"        3.000   Maximum water level    metre"
"        0.000   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                436.900     0.000     0.000"
"                437.000   0.00500   216.300"
"                437.100   0.01000   444.100"
"                437.200   0.01300   683.600"
"                437.300   0.01500   935.100"
"                437.400   0.04700  1198.700"
"                437.500   0.07800  1474.800"
"                437.600    0.1390  1763.600"
"                437.700    0.2590  2065.400"
"                437.800    0.3590  2380.500"
"                437.900    0.4360  2709.100"
"                438.000    0.5010  3051.300"
"                438.100    0.5580  3407.400"
"                438.200     1.048  3777.800"
"                438.300     1.917  4163.200"
"                438.400     3.051  4565.600"
"                438.480     4.123  4902.700"
"            Peak outflow                  0.494    c.m/sec"
"            Maximum level               438.006    metre"
"            Maximum storage            3073.449    c.m"
"            Centroidal lag               44.845   hours"
"                 0.070     0.624     0.494     0.047 c.m/sec"
" 40          HYDROGRAPH Next link "
"            5   Next link "
"                     0.070     0.494     0.494     0.047"
" 33          CATCHMENT 204"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          204   Rear yard slope - Uncontrolled"
"        0.000   % Impervious"
"        0.170   Total Area"
"       10.000   Flow length"
"        2.000   Overland Slope"
"        0.170   Pervious Area"
"       10.000   Pervious length"
"       33.000   Pervious slope"
```

```
"        0.000   Impervious Area"
"       10.000   Impervious length"
"       33.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.016     0.494     0.494     0.047 c.m/sec"
"             Catchment 204          Pervious   Impervious Total Area "
"             Surface Area           0.170      0.000      0.170      hectare"
"             Time of concentration  3.843      0.638      3.843      minutes"
"             Time to Centroid       2754.335   2273.618   2754.333   minutes"
"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        484.50     0.00       484.50     c.m"
"             Rainfall losses        218.261    34.309     218.261    mm"
"             Runoff depth           66.739     250.691    66.739     mm"
"             Runoff volume          113.46     0.00       113.46     c.m"
"             Runoff coefficient     0.234      0.000      0.234      "
"             Maximum flow           0.016      0.000      0.016      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.016     0.504     0.494     0.047"
" 33          CATCHMENT 202"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          202   Ditch"
"        0.000   % Impervious"
"        0.320   Total Area"
"       10.000   Flow length"
"        2.000   Overland Slope"
"        0.320   Pervious Area"
"       10.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       10.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
```

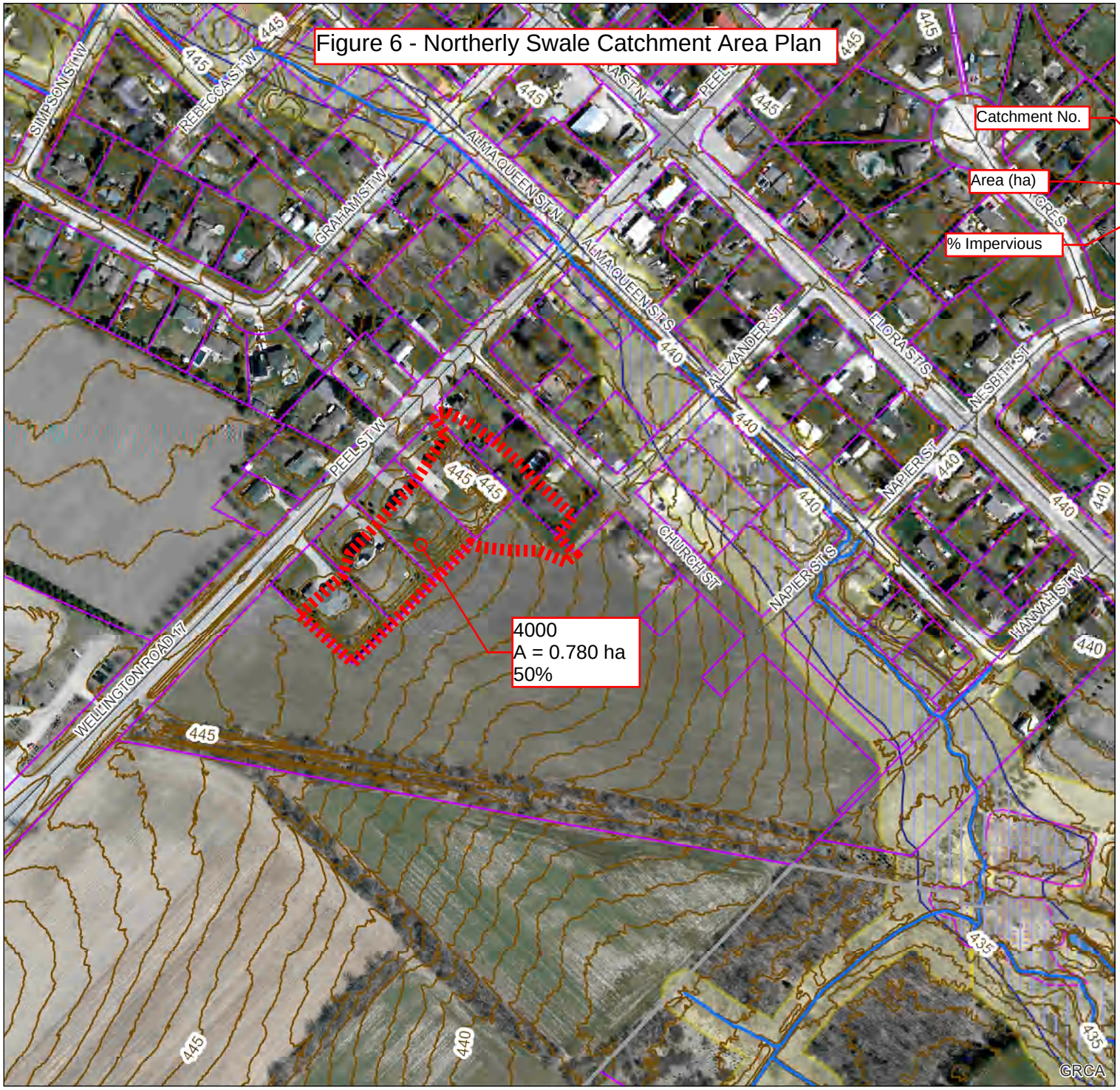
```
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.029     0.504     0.494     0.047 c.m/sec"
"             Catchment 202          Pervious   Impervious Total Area "
"             Surface Area           0.320      0.000      0.320      hectare"
"             Time of concentration  8.910      1.479      8.910      minutes"
"             Time to Centroid       2761.635   2281.822   2761.633   minutes"
"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        912.00     0.00       912.00     c.m"
"             Rainfall losses        213.998    40.260     213.998    mm"
"             Runoff depth           71.002     244.740    71.002     mm"
"             Runoff volume          227.21     0.00       227.21     c.m"
"             Runoff coefficient     0.249      0.000      0.249      "
"             Maximum flow           0.029      0.000      0.029      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.029     0.524     0.494     0.047"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.029     0.524     0.524     0.047"
" 40          HYDROGRAPH   Combine    1000"
"            6   Combine "
"         1000   Node #"
"                Total from Site "
"             Maximum flow                 0.559    c.m/sec"
"             Hydrograph volume        12501.030    c.m"
"                    0.029     0.524     0.524     0.559"
" 40          HYDROGRAPH   Confluence    1000"
"            7   Confluence "
"         1000   Node #"
"                Total from Site "
"             Maximum flow                 0.559    c.m/sec"
"             Hydrograph volume        12501.030    c.m"
"                    0.029     0.559     0.524     0.000"
" 38          START/RE-START TOTALS 1000"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                     8.090    hectare"
"             Total Impervious area                    3.495    hectare"
"             Total % impervious                      43.201"
" 19          EXIT"
```

APPENDIX G

Preliminary Swale Calculations (Northerly and North-Easterly Swale)

NORTHERLY SWALE

Figure 6 - Northerly Swale Catchment Area Plan



Grand River Conservation Authority

Date: Nov 14, 2022

Catchment No.

Area (ha)

% Impervious

1000
A = 64.54 ha
5%

Catchment Boundary

Legend

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

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

0 20 40 80 120 Metres

N

Map Centre (UTM NAD83 z17): 540,010.12 4,841,739.88

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

NAD 1983 UTM Zone 17N

Scale: 3,804

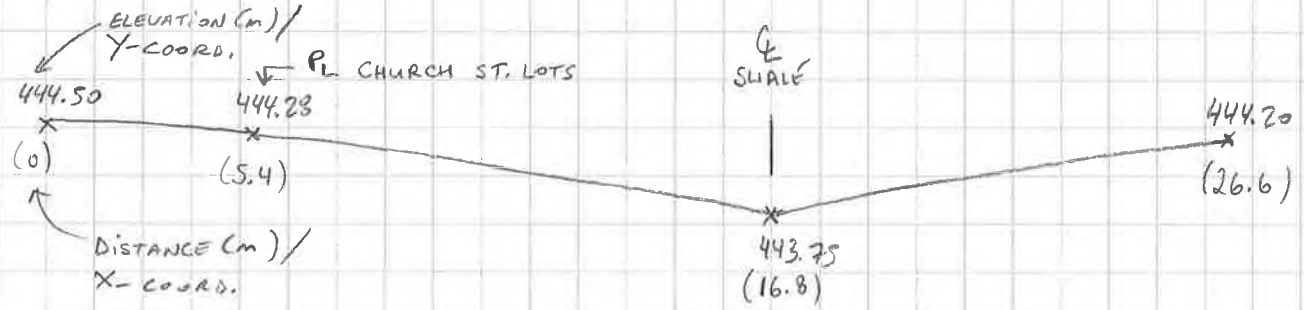
BluePlan ENGINEERING

Project No: 120139 Date: Nov. 14/22

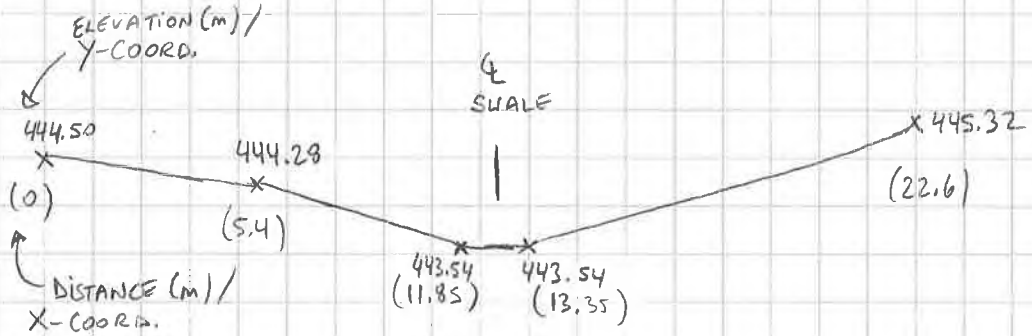
Project: Alma Subdivision

Name: Northerly Swale - Midoss Section Sheet:

Existing Cross-Section



Proposed Cross-Section



SECTION A-A, SEE GM BLUEPLAN DWG. NO. 8.

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:           C:\Users\rsingh\Desktop\My Jobs\120139\"
"                                                          NEW SWM\N-Swale Model"
"                Output filename:         120139 - Existing 2 yr - N Swale.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                 2/2/2024 at 12:28:14 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"     1440.000   Max. Storm length"
"     1440.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"      758.485   Coefficient A"
"        7.538   Constant B"
"        0.806   Exponent C"
"        0.375   Fraction R"
"     1440.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           83.116    mm/hr"
"             Total depth                 51.605    mm"
"            6   002hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 4000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         4000   Existing Peel and Church St. Lots "
"       50.000   % Impervious"
"        0.780   Total Area"
"      115.000   Flow length"
"        2.000   Overland Slope"
"        0.390   Pervious Area"
"      115.000   Pervious length"
"        2.000   Pervious slope"
"        0.390   Impervious Area"
"      115.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    0.075     0.000     0.000     0.000 c.m/sec"
"             Catchment 4000         Pervious   Impervious Total Area "
"             Surface Area           0.390      0.390      0.780      hectare"
"             Time of concentration  41.678     5.349      8.191      minutes"
"             Time to Centroid       584.526    629.349    625.844    minutes"
"             Rainfall depth         51.605     51.605     51.605     mm"
"             Rainfall volume        201.26     201.26     402.52     c.m"
"             Rainfall losses        47.386     1.889      24.637     mm"
"             Runoff depth           4.219      49.716     26.968     mm"
"             Runoff volume          16.45      193.89     210.35     c.m"
"             Runoff coefficient     0.082      0.963      0.523      "
"             Maximum flow           0.006      0.074      0.075      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"              4   Add Runoff "
"                    0.075     0.075     0.000     0.000"
" 52          CHANNEL DESIGN"
"         0.075   Current peak flow    c.m/sec"
"         0.035   Manning 'n'"
"            1.   Cross-section type: 0=trapezoidal; 1=general"
"            4.   Define an arbitrary cross-section"
"                   0.000     5.400    16.800    26.600"
"                 445.500   444.280   443.750   444.200"
"         0.450   Channel depth    metre"
"         0.970   Gradient   %"
"            0.   Variable roughness: 0=False; 1=True"
"                  0.0400    0.0400    0.0400    0.0400"
"             Depth of flow                 0.096    metre"
"             Velocity                      0.372    m/sec"
"             Channel capacity              2.266    c.m/sec"
"             Critical depth                0.075    metre"
" 38          START/RE-START TOTALS 4000"
"              3   Runoff Totals on EXIT"
"             Total Catchment area                       0.780    hectare"
"             Total Impervious area                      0.390    hectare"
"             Total % impervious                        50.000"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:           C:\Users\rsingh\Desktop\My Jobs\120139\"
"                                                          NEW SWM\N-Swale Model"
"                Output filename:          120139 - Existing 5 yr - N Swale.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                 2/2/2024 at 12:31:22 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"     1440.000   Max. Storm length"
"     1440.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"      876.909   Coefficient A"
"        7.781   Constant B"
"        0.780   Exponent C"
"        0.375   Fraction R"
"     1440.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           101.955    mm/hr"
"             Total depth                  72.080    mm"
"            6   005hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 4000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         4000   Existing Peel and Church St. Lots "
"       50.000   % Impervious"
"        0.780   Total Area"
"      115.000   Flow length"
"        2.000   Overland Slope"
"        0.390   Pervious Area"
"      115.000   Pervious length"
"        2.000   Pervious slope"
"        0.390   Impervious Area"
"      115.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    0.097     0.000     0.000     0.000 c.m/sec"
"             Catchment 4000         Pervious   Impervious Total Area "
"             Surface Area           0.390      0.390      0.780      hectare"
"             Time of concentration  28.782     4.930      8.455      minutes"
"             Time to Centroid       578.679    631.173    623.414    minutes"
"             Rainfall depth         72.080     72.080     72.080     mm"
"             Rainfall volume        281.11     281.11     562.23     c.m"
"             Rainfall losses        59.943     2.104      31.024     mm"
"             Runoff depth           12.137     69.976     41.057     mm"
"             Runoff volume          47.33      272.91     320.24     c.m"
"             Runoff coefficient     0.168      0.971      0.570      "
"             Maximum flow           0.019      0.095      0.097      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"              4   Add Runoff "
"                    0.097     0.097     0.000     0.000"
" 52          CHANNEL DESIGN"
"         0.097   Current peak flow    c.m/sec"
"         0.035   Manning 'n'"
"            1.   Cross-section type: 0=trapezoidal; 1=general"
"            4.   Define an arbitrary cross-section"
"                   0.000     5.400    16.800    26.600"
"                 445.500   444.280   443.750   444.200"
"         0.450   Channel depth    metre"
"         0.970   Gradient   %"
"            0.   Variable roughness: 0=False; 1=True"
"                  0.0400    0.0400    0.0400    0.0400"
"             Depth of flow                 0.106    metre"
"             Velocity                      0.397    m/sec"
"             Channel capacity              2.266    c.m/sec"
"             Critical depth                0.084    metre"
" 38          START/RE-START TOTALS 4000"
"              3   Runoff Totals on EXIT"
"             Total Catchment area                       0.780    hectare"
"             Total Impervious area                      0.390    hectare"
"             Total % impervious                        50.000"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:           C:\Users\rsingh\Desktop\My Jobs\120139\"
"                                                          NEW SWM\N-Swale Model"
"                Output filename:        120139 - Existing 10 yr - N Swale.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                 2/2/2024 at 12:36:15 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"     1440.000   Max. Storm length"
"     1440.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"      997.497   Coefficient A"
"        8.438   Constant B"
"        0.775   Exponent C"
"        0.375   Fraction R"
"     1440.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          113.928    mm/hr"
"             Total depth                 85.001    mm"
"            6   010hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 4000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         4000   Existing Peel and Church St. Lots "
"       50.000   % Impervious"
"        0.780   Total Area"
"      115.000   Flow length"
"        2.000   Overland Slope"
"        0.390   Pervious Area"
"      115.000   Pervious length"
"        2.000   Pervious slope"
"        0.390   Impervious Area"
"      115.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    0.112     0.000     0.000     0.000 c.m/sec"
"             Catchment 4000         Pervious   Impervious Total Area "
"             Surface Area           0.390      0.390      0.780      hectare"
"             Time of concentration  27.015     4.716      8.667      minutes"
"             Time to Centroid       577.306    630.519    621.090    minutes"
"             Rainfall depth         85.001     85.001     85.001     mm"
"             Rainfall volume        331.50     331.50     663.01     c.m"
"             Rainfall losses        67.166     2.184      34.675     mm"
"             Runoff depth           17.835     82.817     50.326     mm"
"             Runoff volume          69.56      322.99     392.55     c.m"
"             Runoff coefficient     0.210      0.974      0.592      "
"             Maximum flow           0.029      0.108      0.112      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"              4   Add Runoff "
"                    0.112     0.112     0.000     0.000"
" 52          CHANNEL DESIGN"
"         0.112   Current peak flow    c.m/sec"
"         0.035   Manning 'n'"
"            1.   Cross-section type: 0=trapezoidal; 1=general"
"            4.   Define an arbitrary cross-section"
"                   0.000     5.400    16.800    26.600"
"                 445.500   444.280   443.750   444.200"
"         0.450   Channel depth    metre"
"         0.970   Gradient   %"
"            0.   Variable roughness: 0=False; 1=True"
"                  0.0400    0.0400    0.0400    0.0400"
"             Depth of flow                 0.112    metre"
"             Velocity                      0.412    m/sec"
"             Channel capacity              2.266    c.m/sec"
"             Critical depth                0.089    metre"
" 38          START/RE-START TOTALS 4000"
"              3   Runoff Totals on EXIT"
"             Total Catchment area                       0.780    hectare"
"             Total Impervious area                      0.390    hectare"
"             Total % impervious                        50.000"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:           C:\Users\rsingh\Desktop\My Jobs\120139\"
"                                                          NEW SWM\N-Swale Model"
"                Output filename:        120139 - Existing 25 yr - N Swale.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                 2/2/2024 at 12:38:43 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"     1440.000   Max. Storm length"
"     1440.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     1145.741   Coefficient A"
"        9.035   Constant B"
"        0.769   Exponent C"
"        0.375   Fraction R"
"     1440.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          129.475    mm/hr"
"             Total depth                101.960    mm"
"            6   025hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 4000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         4000   Existing Peel and Church St. Lots "
"       50.000   % Impervious"
"        0.780   Total Area"
"      115.000   Flow length"
"        2.000   Overland Slope"
"        0.390   Pervious Area"
"      115.000   Pervious length"
"        2.000   Pervious slope"
"        0.390   Impervious Area"
"      115.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    0.133     0.000     0.000     0.000 c.m/sec"
"             Catchment 4000         Pervious   Impervious Total Area "
"             Surface Area           0.390      0.390      0.780      hectare"
"             Time of concentration  25.334     4.480      8.717      minutes"
"             Time to Centroid       575.537    630.191    619.088    minutes"
"             Rainfall depth         101.960    101.960    101.960    mm"
"             Rainfall volume        397.64     397.64     795.28     c.m"
"             Rainfall losses        76.587     2.434      39.510     mm"
"             Runoff depth           25.373     99.526     62.449     mm"
"             Runoff volume          98.95      388.15     487.10     c.m"
"             Runoff coefficient     0.249      0.976      0.612      "
"             Maximum flow           0.044      0.125      0.133      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"              4   Add Runoff "
"                    0.133     0.133     0.000     0.000"
" 52          CHANNEL DESIGN"
"         0.133   Current peak flow    c.m/sec"
"         0.035   Manning 'n'"
"            1.   Cross-section type: 0=trapezoidal; 1=general"
"            4.   Define an arbitrary cross-section"
"                   0.000     5.400    16.800    26.600"
"                 445.500   444.280   443.750   444.200"
"         0.450   Channel depth    metre"
"         0.970   Gradient   %"
"            0.   Variable roughness: 0=False; 1=True"
"                  0.0400    0.0400    0.0400    0.0400"
"             Depth of flow                 0.120    metre"
"             Velocity                      0.430    m/sec"
"             Channel capacity              2.266    c.m/sec"
"             Critical depth                0.095    metre"
" 38          START/RE-START TOTALS 4000"
"              3   Runoff Totals on EXIT"
"             Total Catchment area                       0.780    hectare"
"             Total Impervious area                      0.390    hectare"
"             Total % impervious                        50.000"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:           C:\Users\rsingh\Desktop\My Jobs\120139\"
"                                                          NEW SWM\N-Swale Model"
"                Output filename:        120139 - Existing 50 yr - N Swale.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                 2/2/2024 at 12:40:25 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"     1440.000   Max. Storm length"
"     1440.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     1273.113   Coefficient A"
"        9.492   Constant B"
"        0.770   Exponent C"
"        0.375   Fraction R"
"     1440.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          140.566    mm/hr"
"             Total depth                112.445    mm"
"            6   050hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 4000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         4000   Existing Peel and Church St. Lots "
"       50.000   % Impervious"
"        0.780   Total Area"
"      115.000   Flow length"
"        2.000   Overland Slope"
"        0.390   Pervious Area"
"      115.000   Pervious length"
"        2.000   Pervious slope"
"        0.390   Impervious Area"
"      115.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    0.149     0.000     0.000     0.000 c.m/sec"
"             Catchment 4000         Pervious   Impervious Total Area "
"             Surface Area           0.390      0.390      0.780      hectare"
"             Time of concentration  24.388     4.335      8.705      minutes"
"             Time to Centroid       574.731    629.205    617.334    minutes"
"             Rainfall depth         112.445    112.445    112.445    mm"
"             Rainfall volume        438.54     438.54     877.07     c.m"
"             Rainfall losses        81.858     2.678      42.268     mm"
"             Runoff depth           30.587     109.767    70.177     mm"
"             Runoff volume          119.29     428.09     547.38     c.m"
"             Runoff coefficient     0.272      0.976      0.624      "
"             Maximum flow           0.055      0.137      0.149      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"              4   Add Runoff "
"                    0.149     0.149     0.000     0.000"
" 52          CHANNEL DESIGN"
"         0.149   Current peak flow    c.m/sec"
"         0.035   Manning 'n'"
"            1.   Cross-section type: 0=trapezoidal; 1=general"
"            4.   Define an arbitrary cross-section"
"                   0.000     5.400    16.800    26.600"
"                 445.500   444.280   443.750   444.200"
"         0.450   Channel depth    metre"
"         0.970   Gradient   %"
"            0.   Variable roughness: 0=False; 1=True"
"                  0.0400    0.0400    0.0400    0.0400"
"             Depth of flow                 0.125    metre"
"             Velocity                      0.442    m/sec"
"             Channel capacity              2.266    c.m/sec"
"             Critical depth                0.099    metre"
" 38          START/RE-START TOTALS 4000"
"              3   Runoff Totals on EXIT"
"             Total Catchment area                       0.780    hectare"
"             Total Impervious area                      0.390    hectare"
"             Total % impervious                        50.000"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:           C:\Users\rsingh\Desktop\My Jobs\120139\"
"                                                        NEW SWM\N-Swale Model"
"                Output filename:       120139 - Existing 100 yr - N Swale.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                 2/2/2024 at 12:42:05 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"     1440.000   Max. Storm length"
"     1440.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     1357.120   Coefficient A"
"        9.595   Constant B"
"        0.763   Exponent C"
"        0.375   Fraction R"
"     1440.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          152.190    mm/hr"
"             Total depth                126.124    mm"
"            6   100hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 4000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         4000   Existing Peel and Church St. Lots "
"       50.000   % Impervious"
"        0.780   Total Area"
"      115.000   Flow length"
"        2.000   Overland Slope"
"        0.390   Pervious Area"
"      115.000   Pervious length"
"        2.000   Pervious slope"
"        0.390   Impervious Area"
"      115.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    0.165     0.000     0.000     0.000 c.m/sec"
"             Catchment 4000         Pervious   Impervious Total Area "
"             Surface Area           0.390      0.390      0.780      hectare"
"             Time of concentration  23.526     4.200      8.605      minutes"
"             Time to Centroid       574.951    629.808    617.304    minutes"
"             Rainfall depth         126.124    126.124    126.124    mm"
"             Rainfall volume        491.88     491.88     983.77     c.m"
"             Rainfall losses        89.735     2.873      46.304     mm"
"             Runoff depth           36.389     123.251    79.820     mm"
"             Runoff volume          141.92     480.68     622.60     c.m"
"             Runoff coefficient     0.289      0.977      0.633      "
"             Maximum flow           0.064      0.149      0.165      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.165     0.165     0.000     0.000"
" 52          CHANNEL DESIGN"
"        0.165   Current peak flow    c.m/sec"
"        0.035   Manning 'n'"
"           1.   Cross-section type: 0=trapezoidal; 1=general"
"           4.   Define an arbitrary cross-section"
"                  0.000     5.400    16.800    26.600"
"                445.500   444.280   443.750   444.200"
"        0.450   Channel depth    metre"
"        0.970   Gradient   %"
"           0.   Variable roughness: 0=False; 1=True"
"                 0.0400    0.0400    0.0400    0.0400"
"             Depth of flow                0.130    metre"
"             Velocity                     0.454    m/sec"
"             Channel capacity             2.266    c.m/sec"
"             Critical depth               0.103    metre"
" 38          START/RE-START TOTALS 4000"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                      0.780    hectare"
"             Total Impervious area                     0.390    hectare"
"             Total % impervious                       50.000"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:        \\gue-projects\users stuff\szaga\Documents\"
"                                                Alma Subdivision\MIDUSS\N Swale"
"                Output filename:                     120139_EX_Reg-N-Swale.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                11/14/2022 at 3:23:06 PM"
" 31          TIME PARAMETERS"
"       60.000   Time Step"
"     2880.000   Max. Storm length"
"     5000.000   Max. Hydrograph"
" 32          STORM Historic"
"            5   Historic"
"     2880.000   Duration"
"       48.000   Rainfall intensity values"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.026     2.026     2.026     2.028"
"                  2.026     6.000     4.000     6.000    13.000"
"                 17.000    13.000    23.000    13.000    13.000"
"                 53.000    38.000    13.000"
"             Maximum intensity            53.000    mm/hr"
"             Total depth                 285.000    mm"
"            7   9999hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 4000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         4000   Existing Peel and Church St. Lots "
"       50.000   % Impervious"
"        0.780   Total Area"
"      115.000   Flow length"
"        2.000   Overland Slope"
"        0.390   Pervious Area"
"      115.000   Pervious length"
"        2.000   Pervious slope"
"        0.390   Impervious Area"
"      115.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
```

```
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.070     0.000     0.000     0.000 c.m/sec"
"             Catchment 4000         Pervious   Impervious Total Area "
"             Surface Area           0.390      0.390      0.780      hectare"
"             Time of concentration  38.575     6.404      13.705     minutes"
"             Time to Centroid       2792.332   2237.227   2363.201   minutes"
"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        1111.50    1111.50    2223.00    c.m"
"             Rainfall losses        209.180    26.719     117.949    mm"
"             Runoff depth           75.820     258.281    167.051    mm"
"             Runoff volume          295.70     1007.29    1302.99    c.m"
"             Runoff coefficient     0.266      0.906      0.586      "
"             Maximum flow           0.033      0.049      0.070      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.070     0.070     0.000     0.000"
" 52          CHANNEL DESIGN"
"        0.070   Current peak flow    c.m/sec"
"        0.035   Manning 'n'"
"           1.   Cross-section type: 0=trapezoidal; 1=general"
"           4.   Define an arbitrary cross-section"
"                  0.000     5.400    16.800    26.600"
"                445.500   444.280   443.750   444.200"
"        0.450   Channel depth    metre"
"        0.970   Gradient   %"
"           0.   Variable roughness: 0=False; 1=True"
"                 0.0400    0.0400    0.0400    0.0400"
"             Depth of flow                 0.094    metre"
"             Velocity                      0.366    m/sec"
"             Channel capacity              2.266    c.m/sec"
"             Critical depth                0.073    metre"
" 38          START/RE-START TOTALS 4000"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                      0.780    hectare"
"             Total Impervious area                     0.390    hectare"
"             Total % impervious                       50.000"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:           C:\Users\rsingh\Desktop\My Jobs\120139\"
"                                                        NEW SWM\N-Swale Model"
"                Output filename:            120139 - Prop. 2 yr - N Swale.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                  2/2/2024 at 1:12:01 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"     1440.000   Max. Storm length"
"     1440.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"      758.485   Coefficient A"
"        7.538   Constant B"
"        0.806   Exponent C"
"        0.375   Fraction R"
"     1440.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           83.116    mm/hr"
"             Total depth                 51.605    mm"
"            6   002hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 4000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         4000   Existing Peel and Church St. Lots "
"       50.000   % Impervious"
"        0.780   Total Area"
"      115.000   Flow length"
"        2.000   Overland Slope"
"        0.390   Pervious Area"
"      115.000   Pervious length"
"        2.000   Pervious slope"
"        0.390   Impervious Area"
"      115.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    0.075     0.000     0.000     0.000 c.m/sec"
"             Catchment 4000         Pervious   Impervious Total Area "
"             Surface Area           0.390      0.390      0.780      hectare"
"             Time of concentration  41.678     5.349      8.191      minutes"
"             Time to Centroid       584.526    629.349    625.844    minutes"
"             Rainfall depth         51.605     51.605     51.605     mm"
"             Rainfall volume        201.26     201.26     402.52     c.m"
"             Rainfall losses        47.386     1.889      24.637     mm"
"             Runoff depth           4.219      49.716     26.968     mm"
"             Runoff volume          16.45      193.89     210.35     c.m"
"             Runoff coefficient     0.082      0.963      0.523      "
"             Maximum flow           0.006      0.074      0.075      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"              4   Add Runoff "
"                    0.075     0.075     0.000     0.000"
" 52          CHANNEL DESIGN"
"         0.075   Current peak flow    c.m/sec"
"         0.035   Manning 'n'"
"            1.   Cross-section type: 0=trapezoidal; 1=general"
"            5.   Define an arbitrary cross-section"
"                   0.000     5.400    11.850    13.350    22.600"
"                 444.500   444.280   443.540   443.540   445.320"
"         0.960   Channel depth    metre"
"         2.070   Gradient   %"
"            0.   Variable roughness: 0=False; 1=True"
"                  0.0400    0.0400    0.0400    0.0400    0.0400"
"             Depth of flow                 0.066    metre"
"             Velocity                      0.581    m/sec"
"             Channel capacity             19.748    c.m/sec"
"             Critical depth                0.058    metre"
" 38          START/RE-START TOTALS 4000"
"              3   Runoff Totals on EXIT"
"             Total Catchment area                        0.780    hectare"
"             Total Impervious area                       0.390    hectare"
"             Total % impervious                         50.000"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:           C:\Users\rsingh\Desktop\My Jobs\120139\"
"                                                        NEW SWM\N-Swale Model"
"                Output filename:            120139 - Prop. 5 yr - N Swale.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                  2/2/2024 at 1:09:58 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"     1440.000   Max. Storm length"
"     1440.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"      876.909   Coefficient A"
"        7.781   Constant B"
"        0.780   Exponent C"
"        0.375   Fraction R"
"     1440.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          101.955    mm/hr"
"             Total depth                 72.080    mm"
"            6   005hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 4000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         4000   Existing Peel and Church St. Lots "
"       50.000   % Impervious"
"        0.780   Total Area"
"      115.000   Flow length"
"        2.000   Overland Slope"
"        0.390   Pervious Area"
"      115.000   Pervious length"
"        2.000   Pervious slope"
"        0.390   Impervious Area"
"      115.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    0.097     0.000     0.000     0.000 c.m/sec"
"             Catchment 4000         Pervious   Impervious Total Area "
"             Surface Area           0.390      0.390      0.780      hectare"
"             Time of concentration  28.782     4.930      8.455      minutes"
"             Time to Centroid       578.679    631.173    623.414    minutes"
"             Rainfall depth         72.080     72.080     72.080     mm"
"             Rainfall volume        281.11     281.11     562.23     c.m"
"             Rainfall losses        59.943     2.104      31.024     mm"
"             Runoff depth           12.137     69.976     41.057     mm"
"             Runoff volume          47.33      272.91     320.24     c.m"
"             Runoff coefficient     0.168      0.971      0.570      "
"             Maximum flow           0.019      0.095      0.097      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"              4   Add Runoff "
"                    0.097     0.097     0.000     0.000"
" 52          CHANNEL DESIGN"
"         0.097   Current peak flow    c.m/sec"
"         0.035   Manning 'n'"
"            1.   Cross-section type: 0=trapezoidal; 1=general"
"            5.   Define an arbitrary cross-section"
"                   0.000     5.400    11.850    13.350    22.600"
"                 444.500   444.280   443.540   443.540   445.320"
"         0.960   Channel depth    metre"
"         2.070   Gradient   %"
"            0.   Variable roughness: 0=False; 1=True"
"                  0.0400    0.0400    0.0400    0.0400    0.0400"
"             Depth of flow                 0.076    metre"
"             Velocity                      0.630    m/sec"
"             Channel capacity             19.748    c.m/sec"
"             Critical depth                0.067    metre"
" 38          START/RE-START TOTALS 4000"
"              3   Runoff Totals on EXIT"
"             Total Catchment area                        0.780    hectare"
"             Total Impervious area                       0.390    hectare"
"             Total % impervious                         50.000"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:           C:\Users\rsingh\Desktop\My Jobs\120139\"
"                                                        NEW SWM\N-Swale Model"
"                Output filename:           120139 - Prop. 10 yr - N Swale.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                  2/2/2024 at 1:07:12 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"     1440.000   Max. Storm length"
"     1440.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"      997.497   Coefficient A"
"        8.438   Constant B"
"        0.775   Exponent C"
"        0.375   Fraction R"
"     1440.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          113.928    mm/hr"
"             Total depth                 85.001    mm"
"            6   010hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 4000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         4000   Existing Peel and Church St. Lots "
"       50.000   % Impervious"
"        0.780   Total Area"
"      115.000   Flow length"
"        2.000   Overland Slope"
"        0.390   Pervious Area"
"      115.000   Pervious length"
"        2.000   Pervious slope"
"        0.390   Impervious Area"
"      115.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    0.112     0.000     0.000     0.000 c.m/sec"
"             Catchment 4000         Pervious   Impervious Total Area "
"             Surface Area           0.390      0.390      0.780      hectare"
"             Time of concentration  27.015     4.716      8.667      minutes"
"             Time to Centroid       577.306    630.519    621.090    minutes"
"             Rainfall depth         85.001     85.001     85.001     mm"
"             Rainfall volume        331.50     331.50     663.01     c.m"
"             Rainfall losses        67.166     2.184      34.675     mm"
"             Runoff depth           17.835     82.817     50.326     mm"
"             Runoff volume          69.56      322.99     392.55     c.m"
"             Runoff coefficient     0.210      0.974      0.592      "
"             Maximum flow           0.029      0.108      0.112      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"              4   Add Runoff "
"                    0.112     0.112     0.000     0.000"
" 52          CHANNEL DESIGN"
"         0.112   Current peak flow    c.m/sec"
"         0.035   Manning 'n'"
"            1.   Cross-section type: 0=trapezoidal; 1=general"
"            5.   Define an arbitrary cross-section"
"                   0.000     5.400    11.850    13.350    22.600"
"                 444.500   444.280   443.540   443.540   445.320"
"         0.960   Channel depth    metre"
"         2.070   Gradient   %"
"            0.   Variable roughness: 0=False; 1=True"
"                  0.0400    0.0400    0.0400    0.0400    0.0400"
"             Depth of flow                 0.082    metre"
"             Velocity                      0.658    m/sec"
"             Channel capacity             19.748    c.m/sec"
"             Critical depth                0.073    metre"
" 38          START/RE-START TOTALS 4000"
"              3   Runoff Totals on EXIT"
"             Total Catchment area                        0.780    hectare"
"             Total Impervious area                       0.390    hectare"
"             Total % impervious                         50.000"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:           C:\Users\rsingh\Desktop\My Jobs\120139\"
"                                                        NEW SWM\N-Swale Model"
"                Output filename:           120139 - Prop. 25 yr - N Swale.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                 2/2/2024 at 12:56:41 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"     1440.000   Max. Storm length"
"     1440.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     1145.741   Coefficient A"
"        9.035   Constant B"
"        0.769   Exponent C"
"        0.375   Fraction R"
"     1440.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          129.475    mm/hr"
"             Total depth                101.960    mm"
"            6   025hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 4000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         4000   Existing Peel and Church St. Lots "
"       50.000   % Impervious"
"        0.780   Total Area"
"      115.000   Flow length"
"        2.000   Overland Slope"
"        0.390   Pervious Area"
"      115.000   Pervious length"
"        2.000   Pervious slope"
"        0.390   Impervious Area"
"      115.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    0.133     0.000     0.000     0.000 c.m/sec"
"             Catchment 4000         Pervious   Impervious Total Area "
"             Surface Area           0.390      0.390      0.780      hectare"
"             Time of concentration  25.334     4.480      8.717      minutes"
"             Time to Centroid       575.537    630.191    619.088    minutes"
"             Rainfall depth         101.960    101.960    101.960    mm"
"             Rainfall volume        397.64     397.64     795.28     c.m"
"             Rainfall losses        76.587     2.434      39.510     mm"
"             Runoff depth           25.373     99.526     62.449     mm"
"             Runoff volume          98.95      388.15     487.10     c.m"
"             Runoff coefficient     0.249      0.976      0.612      "
"             Maximum flow           0.044      0.125      0.133      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"              4   Add Runoff "
"                    0.133     0.133     0.000     0.000"
" 52          CHANNEL DESIGN"
"         0.133   Current peak flow    c.m/sec"
"         0.035   Manning 'n'"
"            1.   Cross-section type: 0=trapezoidal; 1=general"
"            5.   Define an arbitrary cross-section"
"                   0.000     5.400    11.850    13.350    22.600"
"                 444.500   444.280   443.540   443.540   445.320"
"         0.960   Channel depth    metre"
"         2.070   Gradient   %"
"            0.   Variable roughness: 0=False; 1=True"
"                  0.0400    0.0400    0.0400    0.0400    0.0400"
"             Depth of flow                 0.090    metre"
"             Velocity                      0.694    m/sec"
"             Channel capacity             19.748    c.m/sec"
"             Critical depth                0.081    metre"
" 38          START/RE-START TOTALS 4000"
"              3   Runoff Totals on EXIT"
"             Total Catchment area                        0.780    hectare"
"             Total Impervious area                       0.390    hectare"
"             Total % impervious                         50.000"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:           C:\Users\rsingh\Desktop\My Jobs\120139\"
"                                                        NEW SWM\N-Swale Model"
"                Output filename:           120139 - Prop. 50 yr - N Swale.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                 2/2/2024 at 12:52:48 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"     1440.000   Max. Storm length"
"     1440.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     1273.113   Coefficient A"
"        9.492   Constant B"
"        0.770   Exponent C"
"        0.375   Fraction R"
"     1440.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          140.566    mm/hr"
"             Total depth                112.445    mm"
"            6   050hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 4000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         4000   Existing Peel and Church St. Lots "
"       50.000   % Impervious"
"        0.780   Total Area"
"      115.000   Flow length"
"        2.000   Overland Slope"
"        0.390   Pervious Area"
"      115.000   Pervious length"
"        2.000   Pervious slope"
"        0.390   Impervious Area"
"      115.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

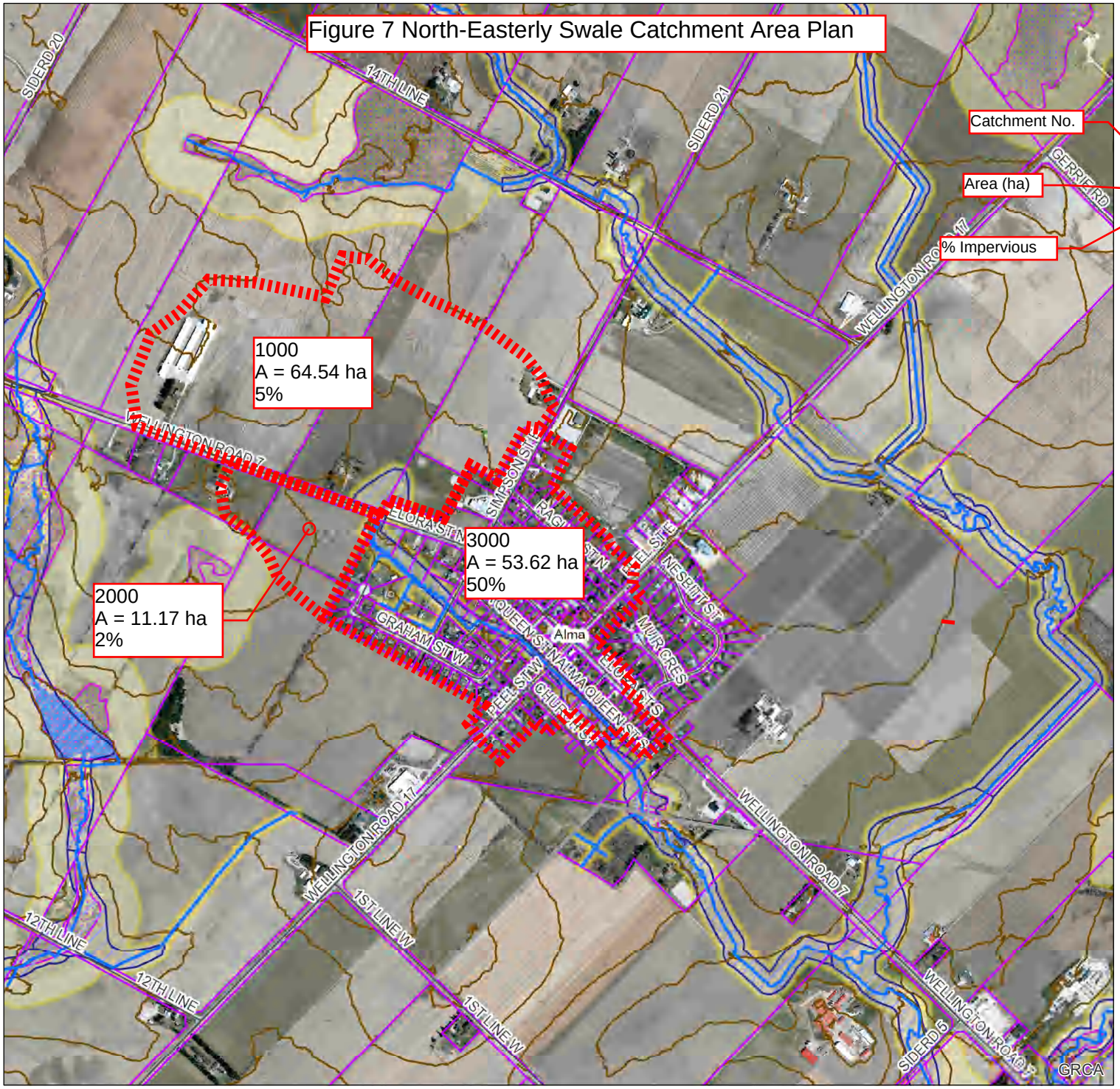
```
"                    0.149     0.000     0.000     0.000 c.m/sec"
"             Catchment 4000         Pervious   Impervious Total Area "
"             Surface Area           0.390      0.390      0.780      hectare"
"             Time of concentration  24.388     4.335      8.705      minutes"
"             Time to Centroid       574.731    629.205    617.334    minutes"
"             Rainfall depth         112.445    112.445    112.445    mm"
"             Rainfall volume        438.54     438.54     877.07     c.m"
"             Rainfall losses        81.858     2.678      42.268     mm"
"             Runoff depth           30.587     109.767    70.177     mm"
"             Runoff volume          119.29     428.09     547.38     c.m"
"             Runoff coefficient     0.272      0.976      0.624      "
"             Maximum flow           0.055      0.137      0.149      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"              4   Add Runoff "
"                    0.149     0.149     0.000     0.000"
" 52          CHANNEL DESIGN"
"         0.149   Current peak flow    c.m/sec"
"         0.035   Manning 'n'"
"            1.   Cross-section type: 0=trapezoidal; 1=general"
"            5.   Define an arbitrary cross-section"
"                   0.000     5.400    11.850    13.350    22.600"
"                 444.500   444.280   443.540   443.540   445.320"
"         0.960   Channel depth    metre"
"         2.070   Gradient   %"
"            0.   Variable roughness: 0=False; 1=True"
"                  0.0400    0.0400    0.0400    0.0400    0.0400"
"             Depth of flow                 0.096    metre"
"             Velocity                      0.717    m/sec"
"             Channel capacity             19.748    c.m/sec"
"             Critical depth                0.087    metre"
" 38          START/RE-START TOTALS 4000"
"              3   Runoff Totals on EXIT"
"             Total Catchment area                        0.780    hectare"
"             Total Impervious area                       0.390    hectare"
"             Total % impervious                         50.000"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:        \\gue-projects\users stuff\szaga\Documents\"
"                                                Alma Subdivision\MIDUSS\N Swale"
"                Output filename:                     120139_PR_Reg-N-Swale.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                11/14/2022 at 4:11:36 PM"
" 31          TIME PARAMETERS"
"       60.000   Time Step"
"     2880.000   Max. Storm length"
"     5000.000   Max. Hydrograph"
" 32          STORM Historic"
"            5   Historic"
"     2880.000   Duration"
"       48.000   Rainfall intensity values"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.026     2.026     2.026     2.028"
"                  2.026     6.000     4.000     6.000    13.000"
"                 17.000    13.000    23.000    13.000    13.000"
"                 53.000    38.000    13.000"
"             Maximum intensity            53.000    mm/hr"
"             Total depth                 285.000    mm"
"            7   9999hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 4000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         4000   Existing Peel and Church St. Lots "
"       50.000   % Impervious"
"        0.780   Total Area"
"      115.000   Flow length"
"        2.000   Overland Slope"
"        0.390   Pervious Area"
"      115.000   Pervious length"
"        2.000   Pervious slope"
"        0.390   Impervious Area"
"      115.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
```

```
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.070     0.000     0.000     0.000 c.m/sec"
"             Catchment 4000         Pervious   Impervious Total Area "
"             Surface Area           0.390      0.390      0.780      hectare"
"             Time of concentration  38.575     6.404      13.705     minutes"
"             Time to Centroid       2792.332   2237.227   2363.201   minutes"
"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        1111.50    1111.50    2223.00    c.m"
"             Rainfall losses        209.180    26.719     117.949    mm"
"             Runoff depth           75.820     258.281    167.051    mm"
"             Runoff volume          295.70     1007.29    1302.99    c.m"
"             Runoff coefficient     0.266      0.906      0.586      "
"             Maximum flow           0.033      0.049      0.070      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.070     0.070     0.000     0.000"
" 52          CHANNEL DESIGN"
"        0.070   Current peak flow    c.m/sec"
"        0.035   Manning 'n'"
"           1.   Cross-section type: 0=trapezoidal; 1=general"
"           5.   Define an arbitrary cross-section"
"                  0.000     5.400    11.850    13.350    22.600"
"                444.500   444.280   443.540   443.540   445.320"
"        0.960   Channel depth    metre"
"        2.070   Gradient   %"
"           0.   Variable roughness: 0=False; 1=True"
"                 0.0400    0.0400    0.0400    0.0400    0.0400"
"             Depth of flow                 0.063    metre"
"             Velocity                      0.569    m/sec"
"             Channel capacity             19.748    c.m/sec"
"             Critical depth                0.055    metre"
" 38          START/RE-START TOTALS 4000"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                       0.780    hectare"
"             Total Impervious area                      0.390    hectare"
"             Total % impervious                        50.000"
" 19          EXIT"
```

NORTH-EASTERLY SWALE

Figure 7 North-Easterly Swale Catchment Area Plan



Grand River Conservation Authority

Date: Oct 21, 2022

Catchment No.

Area (ha)

% Impervious

1000
A = 64.54 ha
5%

Catchment Boundary

Legend

- Lake Erie Shoreline Reach (GRCA)
- Lake Erie Flood (GRCA)
- Regulated Watercourse (GRCA)
- Parcel - Assessment Public (MPAC/MNRF)
- Contour CGVD2013 - Regional (GRCA)
- Floodplain - Special Policy Area (GRCA)

Floodplain (GRCA)

- Engineered
- Estimated
- Approximate
- Lake Erie Erosion (GRCA)
- Lake Erie Dynamic Beach (GRCA)
- Wetland (GRCA)

Slope Valley (GRCA)

- Steep
- Oversteep

0 100 200 400 600 Metres

N

Map Centre (UTM NAD83 z17): 540,045.65 4,842,308.45

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

NAD 1983 UTM Zone 17N

Scale: 16,839

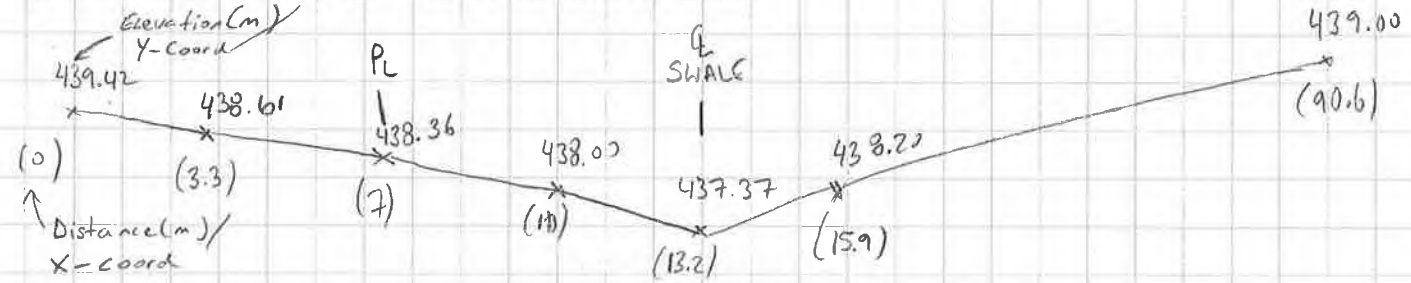
BluePlan ENGINEERING

Project No: 120139 Date:

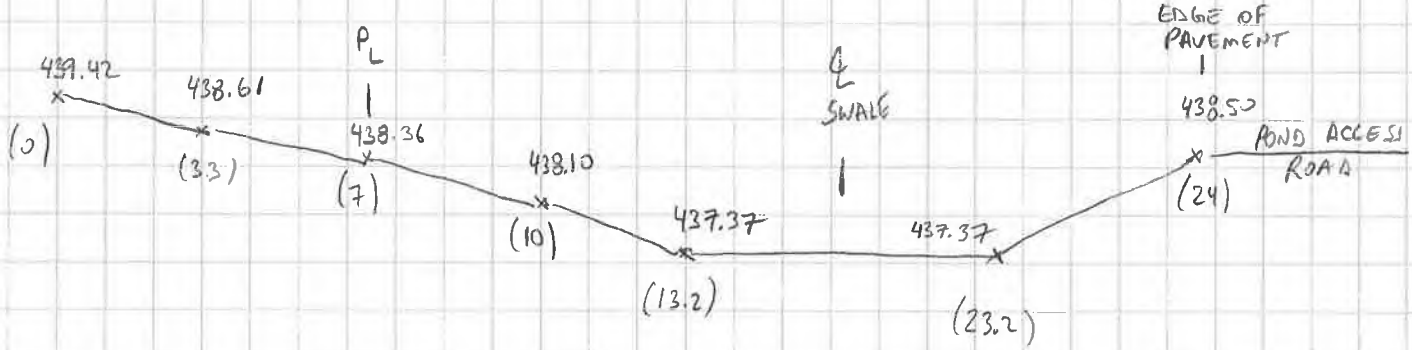
Project: ALMA SUBDIVISION

Name: NORTH-EASTERLY SWALE - MIDUSS SECTION Sheet:

EXISTING CROSS-SECTION - LOT 60 QUEEN



PROPOSED CROSS-SECTION - LOT 60 QUEEN



```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:           C:\Users\rsingh\Desktop\My Jobs\120139\"
"                                                        NEW SWM\NE Swale Model"
"                Output filename:        120139 - Existing 2 yr - NE Swale.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                2/2/2024 at 11:28:31 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"     1440.000   Max. Storm length"
"     1440.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"      758.485   Coefficient A"
"        7.538   Constant B"
"        0.806   Exponent C"
"        0.375   Fraction R"
"     1440.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity            83.116    mm/hr"
"             Total depth                  51.605    mm"
"            6   002hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 1000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         1000   Existing Farm Field "
"        5.000   % Impervious"
"       64.540   Total Area"
"      700.000   Flow length"
"        2.000   Overland Slope"
"       61.313   Pervious Area"
"      700.000   Pervious length"
"        2.000   Pervious slope"
"        3.227   Impervious Area"
"      700.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    0.548     0.000     0.000     0.000 c.m/sec"
"             Catchment 1000         Pervious   Impervious Total Area "
"             Surface Area           61.313     3.227      64.540     hectare"
"             Time of concentration  123.183    15.811     82.282     minutes"
"             Time to Centroid       656.867    646.248    652.821    minutes"
"             Rainfall depth         51.605     51.605     51.605     mm"
"             Rainfall volume        3.1640     0.1665     3.3306     ha-m"
"             Rainfall losses        47.384     2.255      45.127     mm"
"             Runoff depth           4.221      49.350     6.478      mm"
"             Runoff volume          2588.10    1592.52    4180.62    c.m"
"             Runoff coefficient     0.082      0.956      0.126      "
"             Maximum flow           0.338      0.496      0.548      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.548     0.548     0.000     0.000"
" 33          CATCHMENT 2000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         2000   Existing Farm Field"
"        2.000   % Impervious"
"       11.170   Total Area"
"      350.000   Flow length"
"        2.000   Overland Slope"
"       10.947   Pervious Area"
"      350.000   Pervious length"
"        2.000   Pervious slope"
"        0.223   Impervious Area"
"      350.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.094     0.548     0.000     0.000 c.m/sec"
"             Catchment 2000         Pervious   Impervious Total Area "
"             Surface Area           10.947     0.223      11.170     hectare"
"             Time of concentration  81.270     10.431     67.574     minutes"
"             Time to Centroid       619.668    637.569    623.128    minutes"
"             Rainfall depth         51.605     51.605     51.605     mm"
"             Rainfall volume        5648.98    115.29     5764.26    c.m"
"             Rainfall losses        47.384     2.033      46.477     mm"
"             Runoff depth           4.221      49.571     5.128      mm"
"             Runoff volume          462.01     110.74     572.76     c.m"
```

```
"             Runoff coefficient     0.082      0.961      0.099      "
"             Maximum flow           0.089      0.040      0.094      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.094     0.603     0.000     0.000"
" 33          CATCHMENT 3000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         3000   Developed part of Town"
"       50.000   % Impervious"
"       53.620   Total Area"
"      650.000   Flow length"
"        2.000   Overland Slope"
"       26.810   Pervious Area"
"      650.000   Pervious length"
"        2.000   Pervious slope"
"       26.810   Impervious Area"
"      650.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    4.181     0.603     0.000     0.000 c.m/sec"
"             Catchment 3000         Pervious   Impervious Total Area "
"             Surface Area           26.810     26.810     53.620     hectare"
"             Time of concentration  117.826    15.123     23.210     minutes"
"             Time to Centroid       652.115    645.144    645.692    minutes"
"             Rainfall depth         51.605     51.605     51.605     mm"
"             Rainfall volume        1.3835     1.3835     2.7671     ha-m"
"             Rainfall losses        47.384     2.219      24.801     mm"
"             Runoff depth           4.221      49.385     26.803     mm"
"             Runoff volume          0.1132     1.3240     1.4372     ha-m"
"             Runoff coefficient     0.082      0.957      0.519      "
"             Maximum flow           0.153      4.157      4.181      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    4.181     4.784     0.000     0.000"
" 52          CHANNEL DESIGN"
"        4.784   Current peak flow    c.m/sec"
"        0.060   Manning 'n'"
"           1.   Cross-section type: 0=trapezoidal; 1=general"
"           7.   Define an arbitrary cross-section"
```

```
"                  0.000     3.300     7.000    10.000    13.200"
"                 15.900    90.600"
"                439.420   438.610   438.360   438.000   437.370"
"                438.200   439.000"
"        1.630   Channel depth    metre"
"        0.850   Gradient   %"
"           0.   Variable roughness: 0=False; 1=True"
"                 0.0400    0.0400    0.0400    0.0400    0.0400"
"                 0.0400    0.0400"
"             Depth of flow                 1.082    metre"
"             Velocity                      0.591    m/sec"
"             Channel capacity             16.662    c.m/sec"
"             Critical depth                0.774    metre"
" 53          ROUTE    Channel Route 122"
"       121.60      Channel Route 122 Reach length   ( metre)"
"        0.400   X-factor <= 0.5"
"      154.444   K-lag   ( seconds)"
"        0.000   Default(0) or user spec.(1) values used"
"        0.500   X-factor <= 0.5"
"       30.000   K-lag   ( seconds)"
"        0.500   Beta weighting factor"
"      150.000   Routing time step   ( seconds)"
"            1   No. of sub-reaches"
"             Peak outflow                  4.466    c.m/sec"
"                     4.181     4.784     4.466     0.000 c.m/sec"
" 38          START/RE-START TOTALS 3000"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                    129.330    hectare"
"             Total Impervious area                    30.260    hectare"
"             Total % impervious                       23.398"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:           C:\Users\rsingh\Desktop\My Jobs\120139\"
"                                                        NEW SWM\NE Swale Model"
"                Output filename:        120139 - Existing 5 yr - NE Swale.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                2/2/2024 at 11:33:20 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"     1440.000   Max. Storm length"
"     1440.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"      876.909   Coefficient A"
"        7.781   Constant B"
"        0.780   Exponent C"
"        0.375   Fraction R"
"     1440.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          101.955    mm/hr"
"             Total depth                 72.080    mm"
"            6   005hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 1000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         1000   Existing Farm Field "
"        5.000   % Impervious"
"       64.540   Total Area"
"      700.000   Flow length"
"        2.000   Overland Slope"
"       61.313   Pervious Area"
"      700.000   Pervious length"
"        2.000   Pervious slope"
"        3.227   Impervious Area"
"      700.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    1.273     0.000     0.000     0.000 c.m/sec"
"             Catchment 1000         Pervious   Impervious Total Area "
"             Surface Area           61.313     3.227      64.540     hectare"
"             Time of concentration  85.067     14.570     68.739     minutes"
"             Time to Centroid       637.709    646.555    639.758    minutes"
"             Rainfall depth         72.080     72.080     72.080     mm"
"             Rainfall volume        4.4195     0.2326     4.6521     ha-m"
"             Rainfall losses        59.928     2.481      57.056     mm"
"             Runoff depth           12.152     69.600     15.024     mm"
"             Runoff volume          7450.79    2245.98    9696.77    c.m"
"             Runoff coefficient     0.169      0.966      0.208      "
"             Maximum flow           1.184      0.634      1.273      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    1.273     1.273     0.000     0.000"
" 33          CATCHMENT 2000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         2000   Existing Farm Field"
"        2.000   % Impervious"
"       11.170   Total Area"
"      350.000   Flow length"
"        2.000   Overland Slope"
"       10.947   Pervious Area"
"      350.000   Pervious length"
"        2.000   Pervious slope"
"        0.223   Impervious Area"
"      350.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.323     1.273     0.000     0.000 c.m/sec"
"             Catchment 2000         Pervious   Impervious Total Area "
"             Surface Area           10.947     0.223      11.170     hectare"
"             Time of concentration  56.124     9.613      51.250     minutes"
"             Time to Centroid       607.501    638.784    610.778    minutes"
"             Rainfall depth         72.080     72.080     72.080     mm"
"             Rainfall volume        7890.36    161.03     8051.39    c.m"
"             Rainfall losses        59.925     2.374      58.774     mm"
"             Runoff depth           12.155     69.706     13.306     mm"
"             Runoff volume          1330.59    155.72     1486.31    c.m"
```

```
"             Runoff coefficient     0.169      0.967      0.185      "
"             Maximum flow           0.314      0.051      0.323      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.323     1.553     0.000     0.000"
" 33          CATCHMENT 3000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         3000   Developed part of Town"
"       50.000   % Impervious"
"       53.620   Total Area"
"      650.000   Flow length"
"        2.000   Overland Slope"
"       26.810   Pervious Area"
"      650.000   Pervious length"
"        2.000   Pervious slope"
"       26.810   Impervious Area"
"      650.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     5.422     1.553     0.000     0.000 c.m/sec"
"             Catchment 3000         Pervious   Impervious Total Area "
"             Surface Area           26.810     26.810     53.620     hectare"
"             Time of concentration  81.368     13.936     23.958     minutes"
"             Time to Centroid       633.860    645.547    643.810    minutes"
"             Rainfall depth         72.080     72.080     72.080     mm"
"             Rainfall volume        1.9325     1.9325     3.8650     ha-m"
"             Rainfall losses        59.927     2.461      31.194     mm"
"             Runoff depth           12.154     69.620     40.887     mm"
"             Runoff volume          0.3258     1.8665     2.1923     ha-m"
"             Runoff coefficient     0.169      0.966      0.567      "
"             Maximum flow           0.548      5.296      5.422      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     5.422     6.467     0.000     0.000"
" 52          CHANNEL DESIGN"
"        6.467   Current peak flow    c.m/sec"
"        0.060   Manning 'n'"
"           1.   Cross-section type: 0=trapezoidal; 1=general"
"           7.   Define an arbitrary cross-section"
```

```
"                  0.000     3.300     7.000    10.000    13.200"
"                 15.900    90.600"
"                439.420   438.610   438.360   438.000   437.370"
"                438.200   439.000"
"        1.630   Channel depth    metre"
"        0.850   Gradient   %"
"           0.   Variable roughness: 0=False; 1=True"
"                 0.0400    0.0400    0.0400    0.0400    0.0400"
"                 0.0400    0.0400"
"             Depth of flow                 1.145    metre"
"             Velocity                      0.619    m/sec"
"             Channel capacity             16.662    c.m/sec"
"             Critical depth                0.933    metre"
" 53          ROUTE    Channel Route 122"
"       121.60      Channel Route 122 Reach length   ( metre)"
"        0.397   X-factor <= 0.5"
"      147.267   K-lag   ( seconds)"
"        0.000   Default(0) or user spec.(1) values used"
"        0.500   X-factor <= 0.5"
"       30.000   K-lag   ( seconds)"
"        0.500   Beta weighting factor"
"      150.000   Routing time step   ( seconds)"
"            1   No. of sub-reaches"
"             Peak outflow                  6.200    c.m/sec"
"                     5.422     6.467     6.200     0.000 c.m/sec"
" 38          START/RE-START TOTALS 3000"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                    129.330    hectare"
"             Total Impervious area                    30.260    hectare"
"             Total % impervious                       23.398"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:           C:\Users\rsingh\Desktop\My Jobs\120139\"
"                                                        NEW SWM\NE Swale Model"
"                Output filename:       120139 - Existing 10 yr - NE Swale.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                 2/2/2024 at 11:35:23 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"     1440.000   Max. Storm length"
"     1440.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"      997.497   Coefficient A"
"        8.438   Constant B"
"        0.775   Exponent C"
"        0.375   Fraction R"
"     1440.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          113.928    mm/hr"
"             Total depth                 85.001    mm"
"            6   010hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 1000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         1000   Existing Farm Field "
"        5.000   % Impervious"
"       64.540   Total Area"
"      700.000   Flow length"
"        2.000   Overland Slope"
"       61.313   Pervious Area"
"      700.000   Pervious length"
"        2.000   Pervious slope"
"        3.227   Impervious Area"
"      700.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    1.862     0.000     0.000     0.000 c.m/sec"
"             Catchment 1000         Pervious   Impervious Total Area "
"             Surface Area           61.313     3.227      64.540     hectare"
"             Time of concentration  79.845     13.937     66.959     minutes"
"             Time to Centroid       633.544    645.136    635.811    minutes"
"             Rainfall depth         85.001     85.001     85.001     mm"
"             Rainfall volume        5.2117     0.2743     5.4860     ha-m"
"             Rainfall losses        67.162     2.623      63.935     mm"
"             Runoff depth           17.840     82.379     21.067     mm"
"             Runoff volume          1.0938     0.2658     1.3596     ha-m"
"             Runoff coefficient     0.210      0.969      0.248      "
"             Maximum flow           1.756      0.725      1.862      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    1.862     1.862     0.000     0.000"
" 33          CATCHMENT 2000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         2000   Existing Farm Field"
"        2.000   % Impervious"
"       11.170   Total Area"
"      350.000   Flow length"
"        2.000   Overland Slope"
"       10.947   Pervious Area"
"      350.000   Pervious length"
"        2.000   Pervious slope"
"        0.223   Impervious Area"
"      350.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.468     1.862     0.000     0.000 c.m/sec"
"             Catchment 2000         Pervious   Impervious Total Area "
"             Surface Area           10.947     0.223      11.170     hectare"
"             Time of concentration  52.678     9.195      48.925     minutes"
"             Time to Centroid       604.626    637.708    607.481    minutes"
"             Rainfall depth         85.001     85.001     85.001     mm"
"             Rainfall volume        9304.75    189.89     9494.64    c.m"
"             Rainfall losses        67.163     2.437      65.868     mm"
"             Runoff depth           17.838     82.564     19.133     mm"
"             Runoff volume          1952.70    184.45     2137.15    c.m"
```

```
"             Runoff coefficient     0.210      0.971      0.225      "
"             Maximum flow           0.459      0.059      0.468      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.468     2.289     0.000     0.000"
" 33          CATCHMENT 3000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         3000   Developed part of Town"
"       50.000   % Impervious"
"       53.620   Total Area"
"      650.000   Flow length"
"        2.000   Overland Slope"
"       26.810   Pervious Area"
"      650.000   Pervious length"
"        2.000   Pervious slope"
"       26.810   Impervious Area"
"      650.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     6.243     2.289     0.000     0.000 c.m/sec"
"             Catchment 3000         Pervious   Impervious Total Area "
"             Surface Area           26.810     26.810     53.620     hectare"
"             Time of concentration  76.373     13.331     24.548     minutes"
"             Time to Centroid       629.849    644.186    641.635    minutes"
"             Rainfall depth         85.001     85.001     85.001     mm"
"             Rainfall volume        2.2789     2.2789     4.5578     ha-m"
"             Rainfall losses        67.162     2.583      34.872     mm"
"             Runoff depth           17.839     82.418     50.129     mm"
"             Runoff volume          0.4783     2.2096     2.6879     ha-m"
"             Runoff coefficient     0.210      0.970      0.590      "
"             Maximum flow           0.797      6.045      6.243      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     6.243     7.594     0.000     0.000"
" 52          CHANNEL DESIGN"
"        7.594   Current peak flow    c.m/sec"
"        0.060   Manning 'n'"
"           1.   Cross-section type: 0=trapezoidal; 1=general"
"           7.   Define an arbitrary cross-section"
```

```
"                  0.000     3.300     7.000    10.000    13.200"
"                 15.900    90.600"
"                439.420   438.610   438.360   438.000   437.370"
"                438.200   439.000"
"        1.630   Channel depth    metre"
"        0.850   Gradient   %"
"           0.   Variable roughness: 0=False; 1=True"
"                 0.0400    0.0400    0.0400    0.0400    0.0400"
"                 0.0400    0.0400"
"             Depth of flow                 1.180    metre"
"             Velocity                      0.638    m/sec"
"             Channel capacity             16.662    c.m/sec"
"             Critical depth                0.974    metre"
" 53          ROUTE    Channel Route 122"
"       121.60      Channel Route 122 Reach length   ( metre)"
"        0.395   X-factor <= 0.5"
"      143.034   K-lag   ( seconds)"
"        0.000   Default(0) or user spec.(1) values used"
"        0.500   X-factor <= 0.5"
"       30.000   K-lag   ( seconds)"
"        0.500   Beta weighting factor"
"      150.000   Routing time step   ( seconds)"
"            1   No. of sub-reaches"
"             Peak outflow                  7.356    c.m/sec"
"                     6.243     7.594     7.356     0.000 c.m/sec"
" 38          START/RE-START TOTALS 3000"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                    129.330    hectare"
"             Total Impervious area                    30.260    hectare"
"             Total % impervious                       23.398"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:           C:\Users\rsingh\Desktop\My Jobs\120139\"
"                                                        NEW SWM\NE Swale Model"
"                Output filename:       120139 - Existing 25 yr - NE Swale.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                 2/2/2024 at 11:37:59 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"     1440.000   Max. Storm length"
"     1440.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     1145.741   Coefficient A"
"        9.035   Constant B"
"        0.769   Exponent C"
"        0.375   Fraction R"
"     1440.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          129.475    mm/hr"
"             Total depth                101.960    mm"
"            6   025hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 1000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         1000   Existing Farm Field "
"        5.000   % Impervious"
"       64.540   Total Area"
"      700.000   Flow length"
"        2.000   Overland Slope"
"       61.313   Pervious Area"
"      700.000   Pervious length"
"        2.000   Pervious slope"
"        3.227   Impervious Area"
"      700.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    2.895     0.000     0.000     0.000 c.m/sec"
"             Catchment 1000         Pervious   Impervious Total Area "
"             Surface Area           61.313     3.227      64.540     hectare"
"             Time of concentration  74.876     13.242     64.374     minutes"
"             Time to Centroid       627.502    643.881    630.293    minutes"
"             Rainfall depth         101.960    101.960    101.960    mm"
"             Rainfall volume        6.2514     0.3290     6.5805     ha-m"
"             Rainfall losses        76.549     2.800      72.862     mm"
"             Runoff depth           25.410     99.159     29.098     mm"
"             Runoff volume          1.5580     0.3200     1.8780     ha-m"
"             Runoff coefficient     0.249      0.973      0.285      "
"             Maximum flow           2.769      0.841      2.895      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    2.895     2.895     0.000     0.000"
" 33          CATCHMENT 2000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         2000   Existing Farm Field"
"        2.000   % Impervious"
"       11.170   Total Area"
"      350.000   Flow length"
"        2.000   Overland Slope"
"       10.947   Pervious Area"
"      350.000   Pervious length"
"        2.000   Pervious slope"
"        0.223   Impervious Area"
"      350.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.735     2.895     0.000     0.000 c.m/sec"
"             Catchment 2000         Pervious   Impervious Total Area "
"             Surface Area           10.947     0.223      11.170     hectare"
"             Time of concentration  49.400     8.736      46.391     minutes"
"             Time to Centroid       600.836    636.797    603.497    minutes"
"             Rainfall depth         101.960    101.960    101.960    mm"
"             Rainfall volume        1.1161     0.0228     1.1389     ha-m"
"             Rainfall losses        76.550     2.487      75.069     mm"
"             Runoff depth           25.410     99.473     26.891     mm"
"             Runoff volume          2781.50    222.22     3003.72    c.m"
```

```
"             Runoff coefficient     0.249      0.976      0.264      "
"             Maximum flow           0.721      0.069      0.735      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.735     3.520     0.000     0.000"
" 33          CATCHMENT 3000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         3000   Developed part of Town"
"       50.000   % Impervious"
"       53.620   Total Area"
"      650.000   Flow length"
"        2.000   Overland Slope"
"       26.810   Pervious Area"
"      650.000   Pervious length"
"        2.000   Pervious slope"
"       26.810   Impervious Area"
"      650.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     7.327     3.520     0.000     0.000 c.m/sec"
"             Catchment 3000         Pervious   Impervious Total Area "
"             Surface Area           26.810     26.810     53.620     hectare"
"             Time of concentration  71.620     12.666     24.690     minutes"
"             Time to Centroid       624.104    642.996    639.142    minutes"
"             Rainfall depth         101.960    101.960    101.960    mm"
"             Rainfall volume        2.7335     2.7335     5.4671     ha-m"
"             Rainfall losses        76.549     2.787      39.668     mm"
"             Runoff depth           25.410     99.173     62.292     mm"
"             Runoff volume          0.6812     2.6588     3.3401     ha-m"
"             Runoff coefficient     0.249      0.973      0.611      "
"             Maximum flow           1.255      7.052      7.327      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     7.327     9.209     0.000     0.000"
" 52          CHANNEL DESIGN"
"        9.209   Current peak flow    c.m/sec"
"        0.060   Manning 'n'"
"           1.   Cross-section type: 0=trapezoidal; 1=general"
"           7.   Define an arbitrary cross-section"
```

```
"                  0.000     3.300     7.000    10.000    13.200"
"                 15.900    90.600"
"                439.420   438.610   438.360   438.000   437.370"
"                438.200   439.000"
"        1.630   Channel depth    metre"
"        0.850   Gradient   %"
"           0.   Variable roughness: 0=False; 1=True"
"                 0.0400    0.0400    0.0400    0.0400    0.0400"
"                 0.0400    0.0400"
"             Depth of flow                 1.222    metre"
"             Velocity                      0.662    m/sec"
"             Channel capacity             16.662    c.m/sec"
"             Critical depth                1.017    metre"
" 53          ROUTE    Channel Route 122"
"       121.60      Channel Route 122 Reach length   ( metre)"
"        0.390   X-factor <= 0.5"
"      137.780   K-lag   ( seconds)"
"        0.000   Default(0) or user spec.(1) values used"
"        0.500   X-factor <= 0.5"
"       30.000   K-lag   ( seconds)"
"        0.500   Beta weighting factor"
"      150.000   Routing time step   ( seconds)"
"            1   No. of sub-reaches"
"             Peak outflow                  8.997    c.m/sec"
"                     7.327     9.209     8.997     0.000 c.m/sec"
" 38          START/RE-START TOTALS 3000"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                    129.330    hectare"
"             Total Impervious area                    30.260    hectare"
"             Total % impervious                       23.398"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:           C:\Users\rsingh\Desktop\My Jobs\120139\"
"                                                        NEW SWM\NE Swale Model"
"                Output filename:       120139 - Existing 50 yr - NE Swale.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                 2/2/2024 at 11:40:00 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"     1440.000   Max. Storm length"
"     1440.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     1273.113   Coefficient A"
"        9.492   Constant B"
"        0.770   Exponent C"
"        0.375   Fraction R"
"     1440.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          140.566    mm/hr"
"             Total depth                112.445    mm"
"            6   050hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 1000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         1000   Existing Farm Field "
"        5.000   % Impervious"
"       64.540   Total Area"
"      700.000   Flow length"
"        2.000   Overland Slope"
"       61.313   Pervious Area"
"      700.000   Pervious length"
"        2.000   Pervious slope"
"        3.227   Impervious Area"
"      700.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    3.666     0.000     0.000     0.000 c.m/sec"
"             Catchment 1000         Pervious   Impervious Total Area "
"             Surface Area           61.313     3.227      64.540     hectare"
"             Time of concentration  72.079     12.813     62.683     minutes"
"             Time to Centroid       624.418    642.361    627.263    minutes"
"             Rainfall depth         112.445    112.445    112.445    mm"
"             Rainfall volume        6.8944     0.3629     7.2572     ha-m"
"             Rainfall losses        81.856     2.930      77.910     mm"
"             Runoff depth           30.589     109.515    34.535     mm"
"             Runoff volume          1.8755     0.3534     2.2289     ha-m"
"             Runoff coefficient     0.272      0.974      0.307      "
"             Maximum flow           3.510      0.922      3.666      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    3.666     3.666     0.000     0.000"
" 33          CATCHMENT 2000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         2000   Existing Farm Field"
"        2.000   % Impervious"
"       11.170   Total Area"
"      350.000   Flow length"
"        2.000   Overland Slope"
"       10.947   Pervious Area"
"      350.000   Pervious length"
"        2.000   Pervious slope"
"        0.223   Impervious Area"
"      350.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.914     3.666     0.000     0.000 c.m/sec"
"             Catchment 2000         Pervious   Impervious Total Area "
"             Surface Area           10.947     0.223      11.170     hectare"
"             Time of concentration  47.555     8.454      44.882     minutes"
"             Time to Centroid       598.874    635.478    601.376    minutes"
"             Rainfall depth         112.445    112.445    112.445    mm"
"             Rainfall volume        1.2309     0.0251     1.2560     ha-m"
"             Rainfall losses        81.872     2.543      80.285     mm"
"             Runoff depth           30.573     109.903    32.160     mm"
"             Runoff volume          3346.76    245.52     3592.28    c.m"
```

```
"             Runoff coefficient     0.272      0.977      0.286      "
"             Maximum flow           0.899      0.075      0.914      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.914     4.448     0.000     0.000"
" 33          CATCHMENT 3000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         3000   Developed part of Town"
"       50.000   % Impervious"
"       53.620   Total Area"
"      650.000   Flow length"
"        2.000   Overland Slope"
"       26.810   Pervious Area"
"      650.000   Pervious length"
"        2.000   Pervious slope"
"       26.810   Impervious Area"
"      650.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     8.154     4.448     0.000     0.000 c.m/sec"
"             Catchment 3000         Pervious   Impervious Total Area "
"             Surface Area           26.810     26.810     53.620     hectare"
"             Time of concentration  68.945     12.256     24.634     minutes"
"             Time to Centroid       621.170    641.523    637.079    minutes"
"             Rainfall depth         112.445    112.445    112.445    mm"
"             Rainfall volume        3.0147     3.0147     6.0293     ha-m"
"             Rainfall losses        81.855     2.942      42.399     mm"
"             Runoff depth           30.590     109.503    70.047     mm"
"             Runoff volume          0.8201     2.9358     3.7559     ha-m"
"             Runoff coefficient     0.272      0.974      0.623      "
"             Maximum flow           1.577      7.868      8.154      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     8.154    10.319     0.000     0.000"
" 52          CHANNEL DESIGN"
"       10.319   Current peak flow    c.m/sec"
"        0.060   Manning 'n'"
"           1.   Cross-section type: 0=trapezoidal; 1=general"
"           7.   Define an arbitrary cross-section"
```

```
"                  0.000     3.300     7.000    10.000    13.200"
"                 15.900    90.600"
"                439.420   438.610   438.360   438.000   437.370"
"                438.200   439.000"
"        1.630   Channel depth    metre"
"        0.850   Gradient   %"
"           0.   Variable roughness: 0=False; 1=True"
"                 0.0400    0.0400    0.0400    0.0400    0.0400"
"                 0.0400    0.0400"
"             Depth of flow                 1.248    metre"
"             Velocity                      0.678    m/sec"
"             Channel capacity             16.662    c.m/sec"
"             Critical depth                1.042    metre"
" 53          ROUTE    Channel Route 122"
"       121.60      Channel Route 122 Reach length   ( metre)"
"        0.390   X-factor <= 0.5"
"      134.494   K-lag   ( seconds)"
"        0.000   Default(0) or user spec.(1) values used"
"        0.500   X-factor <= 0.5"
"       30.000   K-lag   ( seconds)"
"        0.500   Beta weighting factor"
"      150.000   Routing time step   ( seconds)"
"            1   No. of sub-reaches"
"             Peak outflow                 10.168    c.m/sec"
"                     8.154    10.319    10.168     0.000 c.m/sec"
" 38          START/RE-START TOTALS 3000"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                    129.330    hectare"
"             Total Impervious area                    30.260    hectare"
"             Total % impervious                       23.398"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:           C:\Users\rsingh\Desktop\My Jobs\120139\"
"                                                        NEW SWM\NE Swale Model"
"                Output filename:       120139 - Existing 100yr - NE Swale.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                 2/2/2024 at 11:43:26 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"     1440.000   Max. Storm length"
"     1440.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     1357.120   Coefficient A"
"        9.595   Constant B"
"        0.763   Exponent C"
"        0.375   Fraction R"
"     1440.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          152.190    mm/hr"
"             Total depth                126.124    mm"
"            6   100hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 1000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         1000   Existing Farm Field "
"        5.000   % Impervious"
"       64.540   Total Area"
"      700.000   Flow length"
"        2.000   Overland Slope"
"       61.313   Pervious Area"
"      700.000   Pervious length"
"        2.000   Pervious slope"
"        3.227   Impervious Area"
"      700.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    4.297     0.000     0.000     0.000 c.m/sec"
"             Catchment 1000         Pervious   Impervious Total Area "
"             Surface Area           61.313     3.227      64.540     hectare"
"             Time of concentration  69.534     12.413     60.914     minutes"
"             Time to Centroid       624.563    642.438    627.260    minutes"
"             Rainfall depth         126.124    126.124    126.124    mm"
"             Rainfall volume        7.7330     0.4070     8.1401     ha-m"
"             Rainfall losses        89.696     3.121      85.367     mm"
"             Runoff depth           36.428     123.003    40.757     mm"
"             Runoff volume          2.2335     0.3969     2.6305     ha-m"
"             Runoff coefficient     0.289      0.975      0.323      "
"             Maximum flow           4.128      1.024      4.297      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    4.297     4.297     0.000     0.000"
" 33          CATCHMENT 2000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         2000   Existing Farm Field"
"        2.000   % Impervious"
"       11.170   Total Area"
"      350.000   Flow length"
"        2.000   Overland Slope"
"       10.947   Pervious Area"
"      350.000   Pervious length"
"        2.000   Pervious slope"
"        0.223   Impervious Area"
"      350.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    1.070     4.297     0.000     0.000 c.m/sec"
"             Catchment 2000         Pervious   Impervious Total Area "
"             Surface Area           10.947     0.223      11.170     hectare"
"             Time of concentration  45.875     8.189      43.436     minutes"
"             Time to Centroid       599.047    635.789    601.425    minutes"
"             Rainfall depth         126.124    126.124    126.124    mm"
"             Rainfall volume        1.3806     0.0282     1.4088     ha-m"
"             Rainfall losses        89.698     2.615      87.957     mm"
"             Runoff depth           36.426     123.509    38.167     mm"
"             Runoff volume          3987.38    275.92     4263.30    c.m"
```

```
"             Runoff coefficient     0.289      0.979      0.303      "
"             Maximum flow           1.053      0.088      1.070      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     1.070     5.243     0.000     0.000"
" 33          CATCHMENT 3000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         3000   Developed part of Town"
"       50.000   % Impervious"
"       53.620   Total Area"
"      650.000   Flow length"
"        2.000   Overland Slope"
"       26.810   Pervious Area"
"      650.000   Pervious length"
"        2.000   Pervious slope"
"       26.810   Impervious Area"
"      650.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     9.085     5.243     0.000     0.000 c.m/sec"
"             Catchment 3000         Pervious   Impervious Total Area "
"             Surface Area           26.810     26.810     53.620     hectare"
"             Time of concentration  66.510     11.873     24.347     minutes"
"             Time to Centroid       621.301    641.564    636.937    minutes"
"             Rainfall depth         126.124    126.124    126.124    mm"
"             Rainfall volume        3.3814     3.3814     6.7628     ha-m"
"             Rainfall losses        89.698     3.007      46.353     mm"
"             Runoff depth           36.426     123.117    79.771     mm"
"             Runoff volume          0.9766     3.3008     4.2773     ha-m"
"             Runoff coefficient     0.289      0.976      0.632      "
"             Maximum flow           1.914      8.722      9.085      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     9.085    11.536     0.000     0.000"
" 52          CHANNEL DESIGN"
"       11.536   Current peak flow    c.m/sec"
"        0.060   Manning 'n'"
"           1.   Cross-section type: 0=trapezoidal; 1=general"
"           7.   Define an arbitrary cross-section"
```

```
"                  0.000     3.300     7.000    10.000    13.200"
"                 15.900    90.600"
"                439.420   438.610   438.360   438.000   437.370"
"                438.200   439.000"
"        1.630   Channel depth    metre"
"        0.850   Gradient   %"
"           0.   Variable roughness: 0=False; 1=True"
"                 0.0400    0.0400    0.0400    0.0400    0.0400"
"                 0.0400    0.0400"
"             Depth of flow                 1.274    metre"
"             Velocity                      0.696    m/sec"
"             Channel capacity             16.662    c.m/sec"
"             Critical depth                1.066    metre"
" 53          ROUTE    Channel Route 122"
"       121.60      Channel Route 122 Reach length   ( metre)"
"        0.386   X-factor <= 0.5"
"      131.088   K-lag   ( seconds)"
"        0.000   Default(0) or user spec.(1) values used"
"        0.500   X-factor <= 0.5"
"       30.000   K-lag   ( seconds)"
"        0.500   Beta weighting factor"
"      150.000   Routing time step   ( seconds)"
"            1   No. of sub-reaches"
"             Peak outflow                 11.413    c.m/sec"
"                     9.085    11.536    11.413     0.000 c.m/sec"
" 38          START/RE-START TOTALS 3000"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                    129.330    hectare"
"             Total Impervious area                    30.260    hectare"
"             Total % impervious                       23.398"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:            C:\Users\szaga\Documents\MIDUSS\120139"
"                Output filename:                   120139_EX_Reg-NE-Swale.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                2/24/2023 at 5:22:20 PM"
" 31          TIME PARAMETERS"
"       60.000   Time Step"
"     2880.000   Max. Storm length"
"     5000.000   Max. Hydrograph"
" 32          STORM Historic"
"            5   Historic"
"     2880.000   Duration"
"       48.000   Rainfall intensity values"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.026     2.026     2.026     2.028"
"                  2.026     6.000     4.000     6.000    13.000"
"                 17.000    13.000    23.000    13.000    13.000"
"                 53.000    38.000    13.000"
"             Maximum intensity            53.000    mm/hr"
"             Total depth                 285.000    mm"
"            7   9999hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 1000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         1000   Existing Farm Field "
"        5.000   % Impervious"
"       64.540   Total Area"
"      700.000   Flow length"
"        2.000   Overland Slope"
"       61.313   Pervious Area"
"      700.000   Pervious length"
"        2.000   Pervious slope"
"        3.227   Impervious Area"
"      700.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
```

```
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     3.886     0.000     0.000     0.000 c.m/sec"
"             Catchment 1000         Pervious   Impervious Total Area "
"             Surface Area           61.313     3.227      64.540     hectare"
"             Time of concentration  114.011    18.928     98.872     minutes"
"             Time to Centroid       2866.677   2300.051   2776.458   minutes"
"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        17.4742    0.9197     18.3939    ha-m"
"             Rainfall losses        207.052    4.534      196.926    mm"
"             Runoff depth           77.948     280.466    88.074     mm"
"             Runoff volume          4.7792     0.9051     5.6843     ha-m"
"             Runoff coefficient     0.274      0.984      0.309      "
"             Maximum flow           3.703      0.372      3.886      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     3.886     3.886     0.000     0.000"
" 33          CATCHMENT 2000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         2000   Existing Farm Field"
"        2.000   % Impervious"
"       11.170   Total Area"
"      350.000   Flow length"
"        2.000   Overland Slope"
"       10.947   Pervious Area"
"      350.000   Pervious length"
"        2.000   Pervious slope"
"        0.223   Impervious Area"
"      350.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.799     3.886     0.000     0.000 c.m/sec"
"             Catchment 2000         Pervious   Impervious Total Area "
"             Surface Area           10.947     0.223      11.170     hectare"
"             Time of concentration  75.219     12.488     71.002     minutes"
"             Time to Centroid       2831.604   2293.580   2795.432   minutes"
```

```
"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        3.1198     0.0637     3.1834     ha-m"
"             Rainfall losses        207.392    10.907     203.462    mm"
"             Runoff depth           77.608     274.093    81.538     mm"
"             Runoff volume          8495.44    612.32     9107.77    c.m"
"             Runoff coefficient     0.272      0.962      0.286      "
"             Maximum flow           0.776      0.027      0.799      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.799     4.607     0.000     0.000"
" 33          CATCHMENT 3000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         3000   Developed part of Town"
"       50.000   % Impervious"
"       53.620   Total Area"
"      650.000   Flow length"
"        2.000   Overland Slope"
"       26.810   Pervious Area"
"      650.000   Pervious length"
"        2.000   Pervious slope"
"       26.810   Impervious Area"
"      650.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     4.602     4.607     0.000     0.000 c.m/sec"
"             Catchment 3000         Pervious   Impervious Total Area "
"             Surface Area           26.810     26.810     53.620     hectare"
"             Time of concentration  109.053    18.105     37.923     minutes"
"             Time to Centroid       2862.311   2297.705   2420.736   minutes"
"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        7.6409     7.6409     15.2817    ha-m"
"             Rainfall losses        206.803    4.345      105.574    mm"
"             Runoff depth           78.197     280.655    179.426    mm"
"             Runoff volume          2.0965     7.5244     9.6208     ha-m"
"             Runoff coefficient     0.274      0.985      0.630      "
"             Maximum flow           1.633      3.115      4.602      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     4.602     9.209     0.000     0.000"
```

```
" 52          CHANNEL DESIGN"
"        9.209   Current peak flow    c.m/sec"
"        0.060   Manning 'n'"
"           1.   Cross-section type: 0=trapezoidal; 1=general"
"           7.   Define an arbitrary cross-section"
"                  0.000     3.300     7.000    10.000    13.200"
"                 15.900    90.600"
"                439.420   438.610   438.360   438.000   437.370"
"                438.200   439.000"
"        1.630   Channel depth    metre"
"        0.850   Gradient   %"
"           0.   Variable roughness: 0=False; 1=True"
"                 0.0400    0.0400    0.0400    0.0400    0.0400"
"                 0.0400    0.0400"
"             Depth of flow                 1.222    metre"
"             Velocity                      0.662    m/sec"
"             Channel capacity             16.662    c.m/sec"
"             Critical depth                1.017    metre"
" 53          ROUTE    Channel Route 122"
"       121.60      Channel Route 122 Reach length   ( metre)"
"        0.390   X-factor <= 0.5"
"      137.780   K-lag   ( seconds)"
"        0.000   Default(0) or user spec.(1) values used"
"        0.500   X-factor <= 0.5"
"       30.000   K-lag   ( seconds)"
"        0.500   Beta weighting factor"
"      163.636   Routing time step   ( seconds)"
"            1   No. of sub-reaches"
"             Peak outflow                  9.080    c.m/sec"
"                     4.602     9.209     9.080     0.000 c.m/sec"
" 38          START/RE-START TOTALS 3000"
"             3   Runoff Totals on EXIT"
"             Total Catchment area                    129.330    hectare"
"             Total Impervious area                    30.260    hectare"
"             Total % impervious                       23.398"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:           C:\Users\rsingh\Desktop\My Jobs\120139\"
"                                                        NEW SWM\NE Swale Model"
"                Output filename:           120139 - Prop. 2 yr - NE Swale.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                 2/2/2024 at 11:50:00 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"     1440.000   Max. Storm length"
"     1440.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"      758.485   Coefficient A"
"        7.538   Constant B"
"        0.806   Exponent C"
"        0.375   Fraction R"
"     1440.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           83.116    mm/hr"
"             Total depth                 51.605    mm"
"            6   002hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 1000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         1000   Existing Farm Field "
"        5.000   % Impervious"
"       64.540   Total Area"
"      700.000   Flow length"
"        2.000   Overland Slope"
"       61.313   Pervious Area"
"      700.000   Pervious length"
"        2.000   Pervious slope"
"        3.227   Impervious Area"
"      700.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    0.548     0.000     0.000     0.000 c.m/sec"
"             Catchment 1000         Pervious   Impervious Total Area "
"             Surface Area           61.313     3.227      64.540     hectare"
"             Time of concentration  123.183    15.811     82.282     minutes"
"             Time to Centroid       656.867    646.248    652.821    minutes"
"             Rainfall depth         51.605     51.605     51.605     mm"
"             Rainfall volume        3.1640     0.1665     3.3306     ha-m"
"             Rainfall losses        47.384     2.255      45.127     mm"
"             Runoff depth           4.221      49.350     6.478      mm"
"             Runoff volume          2588.10    1592.52    4180.62    c.m"
"             Runoff coefficient     0.082      0.956      0.126      "
"             Maximum flow           0.338      0.496      0.548      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.548     0.548     0.000     0.000"
" 33          CATCHMENT 2000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         2000   Existing Farm Field"
"        2.000   % Impervious"
"       11.170   Total Area"
"      350.000   Flow length"
"        2.000   Overland Slope"
"       10.947   Pervious Area"
"      350.000   Pervious length"
"        2.000   Pervious slope"
"        0.223   Impervious Area"
"      350.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.094     0.548     0.000     0.000 c.m/sec"
"             Catchment 2000         Pervious   Impervious Total Area "
"             Surface Area           10.947     0.223      11.170     hectare"
"             Time of concentration  81.270     10.431     67.574     minutes"
"             Time to Centroid       619.668    637.569    623.128    minutes"
"             Rainfall depth         51.605     51.605     51.605     mm"
"             Rainfall volume        5648.98    115.29     5764.26    c.m"
"             Rainfall losses        47.384     2.033      46.477     mm"
"             Runoff depth           4.221      49.571     5.128      mm"
"             Runoff volume          462.01     110.74     572.76     c.m"
```

```
"             Runoff coefficient     0.082      0.961      0.099      "
"             Maximum flow           0.089      0.040      0.094      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.094     0.603     0.000     0.000"
" 33          CATCHMENT 3000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         3000   Developed part of Town"
"       50.000   % Impervious"
"       53.620   Total Area"
"      650.000   Flow length"
"        2.000   Overland Slope"
"       26.810   Pervious Area"
"      650.000   Pervious length"
"        2.000   Pervious slope"
"       26.810   Impervious Area"
"      650.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    4.181     0.603     0.000     0.000 c.m/sec"
"             Catchment 3000         Pervious   Impervious Total Area "
"             Surface Area           26.810     26.810     53.620     hectare"
"             Time of concentration  117.826    15.123     23.210     minutes"
"             Time to Centroid       652.115    645.144    645.692    minutes"
"             Rainfall depth         51.605     51.605     51.605     mm"
"             Rainfall volume        1.3835     1.3835     2.7671     ha-m"
"             Rainfall losses        47.384     2.219      24.801     mm"
"             Runoff depth           4.221      49.385     26.803     mm"
"             Runoff volume          0.1132     1.3240     1.4372     ha-m"
"             Runoff coefficient     0.082      0.957      0.519      "
"             Maximum flow           0.153      4.157      4.181      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    4.181     4.784     0.000     0.000"
" 52          CHANNEL DESIGN"
"        4.784   Current peak flow    c.m/sec"
"        0.060   Manning 'n'"
"           1.   Cross-section type: 0=trapezoidal; 1=general"
"           7.   Define an arbitrary cross-section"
```

```
"                  0.000     3.300     7.000    10.000    13.200"
"                 23.200    24.000"
"                439.420   438.610   438.360   438.000   437.370"
"                437.370   438.500"
"        1.130   Channel depth    metre"
"        0.850   Gradient   %"
"           0.   Variable roughness: 0=False; 1=True"
"                 0.0400    0.0400    0.0400    0.0400    0.0400"
"                 0.0400    0.0400"
"             Depth of flow                 0.485    metre"
"             Velocity                      0.865    m/sec"
"             Channel capacity             20.173    c.m/sec"
"             Critical depth                0.278    metre"
" 53          ROUTE    Channel Route 122"
"       121.60      Channel Route 122 Reach length   ( metre)"
"        0.363   X-factor <= 0.5"
"      105.468   K-lag   ( seconds)"
"        0.000   Default(0) or user spec.(1) values used"
"        0.500   X-factor <= 0.5"
"       30.000   K-lag   ( seconds)"
"        0.500   Beta weighting factor"
"      100.000   Routing time step   ( seconds)"
"            1   No. of sub-reaches"
"             Peak outflow                  4.571    c.m/sec"
"                     4.181     4.784     4.571     0.000 c.m/sec"
" 38          START/RE-START TOTALS 3000"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                    129.330    hectare"
"             Total Impervious area                    30.260    hectare"
"             Total % impervious                       23.398"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:           C:\Users\rsingh\Desktop\My Jobs\120139\"
"                                                        NEW SWM\NE Swale Model"
"                Output filename:           120139 - Prop. 5 yr - NE Swale.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                2/2/2024 at 11:52:38 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"     1440.000   Max. Storm length"
"     1440.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"      876.909   Coefficient A"
"        7.781   Constant B"
"        0.780   Exponent C"
"        0.375   Fraction R"
"     1440.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          101.955    mm/hr"
"             Total depth                 72.080    mm"
"            6   005hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 1000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         1000   Existing Farm Field "
"        5.000   % Impervious"
"       64.540   Total Area"
"      700.000   Flow length"
"        2.000   Overland Slope"
"       61.313   Pervious Area"
"      700.000   Pervious length"
"        2.000   Pervious slope"
"        3.227   Impervious Area"
"      700.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    1.273     0.000     0.000     0.000 c.m/sec"
"             Catchment 1000         Pervious   Impervious Total Area "
"             Surface Area           61.313     3.227      64.540     hectare"
"             Time of concentration  85.067     14.570     68.739     minutes"
"             Time to Centroid       637.709    646.555    639.758    minutes"
"             Rainfall depth         72.080     72.080     72.080     mm"
"             Rainfall volume        4.4195     0.2326     4.6521     ha-m"
"             Rainfall losses        59.928     2.481      57.056     mm"
"             Runoff depth           12.152     69.600     15.024     mm"
"             Runoff volume          7450.79    2245.98    9696.77    c.m"
"             Runoff coefficient     0.169      0.966      0.208      "
"             Maximum flow           1.184      0.634      1.273      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    1.273     1.273     0.000     0.000"
" 33          CATCHMENT 2000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         2000   Existing Farm Field"
"        2.000   % Impervious"
"       11.170   Total Area"
"      350.000   Flow length"
"        2.000   Overland Slope"
"       10.947   Pervious Area"
"      350.000   Pervious length"
"        2.000   Pervious slope"
"        0.223   Impervious Area"
"      350.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.323     1.273     0.000     0.000 c.m/sec"
"             Catchment 2000         Pervious   Impervious Total Area "
"             Surface Area           10.947     0.223      11.170     hectare"
"             Time of concentration  56.124     9.613      51.250     minutes"
"             Time to Centroid       607.501    638.784    610.778    minutes"
"             Rainfall depth         72.080     72.080     72.080     mm"
"             Rainfall volume        7890.36    161.03     8051.39    c.m"
"             Rainfall losses        59.925     2.374      58.774     mm"
"             Runoff depth           12.155     69.706     13.306     mm"
"             Runoff volume          1330.59    155.72     1486.31    c.m"
```

```
"             Runoff coefficient     0.169      0.967      0.185      "
"             Maximum flow           0.314      0.051      0.323      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.323     1.553     0.000     0.000"
" 33          CATCHMENT 3000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         3000   Developed part of Town"
"       50.000   % Impervious"
"       53.620   Total Area"
"      650.000   Flow length"
"        2.000   Overland Slope"
"       26.810   Pervious Area"
"      650.000   Pervious length"
"        2.000   Pervious slope"
"       26.810   Impervious Area"
"      650.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     5.422     1.553     0.000     0.000 c.m/sec"
"             Catchment 3000         Pervious   Impervious Total Area "
"             Surface Area           26.810     26.810     53.620     hectare"
"             Time of concentration  81.368     13.936     23.958     minutes"
"             Time to Centroid       633.860    645.547    643.810    minutes"
"             Rainfall depth         72.080     72.080     72.080     mm"
"             Rainfall volume        1.9325     1.9325     3.8650     ha-m"
"             Rainfall losses        59.927     2.461      31.194     mm"
"             Runoff depth           12.154     69.620     40.887     mm"
"             Runoff volume          0.3258     1.8665     2.1923     ha-m"
"             Runoff coefficient     0.169      0.966      0.567      "
"             Maximum flow           0.548      5.296      5.422      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     5.422     6.467     0.000     0.000"
" 52          CHANNEL DESIGN"
"        6.467   Current peak flow    c.m/sec"
"        0.060   Manning 'n'"
"           1.   Cross-section type: 0=trapezoidal; 1=general"
"           7.   Define an arbitrary cross-section"
```

```
"                  0.000     3.300     7.000    10.000    13.200"
"                 23.200    24.000"
"                439.420   438.610   438.360   438.000   437.370"
"                437.370   438.500"
"        1.130   Channel depth    metre"
"        0.850   Gradient   %"
"           0.   Variable roughness: 0=False; 1=True"
"                 0.0400    0.0400    0.0400    0.0400    0.0400"
"                 0.0400    0.0400"
"              Depth of flow                 0.578    metre"
"              Velocity                      0.958    m/sec"
"              Channel capacity             20.173    c.m/sec"
"              Critical depth                0.338    metre"
" 53           ROUTE    Channel Route 122"
"       121.60      Channel Route 122 Reach length   ( metre)"
"        0.338   X-factor <= 0.5"
"       95.162   K-lag   ( seconds)"
"        0.000   Default(0) or user spec.(1) values used"
"        0.500   X-factor <= 0.5"
"       30.000   K-lag   ( seconds)"
"        0.500   Beta weighting factor"
"      100.000   Routing time step   ( seconds)"
"            1   No. of sub-reaches"
"              Peak outflow                  6.298    c.m/sec"
"                      5.422     6.467     6.298     0.000 c.m/sec"
" 38           START/RE-START TOTALS 3000"
"              3   Runoff Totals on EXIT"
"              Total Catchment area                    129.330    hectare"
"              Total Impervious area                    30.260    hectare"
"              Total % impervious                       23.398"
" 19           EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:           C:\Users\rsingh\Desktop\My Jobs\120139\"
"                                                        NEW SWM\NE Swale Model"
"                Output filename:          120139 - Prop. 10 yr - NE Swale.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                 2/2/2024 at 12:14:31 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"     1440.000   Max. Storm length"
"     1440.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"      997.497   Coefficient A"
"        8.438   Constant B"
"        0.775   Exponent C"
"        0.375   Fraction R"
"     1440.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          113.928    mm/hr"
"             Total depth                 85.001    mm"
"            6   010hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 1000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         1000   Existing Farm Field "
"        5.000   % Impervious"
"       64.540   Total Area"
"      700.000   Flow length"
"        2.000   Overland Slope"
"       61.313   Pervious Area"
"      700.000   Pervious length"
"        2.000   Pervious slope"
"        3.227   Impervious Area"
"      700.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    1.862     0.000     0.000     0.000 c.m/sec"
"             Catchment 1000         Pervious   Impervious Total Area "
"             Surface Area           61.313     3.227      64.540     hectare"
"             Time of concentration  79.845     13.937     66.959     minutes"
"             Time to Centroid       633.544    645.136    635.811    minutes"
"             Rainfall depth         85.001     85.001     85.001     mm"
"             Rainfall volume        5.2117     0.2743     5.4860     ha-m"
"             Rainfall losses        67.162     2.623      63.935     mm"
"             Runoff depth           17.840     82.379     21.067     mm"
"             Runoff volume          1.0938     0.2658     1.3596     ha-m"
"             Runoff coefficient     0.210      0.969      0.248      "
"             Maximum flow           1.756      0.725      1.862      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    1.862     1.862     0.000     0.000"
" 33          CATCHMENT 2000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         2000   Existing Farm Field"
"        2.000   % Impervious"
"       11.170   Total Area"
"      350.000   Flow length"
"        2.000   Overland Slope"
"       10.947   Pervious Area"
"      350.000   Pervious length"
"        2.000   Pervious slope"
"        0.223   Impervious Area"
"      350.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.468     1.862     0.000     0.000 c.m/sec"
"             Catchment 2000         Pervious   Impervious Total Area "
"             Surface Area           10.947     0.223      11.170     hectare"
"             Time of concentration  52.678     9.195      48.925     minutes"
"             Time to Centroid       604.626    637.708    607.481    minutes"
"             Rainfall depth         85.001     85.001     85.001     mm"
"             Rainfall volume        9304.75    189.89     9494.64    c.m"
"             Rainfall losses        67.163     2.437      65.868     mm"
"             Runoff depth           17.838     82.564     19.133     mm"
"             Runoff volume          1952.70    184.45     2137.15    c.m"
```

```
"             Runoff coefficient     0.210      0.971      0.225      "
"             Maximum flow           0.459      0.059      0.468      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.468     2.289     0.000     0.000"
" 33          CATCHMENT 3000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         3000   Developed part of Town"
"       50.000   % Impervious"
"       53.620   Total Area"
"      650.000   Flow length"
"        2.000   Overland Slope"
"       26.810   Pervious Area"
"      650.000   Pervious length"
"        2.000   Pervious slope"
"       26.810   Impervious Area"
"      650.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     6.243     2.289     0.000     0.000 c.m/sec"
"             Catchment 3000         Pervious   Impervious Total Area "
"             Surface Area           26.810     26.810     53.620     hectare"
"             Time of concentration  76.373     13.331     24.548     minutes"
"             Time to Centroid       629.849    644.186    641.635    minutes"
"             Rainfall depth         85.001     85.001     85.001     mm"
"             Rainfall volume        2.2789     2.2789     4.5578     ha-m"
"             Rainfall losses        67.162     2.583      34.872     mm"
"             Runoff depth           17.839     82.418     50.129     mm"
"             Runoff volume          0.4783     2.2096     2.6879     ha-m"
"             Runoff coefficient     0.210      0.970      0.590      "
"             Maximum flow           0.797      6.045      6.243      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     6.243     7.594     0.000     0.000"
" 52          CHANNEL DESIGN"
"        7.594   Current peak flow    c.m/sec"
"        0.060   Manning 'n'"
"           1.   Cross-section type: 0=trapezoidal; 1=general"
"           7.   Define an arbitrary cross-section"
```

```
"                  0.000     3.300     7.000    10.000    13.200"
"                 23.200    24.000"
"                439.420   438.610   438.360   438.000   437.370"
"                437.370   438.500"
"        1.130   Channel depth    metre"
"        0.850   Gradient   %"
"           0.   Variable roughness: 0=False; 1=True"
"                 0.0400    0.0400    0.0400    0.0400    0.0400"
"                 0.0400    0.0400"
"             Depth of flow                 0.635    metre"
"             Velocity                      1.011    m/sec"
"             Channel capacity             20.173    c.m/sec"
"             Critical depth                0.375    metre"
" 53          ROUTE    Channel Route 122"
"       121.60      Channel Route 122 Reach length   ( metre)"
"        0.313   X-factor <= 0.5"
"       90.215   K-lag   ( seconds)"
"        0.000   Default(0) or user spec.(1) values used"
"        0.500   X-factor <= 0.5"
"       30.000   K-lag   ( seconds)"
"        0.500   Beta weighting factor"
"      100.000   Routing time step   ( seconds)"
"            1   No. of sub-reaches"
"             Peak outflow                  7.447    c.m/sec"
"                     6.243     7.594     7.447     0.000 c.m/sec"
" 38          START/RE-START TOTALS 3000"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                    129.330    hectare"
"             Total Impervious area                    30.260    hectare"
"             Total % impervious                       23.398"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:           C:\Users\rsingh\Desktop\My Jobs\120139\"
"                                                        NEW SWM\NE Swale Model"
"                Output filename:          120139 - Prop. 25 yr - NE Swale.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                 2/2/2024 at 12:19:50 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"     1440.000   Max. Storm length"
"     1440.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     1145.741   Coefficient A"
"        9.035   Constant B"
"        0.769   Exponent C"
"        0.375   Fraction R"
"     1440.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          129.475    mm/hr"
"             Total depth                101.960    mm"
"            6   025hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 1000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         1000   Existing Farm Field "
"        5.000   % Impervious"
"       64.540   Total Area"
"      700.000   Flow length"
"        2.000   Overland Slope"
"       61.313   Pervious Area"
"      700.000   Pervious length"
"        2.000   Pervious slope"
"        3.227   Impervious Area"
"      700.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    2.895     0.000     0.000     0.000 c.m/sec"
"             Catchment 1000         Pervious   Impervious Total Area "
"             Surface Area           61.313     3.227      64.540     hectare"
"             Time of concentration  74.876     13.242     64.374     minutes"
"             Time to Centroid       627.502    643.881    630.293    minutes"
"             Rainfall depth         101.960    101.960    101.960    mm"
"             Rainfall volume        6.2514     0.3290     6.5805     ha-m"
"             Rainfall losses        76.549     2.800      72.862     mm"
"             Runoff depth           25.410     99.159     29.098     mm"
"             Runoff volume          1.5580     0.3200     1.8780     ha-m"
"             Runoff coefficient     0.249      0.973      0.285      "
"             Maximum flow           2.769      0.841      2.895      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    2.895     2.895     0.000     0.000"
" 33          CATCHMENT 2000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         2000   Existing Farm Field"
"        2.000   % Impervious"
"       11.170   Total Area"
"      350.000   Flow length"
"        2.000   Overland Slope"
"       10.947   Pervious Area"
"      350.000   Pervious length"
"        2.000   Pervious slope"
"        0.223   Impervious Area"
"      350.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.735     2.895     0.000     0.000 c.m/sec"
"             Catchment 2000         Pervious   Impervious Total Area "
"             Surface Area           10.947     0.223      11.170     hectare"
"             Time of concentration  49.400     8.736      46.391     minutes"
"             Time to Centroid       600.836    636.797    603.497    minutes"
"             Rainfall depth         101.960    101.960    101.960    mm"
"             Rainfall volume        1.1161     0.0228     1.1389     ha-m"
"             Rainfall losses        76.550     2.487      75.069     mm"
"             Runoff depth           25.410     99.473     26.891     mm"
"             Runoff volume          2781.50    222.22     3003.72    c.m"
```

```
"             Runoff coefficient     0.249      0.976      0.264      "
"             Maximum flow           0.721      0.069      0.735      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.735     3.520     0.000     0.000"
" 33          CATCHMENT 3000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         3000   Developed part of Town"
"       50.000   % Impervious"
"       53.620   Total Area"
"      650.000   Flow length"
"        2.000   Overland Slope"
"       26.810   Pervious Area"
"      650.000   Pervious length"
"        2.000   Pervious slope"
"       26.810   Impervious Area"
"      650.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     7.327     3.520     0.000     0.000 c.m/sec"
"             Catchment 3000         Pervious   Impervious Total Area "
"             Surface Area           26.810     26.810     53.620     hectare"
"             Time of concentration  71.620     12.666     24.690     minutes"
"             Time to Centroid       624.104    642.996    639.142    minutes"
"             Rainfall depth         101.960    101.960    101.960    mm"
"             Rainfall volume        2.7335     2.7335     5.4671     ha-m"
"             Rainfall losses        76.549     2.787      39.668     mm"
"             Runoff depth           25.410     99.173     62.292     mm"
"             Runoff volume          0.6812     2.6588     3.3401     ha-m"
"             Runoff coefficient     0.249      0.973      0.611      "
"             Maximum flow           1.255      7.052      7.327      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     7.327     9.209     0.000     0.000"
" 52          CHANNEL DESIGN"
"        9.209   Current peak flow    c.m/sec"
"        0.060   Manning 'n'"
"           1.   Cross-section type: 0=trapezoidal; 1=general"
"           7.   Define an arbitrary cross-section"
```

```
"                  0.000     3.300     7.000    10.000    13.200"
"                 23.200    24.000"
"                439.420   438.610   438.360   438.000   437.370"
"                437.370   438.500"
"        1.130   Channel depth    metre"
"        0.850   Gradient   %"
"           0.   Variable roughness: 0=False; 1=True"
"                 0.0400    0.0400    0.0400    0.0400    0.0400"
"                 0.0400    0.0400"
"              Depth of flow                 0.713    metre"
"              Velocity                      1.069    m/sec"
"              Channel capacity             20.173    c.m/sec"
"              Critical depth                0.424    metre"
" 53           ROUTE    Channel Route 122"
"       121.60      Channel Route 122 Reach length   ( metre)"
"        0.294   X-factor <= 0.5"
"       85.279   K-lag   ( seconds)"
"        0.000   Default(0) or user spec.(1) values used"
"        0.500   X-factor <= 0.5"
"       30.000   K-lag   ( seconds)"
"        0.500   Beta weighting factor"
"      100.000   Routing time step   ( seconds)"
"            1   No. of sub-reaches"
"              Peak outflow                  9.080    c.m/sec"
"                      7.327     9.209     9.080     0.000 c.m/sec"
" 38           START/RE-START TOTALS 3000"
"              3   Runoff Totals on EXIT"
"              Total Catchment area                    129.330    hectare"
"              Total Impervious area                    30.260    hectare"
"              Total % impervious                       23.398"
" 19           EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:           C:\Users\rsingh\Desktop\My Jobs\120139\"
"                                                        NEW SWM\NE Swale Model"
"                Output filename:          120139 - Prop. 50 yr - NE Swale.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                 2/2/2024 at 12:21:59 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"     1440.000   Max. Storm length"
"     1440.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     1273.113   Coefficient A"
"        9.492   Constant B"
"        0.770   Exponent C"
"        0.375   Fraction R"
"     1440.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          140.566    mm/hr"
"             Total depth                112.445    mm"
"            6   050hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 1000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         1000   Existing Farm Field "
"        5.000   % Impervious"
"       64.540   Total Area"
"      700.000   Flow length"
"        2.000   Overland Slope"
"       61.313   Pervious Area"
"      700.000   Pervious length"
"        2.000   Pervious slope"
"        3.227   Impervious Area"
"      700.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    3.666     0.000     0.000     0.000 c.m/sec"
"             Catchment 1000         Pervious   Impervious Total Area "
"             Surface Area           61.313     3.227      64.540     hectare"
"             Time of concentration  72.079     12.813     62.683     minutes"
"             Time to Centroid       624.418    642.361    627.263    minutes"
"             Rainfall depth         112.445    112.445    112.445    mm"
"             Rainfall volume        6.8944     0.3629     7.2572     ha-m"
"             Rainfall losses        81.856     2.930      77.910     mm"
"             Runoff depth           30.589     109.515    34.535     mm"
"             Runoff volume          1.8755     0.3534     2.2289     ha-m"
"             Runoff coefficient     0.272      0.974      0.307      "
"             Maximum flow           3.510      0.922      3.666      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    3.666     3.666     0.000     0.000"
" 33          CATCHMENT 2000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         2000   Existing Farm Field"
"        2.000   % Impervious"
"       11.170   Total Area"
"      350.000   Flow length"
"        2.000   Overland Slope"
"       10.947   Pervious Area"
"      350.000   Pervious length"
"        2.000   Pervious slope"
"        0.223   Impervious Area"
"      350.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    0.914     3.666     0.000     0.000 c.m/sec"
"             Catchment 2000         Pervious   Impervious Total Area "
"             Surface Area           10.947     0.223      11.170     hectare"
"             Time of concentration  47.555     8.454      44.882     minutes"
"             Time to Centroid       598.874    635.478    601.376    minutes"
"             Rainfall depth         112.445    112.445    112.445    mm"
"             Rainfall volume        1.2309     0.0251     1.2560     ha-m"
"             Rainfall losses        81.872     2.543      80.285     mm"
"             Runoff depth           30.573     109.903    32.160     mm"
"             Runoff volume          3346.76    245.52     3592.28    c.m"
```

```
"             Runoff coefficient     0.272      0.977      0.286      "
"             Maximum flow           0.899      0.075      0.914      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.914     4.448     0.000     0.000"
" 33          CATCHMENT 3000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         3000   Developed part of Town"
"       50.000   % Impervious"
"       53.620   Total Area"
"      650.000   Flow length"
"        2.000   Overland Slope"
"       26.810   Pervious Area"
"      650.000   Pervious length"
"        2.000   Pervious slope"
"       26.810   Impervious Area"
"      650.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     8.154     4.448     0.000     0.000 c.m/sec"
"             Catchment 3000         Pervious   Impervious Total Area "
"             Surface Area           26.810     26.810     53.620     hectare"
"             Time of concentration  68.945     12.256     24.634     minutes"
"             Time to Centroid       621.170    641.523    637.079    minutes"
"             Rainfall depth         112.445    112.445    112.445    mm"
"             Rainfall volume        3.0147     3.0147     6.0293     ha-m"
"             Rainfall losses        81.855     2.942      42.399     mm"
"             Runoff depth           30.590     109.503    70.047     mm"
"             Runoff volume          0.8201     2.9358     3.7559     ha-m"
"             Runoff coefficient     0.272      0.974      0.623      "
"             Maximum flow           1.577      7.868      8.154      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     8.154    10.319     0.000     0.000"
" 52          CHANNEL DESIGN"
"       10.319   Current peak flow    c.m/sec"
"        0.060   Manning 'n'"
"           1.   Cross-section type: 0=trapezoidal; 1=general"
"           7.   Define an arbitrary cross-section"
```

```
"                  0.000     3.300     7.000    10.000    13.200"
"                 23.200    24.000"
"                439.420   438.610   438.360   438.000   437.370"
"                437.370   438.500"
"        1.130   Channel depth    metre"
"        0.850   Gradient   %"
"           0.   Variable roughness: 0=False; 1=True"
"                 0.0400    0.0400    0.0400    0.0400    0.0400"
"                 0.0400    0.0400"
"              Depth of flow                 0.763    metre"
"              Velocity                      1.105    m/sec"
"              Channel capacity             20.173    c.m/sec"
"              Critical depth                0.456    metre"
" 53           ROUTE    Channel Route 122"
"       121.60      Channel Route 122 Reach length   ( metre)"
"        0.283   X-factor <= 0.5"
"       82.521   K-lag   ( seconds)"
"        0.000   Default(0) or user spec.(1) values used"
"        0.500   X-factor <= 0.5"
"       30.000   K-lag   ( seconds)"
"        0.500   Beta weighting factor"
"      100.000   Routing time step   ( seconds)"
"            1   No. of sub-reaches"
"              Peak outflow                 10.228    c.m/sec"
"                      8.154    10.319    10.228     0.000 c.m/sec"
" 38           START/RE-START TOTALS 3000"
"              3   Runoff Totals on EXIT"
"              Total Catchment area                    129.330    hectare"
"              Total Impervious area                    30.260    hectare"
"              Total % impervious                       23.398"
" 19           EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:           C:\Users\rsingh\Desktop\My Jobs\120139\"
"                                                        NEW SWM\NE Swale Model"
"                Output filename:          120139 - Prop. 100 yr - NE Swale.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                 2/2/2024 at 12:24:04 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"     1440.000   Max. Storm length"
"     1440.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     1357.120   Coefficient A"
"        9.595   Constant B"
"        0.763   Exponent C"
"        0.375   Fraction R"
"     1440.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           152.190    mm/hr"
"             Total depth                 126.124    mm"
"            6   100hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 1000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         1000   Existing Farm Field "
"        5.000   % Impervious"
"       64.540   Total Area"
"      700.000   Flow length"
"        2.000   Overland Slope"
"       61.313   Pervious Area"
"      700.000   Pervious length"
"        2.000   Pervious slope"
"        3.227   Impervious Area"
"      700.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    4.297     0.000     0.000     0.000 c.m/sec"
"             Catchment 1000         Pervious   Impervious Total Area "
"             Surface Area           61.313     3.227      64.540     hectare"
"             Time of concentration  69.534     12.413     60.914     minutes"
"             Time to Centroid       624.563    642.438    627.260    minutes"
"             Rainfall depth         126.124    126.124    126.124    mm"
"             Rainfall volume        7.7330     0.4070     8.1401     ha-m"
"             Rainfall losses        89.696     3.121      85.367     mm"
"             Runoff depth           36.428     123.003    40.757     mm"
"             Runoff volume          2.2335     0.3969     2.6305     ha-m"
"             Runoff coefficient     0.289      0.975      0.323      "
"             Maximum flow           4.128      1.024      4.297      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    4.297     4.297     0.000     0.000"
" 33          CATCHMENT 2000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         2000   Existing Farm Field"
"        2.000   % Impervious"
"       11.170   Total Area"
"      350.000   Flow length"
"        2.000   Overland Slope"
"       10.947   Pervious Area"
"      350.000   Pervious length"
"        2.000   Pervious slope"
"        0.223   Impervious Area"
"      350.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                    1.070     4.297     0.000     0.000 c.m/sec"
"             Catchment 2000         Pervious   Impervious Total Area "
"             Surface Area           10.947     0.223      11.170     hectare"
"             Time of concentration  45.875     8.189      43.436     minutes"
"             Time to Centroid       599.047    635.789    601.425    minutes"
"             Rainfall depth         126.124    126.124    126.124    mm"
"             Rainfall volume        1.3806     0.0282     1.4088     ha-m"
"             Rainfall losses        89.698     2.615      87.957     mm"
"             Runoff depth           36.426     123.509    38.167     mm"
"             Runoff volume          3987.38    275.92     4263.30    c.m"
```

```
"             Runoff coefficient     0.289      0.979      0.303      "
"             Maximum flow           1.053      0.088      1.070      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     1.070     5.243     0.000     0.000"
" 33          CATCHMENT 3000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         3000   Developed part of Town"
"       50.000   % Impervious"
"       53.620   Total Area"
"      650.000   Flow length"
"        2.000   Overland Slope"
"       26.810   Pervious Area"
"      650.000   Pervious length"
"        2.000   Pervious slope"
"       26.810   Impervious Area"
"      650.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     9.085     5.243     0.000     0.000 c.m/sec"
"             Catchment 3000         Pervious   Impervious Total Area "
"             Surface Area           26.810     26.810     53.620     hectare"
"             Time of concentration  66.510     11.873     24.347     minutes"
"             Time to Centroid       621.301    641.564    636.937    minutes"
"             Rainfall depth         126.124    126.124    126.124    mm"
"             Rainfall volume        3.3814     3.3814     6.7628     ha-m"
"             Rainfall losses        89.698     3.007      46.353     mm"
"             Runoff depth           36.426     123.117    79.771     mm"
"             Runoff volume          0.9766     3.3008     4.2773     ha-m"
"             Runoff coefficient     0.289      0.976      0.632      "
"             Maximum flow           1.914      8.722      9.085      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     9.085    11.536     0.000     0.000"
" 52          CHANNEL DESIGN"
"       11.536   Current peak flow    c.m/sec"
"        0.060   Manning 'n'"
"           1.   Cross-section type: 0=trapezoidal; 1=general"
"           7.   Define an arbitrary cross-section"
```

```
"                  0.000     3.300     7.000    10.000    13.200"
"                 23.200    24.000"
"                439.420   438.610   438.360   438.000   437.370"
"                437.370   438.500"
"        1.130   Channel depth    metre"
"        0.850   Gradient   %"
"           0.   Variable roughness: 0=False; 1=True"
"                 0.0400    0.0400    0.0400    0.0400    0.0400"
"                 0.0400    0.0400"
"             Depth of flow                 0.814    metre"
"             Velocity                      1.141    m/sec"
"             Channel capacity             20.173    c.m/sec"
"             Critical depth                0.489    metre"
" 53          ROUTE    Channel Route 122"
"       121.60      Channel Route 122 Reach length   ( metre)"
"        0.272   X-factor <= 0.5"
"       79.934   K-lag   ( seconds)"
"        0.000   Default(0) or user spec.(1) values used"
"        0.500   X-factor <= 0.5"
"       30.000   K-lag   ( seconds)"
"        0.500   Beta weighting factor"
"      100.000   Routing time step   ( seconds)"
"            1   No. of sub-reaches"
"             Peak outflow                 11.462    c.m/sec"
"                     9.085    11.536    11.462     0.000 c.m/sec"
" 38          START/RE-START TOTALS 3000"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                    129.330    hectare"
"             Total Impervious area                    30.260    hectare"
"             Total % impervious                       23.398"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:            C:\Users\szaga\Documents\MIDUSS\120139"
"                Output filename:                  120139_Prop_Reg-NE-Swale.out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                2/24/2023 at 5:38:40 PM"
" 31          TIME PARAMETERS"
"       60.000   Time Step"
"     2880.000   Max. Storm length"
"     5000.000   Max. Hydrograph"
" 32          STORM Historic"
"            5   Historic"
"     2880.000   Duration"
"       48.000   Rainfall intensity values"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.028     2.028     2.028     2.028     2.028"
"                  2.026     6.000     4.000     6.000    13.000"
"                 17.000    13.000    23.000    13.000    13.000"
"                 53.000    38.000    13.000"
"             Maximum intensity            53.000    mm/hr"
"             Total depth                 285.000    mm"
"            7   9999hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 1000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         1000   Existing Farm Field "
"        5.000   % Impervious"
"       64.540   Total Area"
"      700.000   Flow length"
"        2.000   Overland Slope"
"       61.313   Pervious Area"
"      700.000   Pervious length"
"        2.000   Pervious slope"
"        3.227   Impervious Area"
"      700.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
```

```
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     3.886     0.000     0.000     0.000 c.m/sec"
"             Catchment 1000         Pervious   Impervious Total Area "
"             Surface Area           61.313     3.227      64.540     hectare"
"             Time of concentration  114.011    18.928     98.872     minutes"
"             Time to Centroid       2866.677   2300.051   2776.458   minutes"
"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        17.4742    0.9197     18.3939    ha-m"
"             Rainfall losses        207.052    4.534      196.926    mm"
"             Runoff depth           77.948     280.466    88.074     mm"
"             Runoff volume          4.7792     0.9051     5.6843     ha-m"
"             Runoff coefficient     0.274      0.984      0.309      "
"             Maximum flow           3.703      0.372      3.886      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     3.886     3.886     0.000     0.000"
" 33          CATCHMENT 2000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         2000   Existing Farm Field"
"        2.000   % Impervious"
"       11.170   Total Area"
"      350.000   Flow length"
"        2.000   Overland Slope"
"       10.947   Pervious Area"
"      350.000   Pervious length"
"        2.000   Pervious slope"
"        0.223   Impervious Area"
"      350.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.799     3.886     0.000     0.000 c.m/sec"
"             Catchment 2000         Pervious   Impervious Total Area "
"             Surface Area           10.947     0.223      11.170     hectare"
"             Time of concentration  75.219     12.488     71.002     minutes"
"             Time to Centroid       2831.604   2293.580   2795.432   minutes"
```

```
"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        3.1198     0.0637     3.1834     ha-m"
"             Rainfall losses        207.392    10.907     203.462    mm"
"             Runoff depth           77.608     274.093    81.538     mm"
"             Runoff volume          8495.44    612.32     9107.77    c.m"
"             Runoff coefficient     0.272      0.962      0.286      "
"             Maximum flow           0.776      0.027      0.799      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.799     4.607     0.000     0.000"
" 33          CATCHMENT 3000"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"         3000   Developed part of Town"
"       50.000   % Impervious"
"       53.620   Total Area"
"      650.000   Flow length"
"        2.000   Overland Slope"
"       26.810   Pervious Area"
"      650.000   Pervious length"
"        2.000   Pervious slope"
"       26.810   Impervious Area"
"      650.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     4.602     4.607     0.000     0.000 c.m/sec"
"             Catchment 3000         Pervious   Impervious Total Area "
"             Surface Area           26.810     26.810     53.620     hectare"
"             Time of concentration  109.053    18.105     37.923     minutes"
"             Time to Centroid       2862.311   2297.705   2420.736   minutes"
"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        7.6409     7.6409     15.2817    ha-m"
"             Rainfall losses        206.803    4.345      105.574    mm"
"             Runoff depth           78.197     280.655    179.426    mm"
"             Runoff volume          2.0965     7.5244     9.6208     ha-m"
"             Runoff coefficient     0.274      0.985      0.630      "
"             Maximum flow           1.633      3.115      4.602      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     4.602     9.209     0.000     0.000"
```

```
" 52          CHANNEL DESIGN"
"        9.209   Current peak flow    c.m/sec"
"        0.060   Manning 'n'"
"           1.   Cross-section type: 0=trapezoidal; 1=general"
"           7.   Define an arbitrary cross-section"
"                  0.000     3.300     7.000    10.000    13.200"
"                 23.200    24.000"
"                439.420   438.610   438.360   438.000   437.370"
"                437.370   438.500"
"        1.130   Channel depth    metre"
"        0.850   Gradient   %"
"           0.   Variable roughness: 0=False; 1=True"
"                 0.0400    0.0400    0.0400    0.0400    0.0400"
"                 0.0400    0.0400"
"             Depth of flow                 0.713    metre"
"             Velocity                      1.069    m/sec"
"             Channel capacity             20.173    c.m/sec"
"             Critical depth                0.424    metre"
" 53          ROUTE    Channel Route 122"
"       121.60      Channel Route 122 Reach length   ( metre)"
"        0.294   X-factor <= 0.5"
"       85.279   K-lag   ( seconds)"
"        0.000   Default(0) or user spec.(1) values used"
"        0.500   X-factor <= 0.5"
"       30.000   K-lag   ( seconds)"
"        0.500   Beta weighting factor"
"      120.000   Routing time step   ( seconds)"
"            1   No. of sub-reaches"
"             Peak outflow                  9.129    c.m/sec"
"                     4.602     9.209     9.129     0.000 c.m/sec"
" 38          START/RE-START TOTALS 3000"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                    129.330    hectare"
"             Total Impervious area                    30.260    hectare"
"             Total % impervious                       23.398"
" 19          EXIT"
```