Thomasfield Homes Ltd.

Grand Valley Business Park
Functional Servicing Report

GMBP File: 117184

December 2021

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GRAND VALLEY BUSINESS PARK

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1. SITE DESCRIPTION

The Grand Valley Business Park is located on Part of Lot 32, Concession 1 (Geographic Township of East Luther), Town of Grand Valley, County of Dufferin.

This report outlines the servicing for the development of Grand Valley Business Park. The Grand Valley Business Park is bound by agricultural and future development lands to the north and west, Amaranth East Luther Townline to the east, and County Road 109 to the south. See Figure No. 1 for the site location.

Under pre-development conditions, the Grand Valley Business Park and adjacent lands sheetflow overland towards Boyne Creek, a tributary of Boyne Creek and towards the intersection of Amaranth Townline and County Road 109, ultimately discharging to the Grand River.

2. SITE SERVICING

The Draft Plan of Subdivision, Figure No. 2, illustrates the proposed lot fabric, internal roadways and stormwater management areas. The proposed Grand Valley Business Park development consists of two (2) stormwater management facilities, and seven (7) industrial development blocks.

For continuity purposes, a conceptual layout has been used on the future development lands owned by the applicant to confirm that services can be provided at a later date and to ensure that the services designed as part of the Grand Valley Business Park have adequate capacity to service future development lands.

Access to the Grand Valley Business Park is provided through two (2) connections to Amaranth East Luther Townline.

2.1 Sanitary Sewers

As part of the proposed development, a 250mm diameter sanitary sewer will be extended across Boyne Creek via trenchless technologies from the sanitary sewer stub terminated at the sewage pumping station in the subdivision west of Boyne Creek to the proposed stormwater management facility. The 250mm diameter sanitary sewer will then be extended along the west boundary of the future development lands to Street B, and ultimately to Street A and Street C.

A 150 mm diameter sanitary lateral connection will be provided for each industrial development.

Sanitary sewer design sheets and catchment area boundaries for the Grand Valley Business Park and the future development lands are included in **Appendix A**.

2.2 Storm Sewers

The Grand Valley Business Park storm sewer system on the internal roads will be sized to convey the 5-year design storm peak flows to the stormwater management system.

The storm sewers and proposed stormwater management facility will be designed with capacity and depth to service the Grand Valley Business Park lands and the future development lands once fully developed. The storm sewers will discharge to the proposed stormwater management facility located to the north of the Grand Valley Business Park lands. A portion of the storm sewers within the future development lands will discharge to the second future stormwater management facility at the south limit of the future development lands prior to discharging to the tributary of Boyne Creek. Major storm runoff will be conveyed through the street right-of-way, discharging to the stormwater management facility and ultimately to Boyne Creek.

Storm sewer design sheets and catchment area boundaries for the Grand Valley Business Park and the future development lands are included in **Appendix B**.

2.3 Watermain

A proposed 200mm diameter watermain is to be extended through all interior streets with connections at the existing 200mm diameter watermain located on County Road 109.

A 150 mm diameter water service lateral will be provided for each industrial development block.

Fire hydrants are proposed to be placed at a minimum distance of 100m to provide fire protection, in accordance with Town Standards.

3. STREETS

All streets will be constructed as an urban road cross-section with concrete curb and gutter. All internal streets within the Grand Valley Business Park have a 26m right-of-way width, as per the Town of Grand Valley Standards.

The Grand Valley Business Park development will connect to Amaranth East Luther Townline. Based on the proposed layout of the intersections, the resulting sight lines have been reviewed and are deemed to be satisfactory.

As per the Town of Grand Valley Transportation Master Plan Study (dated March 2017) recommendations, a portion of the future North-South Collector Road has been included in the Grand Valley Business Park development. The future collector road will be extended across Boyne Creek by others as part of a future development.

4. SITE GRADING

All streets will be constructed with minimum slopes of 0.5% and a maximum slope of 6.0%.

The site layout for the stormwater management areas and the internal roads is shown on the Grading Plans.

The grade and elevation of the internal streets and proposed lots is controlled by the elevation of the storm and sanitary sewers, the outlet from the stormwater management system and the major overland flow routes from the municipal right-of-ways to the stormwater management facilities.

The proposed site grading is designed to match the existing elevations along the property limits and the agricultural lands to maintain the existing drainage patterns.

5. STORMWATER MANAGEMENT

5.1 Stormwater Management Criteria

The stormwater management criteria for the Grand Valley Business Park are as follows:

1. Post-development runoff generated from site are to be attenuated to the flow rate under existing conditions during the 2, 5, and 100-year design storm events.
2. Provide long-term average removal of 80% of TSS on an annual loading basis from all runoff leaving the site.
3. Major storm flows are to be routed overland to an appropriate outlet.
4. Perform a water balance that analyses infiltration rates under pre-development and post-development conditions.

Four-hour duration rainfall events were used to generate and compare the mass rainfall data required to model the 2, 5 and 100-year design storms. The Shand Dam Chicago parameters and the total depth of rainfall for each storm are shown below in Table No. 1.

Table No. 1: Shand Dam - Chicago Storm Parameters

	2 Year	5 Year	100 Year
a =	695.047	1459.072	6933.019
b =	6.387	13.690	34.699
c =	0.793	0.850	0.998
r =	0.380	0.380	0.380
Duration (min)	240.00	240.00	240.00
Total Depth (mm)	35.28	52.78	102.10

The Horton infiltration method was used in the runoff calculations, with the parameters summarized in Table No. 2.

From the Geotechnical Investigation completed by V.A. Wood (Guelph) Incorporated (dated July 2021), the soils on site are described as sandy silt till and clayey silt till with a range of estimated coefficient of permeability (k) that correspond to infiltration rates between 12 mm/hr and 75 mm/hr. Therefore, we have used these infiltration rates in the MIDUSS model. The Geotechnical Investigation report has been included in **Appendix C**.

Table No. 2: MIDUSS Horton Parameters

	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.

5.2 Pre-Development Conditions

For pre-development conditions analysis purposes, the site was modelled as five (5) drainage catchments. The pre-development condition drainage catchments are shown on Figure No. 3 and described below. The existing conditions MIDUSS computer modelling is attached in **Appendix D**.

Catchment 101 (28.42 hectares, 0% impervious) represents a north portion of the development. Stormwater runoff generated from Catchment 101 sheetflows overland northwest to Boyne Creek.

Catchment 102 (2.16 hectares, 30% impervious) represents the existing farmhouse property on the site on the frontage with Amaranth East Luther Townline. Under existing conditions, runoff generated from Catchment 102 sheetflows overland northwest to Boyne Creek.

Catchment 103 (24.27 hectares, 0% impervious) represents a portion of the proposed development. Under existing conditions, runoff generated from Catchment 103 sheetflows overland to the west, ultimately discharging into Boyne Creek.

Catchment 104 (2.64 hectares, 0% impervious) represents a southeast portion of the proposed development. Under existing conditions, runoff generated from Catchment 104 sheetflows overland to the roadside ditch of the County Road 109 right-of-way, ultimately discharging to Boyne Creek.

Catchment 105 (12.28 hectares, 0% impervious) represents a southwest portion of the proposed development. Under existing conditions, runoff generated from Catchment 105 sheetflows to the roadside ditch of the County Road 109 right-of-way, ultimately discharging to Boyne Creek.

In summary, the pre-development condition flow rates from the site are as follows:

Table No. 3: Pre-Development Condition Flow Rates

	2-Year	5-Year	100-Year	Regional
Catchment 101	0.072 m^3/s	1.171 m^3/s	5.558 m^3/s	2.391 m^3/s
Catchment 102	0.140 m^3/s	0.199 m^3/s	0.601 m^3/s	0.191 m^3/s
Catchment 103	0.043 m^3/s	0.734 m^3/s	3.719 m^3/s	1.860 m^3/s
Catchment 104	0.010 m^3/s	0.150 m^3/s	0.663 m^3/s	0.225 m^3/s
Catchment 105	0.034 m^3/s	0.541 m^3/s	2.524 m^3/s	1.043 m^3/s
Total	**0.158 m^3/s**	**2.587 m^3/s**	**12.532 m^3/s**	**5.702 m^3/s**

5.3 Allowable Release Rates

The allowable release rates from the site to Boyne Creek and to the roadside ditch on County Road 109 have been established by determining the flow rates from areas contributing to Boyne Creek under pre-development conditions during all design storm events.

Table No. 4: Allowable Release Rates

	2-Year	5-Year	100-Year
To Boyne Creek (Catchment 101, 102, 103)	0.140 m^3/s	1.956 m^3/s	9.428 m^3/s
To Roadside Ditch on County Road 109 (Catchment 104, 105)	0.043 m^3/s	0.690 m^3/s	3.168 m^3/s

Post-development flow rates will be attenuated to the allowable release rates under all design storm events.

5.4 Post-Development Conditions

For post-development analysis purposes, the site was modelled as three (3) drainage catchments. The post-development drainage catchments are shown on Figure No. 4 and described below. The post-development MIDUSS computer modelling is attached in **Appendix D**.

Catchment 201 (57.38 hectares, 80% impervious) represents a northern portion proposed development. Stormwater runoff generated from Catchment 201 will be directed to the proposed stormwater management facility Pond A, ultimately discharging to Boyne Creek.

Catchment 202 (2.16 hectares, 30% impervious) represents the existing farmhouse property on the site on the frontage with Amaranth East Luther Townline. Under post-development conditions, runoff generated from Catchment 202 will be directed to the proposed stormwater management facility Pond A, ultimately discharging to Boyne Creek.

Catchment 203 (10.21 hectares, 80% impervious) represents a south portion of the proposed development. Stormwater runoff generated from Catchment 203 will be directed to the proposed stormwater management facility Pond B, discharging to the roadside ditch in the County Road 109 right-of-way and ultimately Boyne Creek.

5.5 Stormwater Management System Details – Post-Development Conditions

5.5.1 Pond A

The proposed stormwater management facility will be designed to function as a hybrid wetland / wet pond. From Table 3.2, Stormwater Management Planning and Design Manual, 2003, in order to provide Enhanced water quality treatment, a wet pond facility requires approximately 238.3 m^3/ha of storage volume for a contributing drainage area that is 78% impervious. 40 m^3/ha of the required storage volume is extended detention volume, while the remaining 198.3 m^3/ha is permanent pool.

Based on a total contributing drainage area of 59.54 hectares (Catchment 201 and Catchment 202), 11,807 m^3 of permanent pool storage is required. The stormwater management facility has been designed with a 0.70 metre permanent pool, which provides 8,332.8 m^3 of permanent pool volume. A further 3,825 m^3 of permanent pool volume has been provided in the 1.5m deep sediment forebay created at the pipe inlet for a total permanent pool volume of 12,158 m^3.

Based on a total contributing drainage area of 59.54 hectares, 2,382 m^3 of extended detention storage is required. The stormwater management facility has been designed with approximately 40,986 m^3 of active storage beneath the weir elevation. The drawdown in the stormwater management facility is 86 hours for the 2-year design storm event. The drawdown calculations have been included in Appendix C.

There are three (3) catchbasin outlet structures that control the outflow from the pond. The first outlet structure includes a knockout at the base of the active storage to provide extended detention. The three (3) catchbasin structures allows the major flows up to and including the 100-year design storm to be conveyed to Boyne Creek. An overflow weir (10.0 m x 0.3 m) provides an additional outlet to Boyne Creek. Runoff from the pond begins to flow through the weir at a ponding elevation of 458.30 metres.

Sediment Forebay Design

The proposed stormwater management facility has been designed with one (1) sediment forebay at the main pipe inlet location. The sediment forebay is 1.5 m deep and has been designed as recommended within the MOE guidelines. The full sediment forebay sizing information has been included in **Appendix D**.

Table No. 5 summarizes the required and provided parameters within the sediment forebay design.

Table No. 5: Sediment Forebay Design Details

		Forebay
Required	**Dispersion Length (m)**	131
	Settling Length (m)	50
	Flow Velocity (m/s)	<0.50
	Length to Width Ratio	2:1
	Settling Velocity (m/s)	0.0003
Provided	**Forebay Length (m)**	135
	Flow Velocity (m/s)	0.47
	Length to Width Ratio	5:1

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

Sediment Loading and Cleanout Frequency

Table No. 6 illustrates sediment loading to the sediment forebays as well as the subsequent cleanout frequency required to maintain these systems.

Table No. 6: Sediment Loading and Cleanout Frequency – Sediment Forebay

System Component	Catchment Area	Imp. (%)	Annual Sediment Loading	TSS Removal	Annual TSS Reduction	Storage Volume (1/3 of forebay)	Cleanout Frequency
Forebay	59.54 ha	78	196.5 m^3	80%	157.2 m^3	776 m^3	~ 5 years

5.5.2 Pond B

The proposed stormwater management facility will be designed to function as a wetland. From Table 3.2, Stormwater Management Planning and Design Manual, 2003, in order to provide Enhanced water quality treatment, a wetland facility requires approximately 127.5 m³/ha of storage volume for a contributing drainage area that is 80% impervious. 40 m³/ha of the required storage volume is extended detention volume, while the remaining 87.5 m³/ha is permanent pool.

Based on a total contributing drainage area of 10.21 hectares (Catchment 203), 1,302 m³ of permanent pool storage is required. The stormwater management facility has been designed with a 0.2 metre shallow permanent pool, which provides 1,081.1 m³ of permanent pool volume. A further 255.6 m³ of permanent pool volume has been provided in the sediment forebay created at the pipe inlet for a total permanent pool volume of 1,336.7 m³.

Based on a total contributing drainage area of 10.21 hectares, 408 m³ of extended detention storage is required. The stormwater management facility has been designed with approximately 7,165 m³ of active storage beneath the weir elevation. The drawdown in the stormwater management facility is 48 hours for the 2-year design storm event. The drawdown calculations have been included in **Appendix D.**

There are two (2) catchbasin outlet structures that control the outflow from the pond. The first outlet structure includes a knockout at the base of the active storage to provide extended detention. The two (2) catchbasin structures allows the major flows up to and including the 100-year design storm to be conveyed to Boyne Creek. An overflow weir (5.0 m x 0.3 m) provides an additional outlet to Boyne Creek. Runoff from the pond begins to flow through the weir at a ponding elevation of 468.40 metres.

Sediment Forebay Design
The proposed stormwater management facility has been designed with sediment forebay at the main pipe inlet location. The sediment forebays are 1.5 m deep and has been designed as recommended within the MOE guidelines. The full sediment forebay sizing information has been included in **Appendix D**.

Table No. 7 summarizes the required and provided parameters within the sediment forebay design.

Table No. 7: Sediment Forebay Design Details

		Forebay
Required	**Dispersion Length (m)**	25.1
	Settling Length (m)	18.7
	Flow Velocity (m/s)	0.50
	Length to Width Ratio	2:1
	Settling Velocity (m/s)	0.0003
Provided	**Forebay Length (m)**	25.5
	Flow Velocity (m/s)	0.31
	Length to Width Ratio	3:1

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

Sediment Loading and Cleanout Frequency

Table No. 8 illustrates sediment loading to the sediment forebays as well as the subsequent cleanout frequency required to maintain these systems.

Table No. 8: Sediment Loading and Cleanout Frequency – Sediment Forebays

System Component	Catchment Area	Imp. (%)	Annual Sediment Loading	TSS Removal	Annual TSS Reduction	Storage Volume (1/3 of forebay)	Cleanout Frequency
Forebay	10.21 ha	80%	32 m^3	80%	25.6 m^3	85 m^3	~ 3 years

5.5.3 Routing – Post-Development Conditions

MIDUSS was used to calculate the peak flow rate from the site under post-development conditions. A copy of the calculations of the post-development flow rates can be found in **Appendix D**.

Table 9 identifies the storage capacity available, and the capacity used in the Pond A stormwater management facility under each storm condition.

Table 9: Stage/Storage/Discharge Comparison – Pond A Proposed Stormwater Management Facility

Control Point	Available Capacities			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
Knockout Invert	0.000	0	456.00	---	---	---
2 Year	---	---	---	0.128	14,302	456.94
CB Lip Invert	0.130	15,346	457.00	---	---	---
5 Year	---	---	---	1.521	17,851	457.14
100 Year	---	---	---	2.579	37,043	458.12
Weir	2.663	40,986	458.30	---	---	---
Regional	---	---	---	3.273	43,359	458.41
Top of Pond	5.093	47,806	458.60	---	---	---

Table 10 identifies the storage capacity available, and the capacity used in the Pond B stormwater management facility under each storm condition.

Table 10: Stage/Storage/Discharge Comparison – Pond B Proposed Stormwater Management Facility

Control Point	Available Capacities			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
Knockout Invert	0.000	0	468.30	---	---	---
2 Year	---	---	---	0.042	2,374	467.80
CB Lip Invert	0.043	2,495	468.80	---	---	---
5 Year	---	---	---	0.314	3,110	468.93
Regional	---	---	---	0.945	3,898	469.07
100 Year	---	---	---	1.040	4,928	469.24
Weir	1.299	8,175	469.70	---	---	---
Top of Pond	2.586	10,427	470.00	---	---	---

5.6 Post-Development Outlet to Grand River

Table 11 summarizes the post-development flows for the full range of design storm events.

Table 11: Post-Development Flows

		2 Year	5 Year	100 Year	Regional
Catchment 201 and 202 (controlled)	Flow Rate	0.128 m^3/s	1.521 m^3/s	2.579 m^3/s	3.273 m^3/s
	Volume	15,795 m^3	25,320 m^3	53,328 m^3	136,455 m^3
Catchment 203 (controlled)	Flow Rate	0.042 m^3/s	0.314 m^3/s	0.945 m^3/s	1.040 m^3/s
	Volume	2,770 m^3	4,400 m^3	9,198 m^3	23,627 m^3
Total Flow	**Flow Rate**	**0.170 m^3/s**	**1.823 m^3/s**	**3.588 m^3/s**	**3.865 m^3/s**
	Volume	**12,628 m^3**	**22,516 m^3**	**54,581 m^3**	**145,779 m^3**

The following table compares the post-development condition flow rates to the existing condition release rates for the full range of design storm events.

Table 12: Comparison of Allowable Release Rates and Post-Development Condition Flow Rates

	2 Year	5 Year	100 Year
Allowable Release Rate to Boyne Creek	0.140 m^3/s	1.956 m^3/s	9.428 m^3/s
Total Flow to Boyne Creek	0.128 m^3/s	1.521 m^3/s	2.579 m^3/s
Allowable Release Rate to Roadside Ditch on County Road 109 Right-of-Way	0.043 m^3/s	0.690 m^3/s	3.168 m^3/s
Total Flow to Roadside Ditch	0.042 m^3/s	0.314 m^3/s	0.945 m^3/s

6. WATER BALANCE

The average annual precipitation for the area in which the study site is located is estimated to be approximately 945.9 mm. This amount is based on precipitation data recorded at the Fergus Shand Dam meteorological station for the period from 1981 to 2010. The water balance is calculated on a monthly basis based on the strategy identified in Instructions and Tables for Computing Potential Evapotranspiration and the Water Balance (Thornthwaite and Mather, 1957).

Under pre-development conditions, the study area is considered mostly pervious surfaces and the site discharges sheetflows overland north to Boyne Creek or south to the roadside ditch on County Road 109 before ultimately discharging to Boyne Creek. The annual average recharge volume on the site is 95,613 m^3 under pre-development conditions. The annual runoff volume from the site to Boyne Creek is 117,568 m^3 via either direct overland sheetflow or the roadside ditch on County Road 109.

Table No. 13 below summarizes the infiltration volumes under pre-development conditions. See Table No. 16 for further details on the monthly water balance calculations for the site under pre-development conditions.

Table No. 13: Pre-Development Condition Infiltration Volumes

Catchment ID	Outlet	Area (ha)	Imperv. (%)	Annual Infiltration Volume
101, 102, 103	Boyne Creek	54.85	1.2	75,351 m^3
104, 105	Roadside Ditch on County Road 109	14.92	0	20,263 m^3
Total	**--**	**69.77**	**1**	**95,613 m^3**

Under post-development conditions, the site is approximately 78% impervious. The increase in impervious area results in additional precipitation being available for runoff and recharge due to the minimal evapotranspiration. Therefore, the annual average recharge volume for the site under post-development conditions is 36,072 m^3 and the annual average runoff volume for the site to Boyne Creek, either via direct overland sheetflow or via the roadside ditch, is 438,778 m^3.

Table No. 14 below summarizes the infiltration volumes under post-development conditions. See Table No. 17 for further details on the monthly water balance calculations for the site under post-development conditions.

Table No. 14: Post-Development Condition Infiltration Volumes

Catchment ID	Outlet	Area (ha)	Imperv. (%)	Annual Infiltration Volume
201, 202	Stormwater Management Facility Pond A – to Boyne Creek	59.54	78	31,161 m^3
203	Stormwater Management Facility Pond B – to Roadside Ditch	10.21	80	4,911 m^3
Total	**--**	**69.75**	**78**	**36,072 m^3**

Table 16: Monthly Water Balance (Pre-Development Conditions)

PRE-DEVELOPMENT CONDITIONS

Contributing Catchments: Catchment 101, 102, 103 (Outlets to Boyne Creek)
Contributing Area = 54.85 ha
Percent Impervious = 1.2%
Soil Type: Sandy Silt Till, Clayey Silt Till
Vegetation: Shallow rooted
Root Zone Depth = 0.4m
Soil Moisture Retention Capacity (mm) = 100
Runoff Factor = 0.65
Evapotranspiration Factor for Impervious Surfaces = 0.33

Month	Daily Average Temperature (°C)	Monthly Heat Index (I)	Unadjusted Daily Potential Evapotranspiration (mm)	Correction Factors	Adjusted Potential Evapotranspiration (PE) (mm)	Average Precipitation (P) (mm)	P-PE (mm)	Accum. Pot. Water Loss (mm)	Storage (ST) (mm)	ΔS (mm)	Pervious ET	Actual Evapotrans-piration (AE) (mm)	Pervious ET - Actual ET	Moisture Deficit (D) (mm)	Moisture Surplus (S) (mm)	Water Runoff (RO) (mm)	Snow Melt Runoff (mm)	Total Recharge and Runoff (mm)	Actual Runoff (mm)	Recharge Volume (m^3)	Runoff Volume (m^3)
Jan	-7.4	0.0	0.0	24.3	0.0	67.9	67.9		236.5	0.0		0.0	0.0	0.0	0.0	10.3	0.0	10.3	6.7	1,969	3,657
Feb	-6.3	0.0	0.0	24.6	0.0	55.9	55.9		292.4	0.0		0.0	0.0	0.0	0.0	5.1	0.0	5.1	3.3	985	1,829
Mar	-1.9	0.0	0.0	30.6	0.0	59.6	59.6		352.0	0.0		0.0	0.0	0.0	0.0	2.6	0.0	2.6	1.7	492	914
Apr	5.7	1.2	0.9	33.6	30.2	74.1	43.9		100.0	0.0	30.2	30.0	0.2	-0.2	44.1	23.3	25.2	48.5	31.5	9,311	17,292
May	12.2	3.9	2.0	37.8	75.6	86.9	11.3		100.0	0.0	75.6	75.0	0.6	-0.6	11.9	17.6	113.4	131.0	85.2	25,150	46,707
Jun	17.5	6.7	2.9	38.4	111.4	83.8	-27.6	-27.6	75.0	25.0	108.8	107.9	0.9	3.4	0.9	9.2	56.7	65.9	42.9	12,659	23,510
Jul	20.0	8.2	3.4	38.7	131.6	89.2	-42.4	-69.9	49.0	26.0	115.2	114.3	0.9	17.3	0.9	5.1	28.4	33.4	21.7	6,419	11,920
Aug	19.0	7.6	3.2	36.0	115.2	96.6	-18.6	-88.5	40.0	9.0	105.6	104.7	0.9	10.5	0.9	3.0	14.3	17.3	11.2	3,315	6,157
Sep	14.9	5.2	2.5	31.2	78.0	93.1	15.1		55.1	15.1	78.0	77.4	0.6	-0.6	0.6	1.8	8.0	9.8	6.4	1,881	3,493
Oct	8.3	2.2	1.3	28.5	37.1	77.2	40.2		95.3	40.2	37.1	36.8	0.3	-0.3	0.3	1.0	4.0	5.0	3.3	969	1,800
Nov	2.1	0.3	0.3	24.3	7.3	93.0	85.7		100.0	4.8	7.3	7.2	0.1	-0.1	81.0	41.0	2.0	43.0	28.0	8,261	15,343
Dec	-3.9	0.0	0.0	23.1	0.0	68.6	68.6		168.6	0.0		0.0	0.0	0.0	0.0	20.5	0.0	20.5	13.3	3,939	7,315
Total		**35.1**				**945.9**	**359.6**				**557.8**	**553.3**	**4.5**	**29.4**	**140.6**	**140.6**	**252.0**	**392.5**	**255.1**	**75,351**	**139,937**

Contributing Catchments: Catchment 104, 105 (Outlets to Roadside Ditch on County Road 109)
Contributing Area = 14.92 ha
Percent Impervious = 0.0%
Soil Type: Sandy Silt Till, Clayey Silt Till
Vegetation: Shallow rooted
Root Zone Depth = 0.4m
Soil Moisture Retention Capacity (mm) = 100
Runoff Factor = 0.65
Evapotranspiration Factor for Impervious Surfaces = 0.33

Month	Daily Average Temperature (°C)	Monthly Heat Index (I)	Unadjusted Daily Potential Evapotranspiration (mm)	Correction Factors	Adjusted Potential Evapotranspiration (PE) (mm)	Average Precipitation (P) (mm)	P-PE (mm)	Accum. Pot. Water Loss (mm)	Storage (ST) (mm)	ΔS (mm)	Pervious ET	Actual Evapotrans-piration (AE) (mm)	Pervious ET - Actual ET	Moisture Deficit (D) (mm)	Moisture Surplus (S) (mm)	Water Runoff (RO) (mm)	Snow Melt Runoff (mm)	Total Recharge and Runoff (mm)	Actual Runoff (mm)	Recharge Volume (m^3)	Runoff Volume (m^3)
Jan	-7.4	0.0	0.0	24.3	0.0	67.9	67.9		236.5	0.0		0.0	0.0	0.0	0.0	10.2	0.0	10.2	6.6	532	988
Feb	-6.3	0.0	0.0	24.6	0.0	55.9	55.9		292.4	0.0		0.0	0.0	0.0	0.0	5.1	0.0	5.1	3.3	266	494
Mar	-1.9	0.0	0.0	30.6	0.0	59.6	59.6		352.0	0.0		0.0	0.0	0.0	0.0	2.5	0.0	2.5	1.7	133	247
Apr	5.7	1.2	0.9	33.6	30.2	74.1	43.9		100.0	0.0	30.2	30.2	0.0	0.0	43.9	23.2	25.2	48.4	31.4	2,526	4,692
May	12.2	3.9	2.0	37.8	75.6	86.9	11.3		100.0	0.0	75.6	75.6	0.0	0.0	11.3	17.2	113.4	130.6	84.9	6,822	12,669
Jun	17.5	6.7	2.9	38.4	111.4	83.8	-27.6	-27.6	75.0	25.0	108.8	108.8	0.0	2.6	0.0	8.6	56.7	65.3	42.5	3,411	6,335
Jul	20.0	8.2	3.4	38.7	131.6	89.2	-42.4	-69.9	49.0	26.0	115.2	115.2	0.0	16.4	0.0	4.3	28.4	32.7	21.2	1,706	3,167
Aug	19.0	7.6	3.2	36.0	115.2	96.6	-18.6	-88.5	40.0	9.0	105.6	105.6	0.0	9.6	0.0	2.2	14.3	16.5	10.7	859	1,596
Sep	14.9	5.2	2.5	31.2	78.0	93.1	15.1		55.1	15.1	78.0	78.0	0.0	0.0	0.0	1.1	8.0	9.1	5.9	474	880
Oct	8.3	2.2	1.3	28.5	37.1	77.2	40.2		95.3	40.2	37.1	37.1	0.0	0.0	0.0	0.5	4.0	4.5	3.0	237	440
Nov	2.1	0.3	0.3	24.3	7.3	93.0	85.7		100.0	4.8	7.3	7.3	0.0	0.0	81.0	40.7	2.0	42.7	27.8	2,232	4,146
Dec	-3.9	0.0	0.0	23.1	0.0	68.6	68.6		168.6	0.0		0.0	0.0	0.0	0.0	20.4	0.0	20.4	13.2	1,064	1,976
Total		**35.1**				**945.9**	**359.6**				**557.8**	**557.8**	**0.0**	**28.5**	**136.1**	**136.1**	**252.0**	**388.0**	**252.2**	**20,263**	**37,630**

Notes: Precipitation and Temperature data from Environment Canada Climate Normals 1981-2010 for Fergus Shand Dam
Monthly water balance strategy as outlined in the document *Instructions and Tables for Computing Potential Evapotranspiration and the Water Balance (Thornthwaite and Mather, 1957)*
Monthy Heat Index (I) from Table 2 of *Instructions and Tables for Computing Potential Evapotranspiration and the Water Balance*
Correction Factors from Table 6 of *Instructions and Tables for Computing Potential Evapotranspiration and the Water Balance*
Evaporation Factor for Impervious Surfaces = Average Annual Evapotranspiration for Impervious Surfaces (183mm/year) / Average Annual Evapotranspiration for Pervious Surfaces (557.8mm/year) = 0.33
Runoff Factor = [(Impervious Percentage of Site x Average Annual Runoff for Impervious Surfaces) + (Pervious Silt Till Percentage of Site x Average Annual Runoff for Pervious Silt Till Surfaces)] / Total Annual Recharge & Runoff

Table 17: Monthly Water Balance (Post-Development Conditions)

POST-DEVELOPMENT CONDITIONS

Contributing Catchments: 201, 202 (Outlets to Stormwater Management Facility Pond A)
Soil Type: Sandy Silt Till, Clayey Silt Till
Vegetation: Shallow rooted
Contributing Area = 59.54 ha
Root Zone Depth = 0.4m
Percent Impervious = 78.0%
Soil Moisture Retention Capacity (mm) = 100
Runoff Factor = 0.92
Evapotranspiration Factor for Impervious Surfaces = 0.33

Month	Daily Average Temperature (°C)	Monthly Heat Index	Unadjusted Daily Potential Evapotranspiration (mm)	Correction Factors	Adjusted Potential Evapotranspiration (mm)	Average Precipitation (mm)	P-PE (mm)	Accum. Pot. Water Loss (mm)	Storage (mm)	ΔS (mm)	Pervious ET	Actual Evapotrans-piration (mm)	Pervious ET - Actual ET	Moisture Deficit (mm)	Moisture Surplus (mm)	Water Runoff (mm)	Snow Melt Runoff (mm)	Total Recharge & Runoff (mm)	Actual Runoff (mm)	Natural Recharge Volume (m^3)	Runoff Volume (m^3)
Jan	-7.4	0.0	0.0	24.3	0.0	67.9	67.9		236.5	0.0		0.0	0.0	0.0	0.0	14.8	0.0	14.8	13.7	679	8,138
Feb	-6.3	0.0	0.0	24.6	0.0	55.9	55.9		292.4	0.0		0.0	0.0	0.0	0.0	7.4	0.0	7.4	6.8	339	4,069
Mar	-1.9	0.0	0.0	30.6	0.0	59.6	59.6		352.0	0.0		0.0	0.0	0.0	0.0	3.7	0.0	3.7	3.4	170	2,035
Apr	5.7	1.2	0.9	33.6	30.2	74.1	43.9		100.0	0.0	30.2	14.4	15.8	15.8	59.7	31.4	25.2	56.6	52.2	2,593	31,080
May	12.2	3.9	2.0	37.8	75.6	86.9	11.3		100.0	0.0	75.6	36.0	39.6	39.6	50.9	41.1	113.4	154.5	142.6	7,085	84,927
Jun	17.5	6.7	2.9	38.4	111.4	83.8	-27.6	-27.6	75.0	25.0	108.8	51.8	57.0	59.6	57.0	49.1	56.7	105.8	97.6	4,850	58,132
Jul	20.0	8.2	3.4	38.7	131.6	89.2	-42.4	-69.9	49.0	26.0	115.2	54.8	60.4	76.8	60.4	54.7	28.4	83.1	76.7	3,809	45,656
Aug	19.0	7.6	3.2	36.0	115.2	96.6	-18.6	-88.5	40.0	9.0	105.6	50.3	55.3	64.9	55.3	55.0	14.3	69.3	64.0	3,179	38,104
Sep	14.9	5.2	2.5	31.2	78.0	93.1	15.1		55.1	15.1	78.0	37.1	40.9	40.9	40.9	48.0	8.0	56.0	51.6	2,565	30,752
Oct	8.3	2.2	1.3	28.5	37.1	77.2	40.2		95.3	40.2	37.1	17.6	19.4	19.4	19.4	33.7	4.0	37.7	34.8	1,728	20,711
Nov	2.1	0.3	0.3	24.3	7.3	93.0	85.7		100.0	4.8	7.3	3.5	3.8	3.8	84.8	59.2	2.0	61.2	56.5	2,807	33,651
Dec	-3.9	0.0	0.0	23.1	0.0	68.6	68.6		168.6	0.0		0.0	0.0	0.0	0.0	29.6	0.0	29.6	27.3	1,358	16,276
Total		**35.1**				**945.9**	**359.6**				**557.8**	**265.5**	**292.3**	**320.9**	**428.4**	**427.7**	**252.0**	**679.7**	**627.4**	**31,161**	**373,530**

Contributing Catchments: 203 (Outlets to Stormwater Management Facility Pond B)
Soil Type: Sandy Silt Till, Clayey Silt Till
Vegetation: Shallow rooted
Contributing Area = 10.21 ha
Root Zone Depth = 0.4m
Percent Impervious = 80.0%
Soil Moisture Retention Capacity (mm) = 100
Runoff Factor = 0.93
Evapotranspiration Factor for Impervious Surfaces = 0.33

Month	Daily Average Temperature (°C)	Monthly Heat Index	Unadjusted Daily Potential Evapotranspiration (mm)	Correction Factors	Adjusted Potential Evapotranspiration (mm)	Average Precipitation (mm)	P-PE (mm)	Accum. Pot. Water Loss (mm)	Storage (mm)	ΔS (mm)	Pervious ET	Actual Evapotrans-piration (mm)	Pervious ET - Actual ET	Moisture Deficit (mm)	Moisture Surplus (mm)	Water Runoff (mm)	Snow Melt Runoff (mm)	Total Recharge & Runoff (mm)	Actual Runoff (mm)	Natural Recharge Volume (m^3)	Runoff Volume (m^3)
Jan	-7.4	0.0	0.0	24.3	0.0	67.9	67.9		236.5	0.0		0.0	0.0	0.0	0.0	14.9	0.0	14.9	13.9	107	1,417
Feb	-6.3	0.0	0.0	24.6	0.0	55.9	55.9		292.4	0.0		0.0	0.0	0.0	0.0	7.5	0.0	7.5	6.9	53	709
Mar	-1.9	0.0	0.0	30.6	0.0	59.6	59.6		352.0	0.0		0.0	0.0	0.0	0.0	3.7	0.0	3.7	3.5	27	354
Apr	5.7	1.2	0.9	33.6	30.2	74.1	43.9		100.0	0.0	30.2	14.0	16.3	16.3	60.1	31.6	25.2	56.8	52.8	406	5,389
May	12.2	3.9	2.0	37.8	75.6	86.9	11.3		100.0	0.0	75.6	35.0	40.6	40.6	51.9	41.7	113.4	155.1	144.3	1,109	14,732
Jun	17.5	6.7	2.9	38.4	111.4	83.8	-27.6	-27.6	75.0	25.0	108.8	50.3	58.5	61.0	58.5	50.1	56.7	106.8	99.3	763	10,142
Jul	20.0	8.2	3.4	38.7	131.6	89.2	-42.4	-69.9	49.0	26.0	115.2	53.3	61.9	78.3	61.9	56.0	28.4	84.4	78.5	603	8,011
Aug	19.0	7.6	3.2	36.0	115.2	96.6	-18.6	-88.5	40.0	9.0	105.6	48.8	56.8	66.4	56.8	56.4	14.3	70.7	65.7	505	6,712
Sep	14.9	5.2	2.5	31.2	78.0	93.1	15.1		55.1	15.1	78.0	36.1	41.9	41.9	41.9	49.2	8.0	57.2	53.2	409	5,427
Oct	8.3	2.2	1.3	28.5	37.1	77.2	40.2		95.3	40.2	37.1	17.1	19.9	19.9	19.9	34.5	4.0	38.5	35.8	275	3,659
Nov	2.1	0.3	0.3	24.3	7.3	93.0	85.7		100.0	4.8	7.3	3.4	3.9	3.9	84.9	59.7	2.0	61.7	57.4	441	5,859
Dec	-3.9	0.0	0.0	23.1	0.0	68.6	68.6		168.6	0.0		0.0	0.0	0.0	0.0	29.9	0.0	29.9	27.8	213	2,835
Total		**35.1**				**945.9**	**359.6**				**557.8**	**258.0**	**299.8**	**328.4**	**435.9**	**435.2**	**252.0**	**687.2**	**639.1**	**4,911**	**65,248**

Notes: Precipitation and Temperature data from Environment Canada Climate Normals 1981-2010 for Fergus Shand Dam
Monthly water balance strategy as outlined in the document *Instructions and Tables for Computing Potential Evapotranspiration and the Water Balance (Thornthwaite and Mather, 1957)*
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Runoff Factor = [(Impervious Percentage of Site x Average Annual Runoff for Impervious Surfaces) + (Pervious Silt Till Percentage of Site x Average Annual Runoff for Pervious Silt Till Surfaces)] / Total Annual Recharge & Runoff

Grand Valley Business Park
Town of Grand Valley
Date: December 14, 2021

	Pre-Development Conditions	Post-Development Conditions	Difference (Post - Pre)
Recharge			
On Site	95,613	36,072	-62.27%
Runoff			
To Boyne Creek	139,937	373,530	166.93%
To Roadside Ditch on County Road 109	37,630	65,248	73.39%
Total	**177,568**	**438,778**	

Table No. 15 compares the infiltration volumes under pre-development and post-development conditions.

Table No. 15: Comparison of Infiltration Volumes under Pre-Development and Post-Development Conditions

Annual Infiltration Volume		Difference Post-Development to Pre-Development
Pre-Development Conditions	Post-Development Conditions	
95,613 m^3	36,072 m^3	- 59,541 m^3

7. UTILITIES

The hydro servicing design will be completed by others. The location of the streetlights and transformers will be shown on the site servicing drawings at detailed design. The other utilities (Bell, Cable and Gas) will be notified of the development and will complete their designs in conjunction with the hydro company. When available, the design information will be added to the site servicing drawings and grading plan.

8. CONCLUSIONS

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

1. The local storm sewer system on the internal roads will be designed to convey the flow rates from the 5-year design storm event.
2. A 200 mm diameter watermain on all streets will supply the proposed development. Hydrants will be placed at a minimum distance of 100m to provide fire protection.
3. As part of the proposed development, a 250mm diameter sanitary sewer will be extended across Boyne Creek via trenchless technologies from the sanitary sewer stub terminated at the sewage pumping station in the subdivision west of Boyne Creek to the proposed stormwater management facility. The 250mm diameter sanitary sewer will then be extended along the west boundary of the future development lands to Street B, and ultimately to Street A and Street C.

All of which is respectfully submitted.

GM BLUEPLAN ENGINEERING LIMITED
Per:

Angela Kroetsch, P.Eng.

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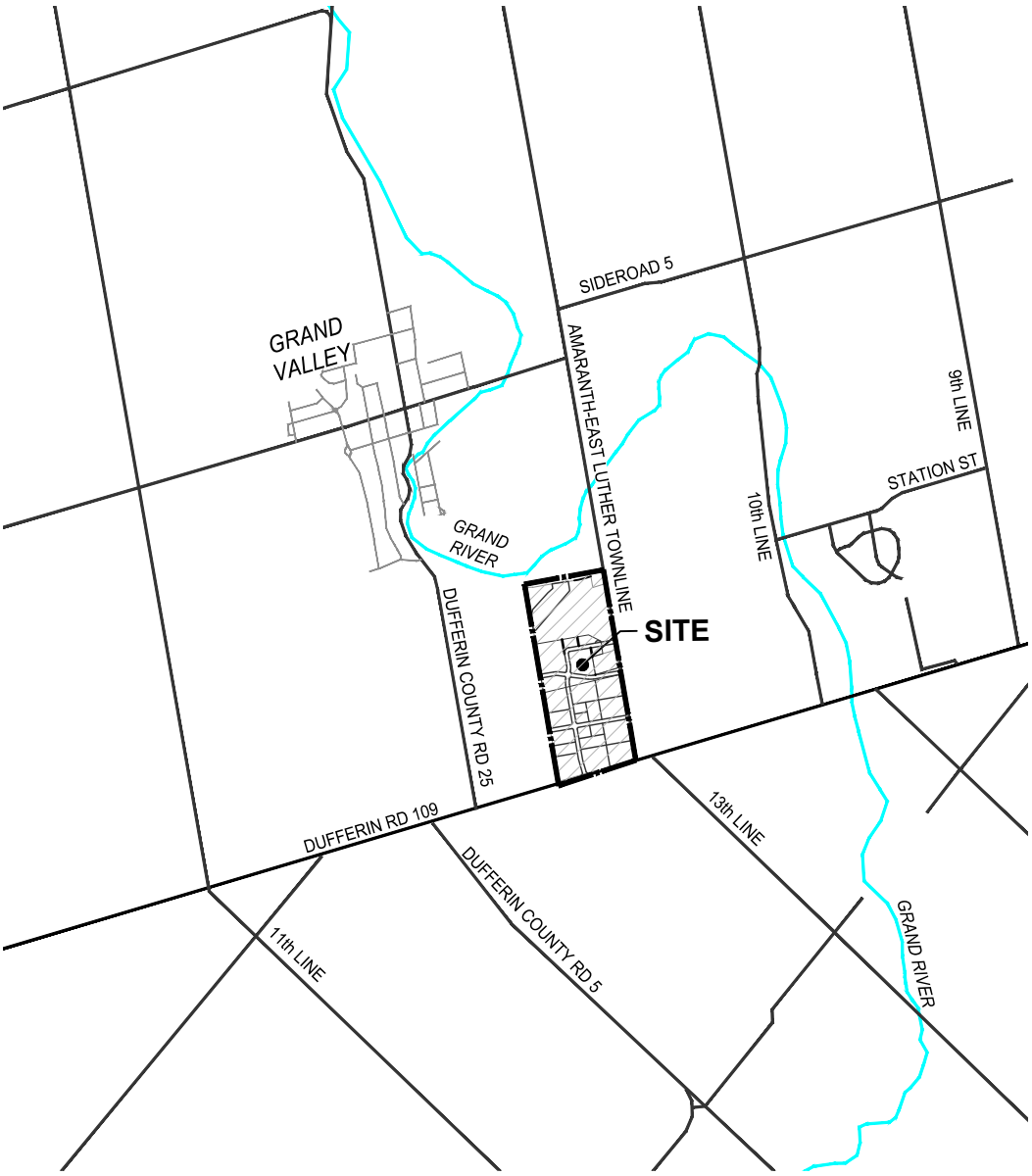
117184
THOMASFIELD INDUSTRIAL LANDS

FUNCTIONAL SERVICING REPORT

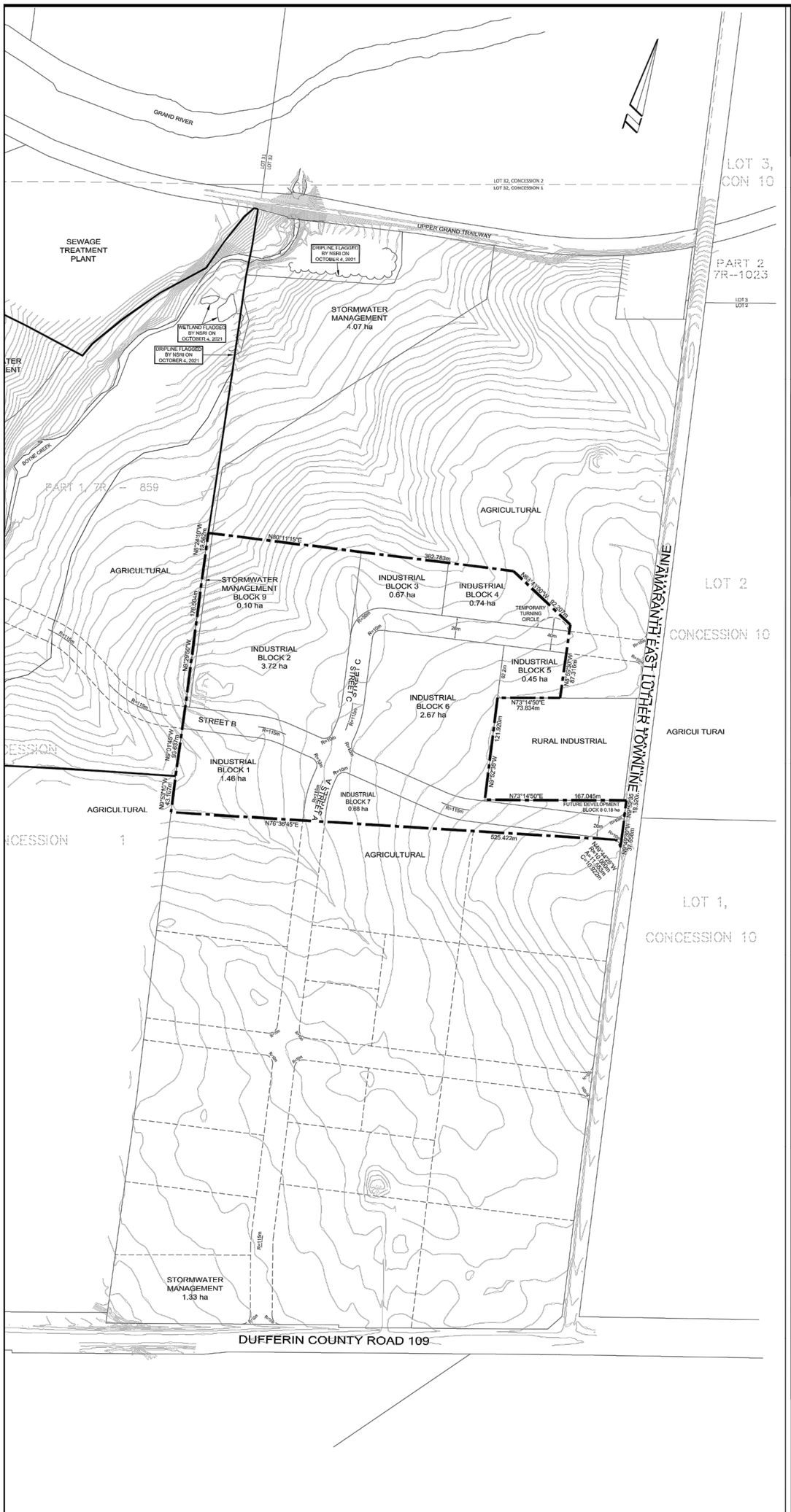


SITE LOCATION

Figure No. 1

BluePlan ENGINEERING

117184
DECEMBER 2021
Scale: 1:50,000 | NAD 1983 UTM Zone 17N



ASTRID J. CLOS
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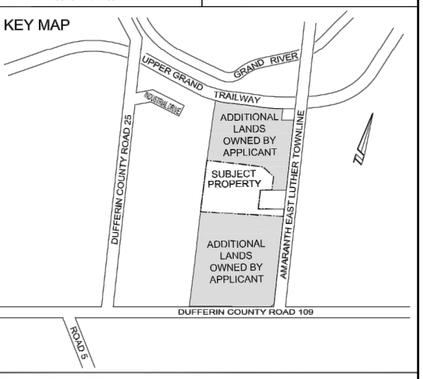
423 Woolwich Street, Suite 201
Guelph , Ontario N1H 3X3
Email: astrid.clos@ajcplanning.ca
Phone: (519) 836-7526 (836-PLAN)

THOMASFIELD HOMES LIMITED
DRAFT PLAN OF SUBDIVISION

DATE: DECEMBER 17, 2021	SCALE 1:2,000
PROJECT No. 2108	DRAWN BY: A.R.N.

KEY MAP



LEGAL DESCRIPTION

PART OF LOT 32, CONCESSION 1 (GEOGRAPHIC TOWNSHIP OF EAST LUTHER) TOWN OF GRAND VALLEY
COUNTY OF DUFFERIN

LAND USE SCHEDULE

DESCRIPTION	BLOCKS	AREA (hectares)
INDUSTRIAL	1-7	10.391
FUTURE DEVELOPMENT	8	0.184
STORMWATER MANAGEMENT	9	0.106
ROADS		2.605
TOTAL	9	13.286

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) silty sand
k) municipal sanitary

OWNER'S CERTIFICATE

I AUTHORIZE ASTRID J. CLOS, PLANNING CONSULTANTS TO PREPARE AND SUBMIT THIS DRAFT PLAN OF SUBDIVISION.

TOM KRZSAN
THOMASFIELD HOMES LIMITED

DECEMBER 21, 2021
DATE

SURVEYOR'S CERTIFICATE

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

JAMES M. LAWS, O.L.S.
VAN HARTEN SURVEYING INC.

DECEMBER 21, 2021
DATE

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117184
THOMASFIELD INDUSTRIAL LANDS
FUNCTIONAL SERVICING REPORT

N

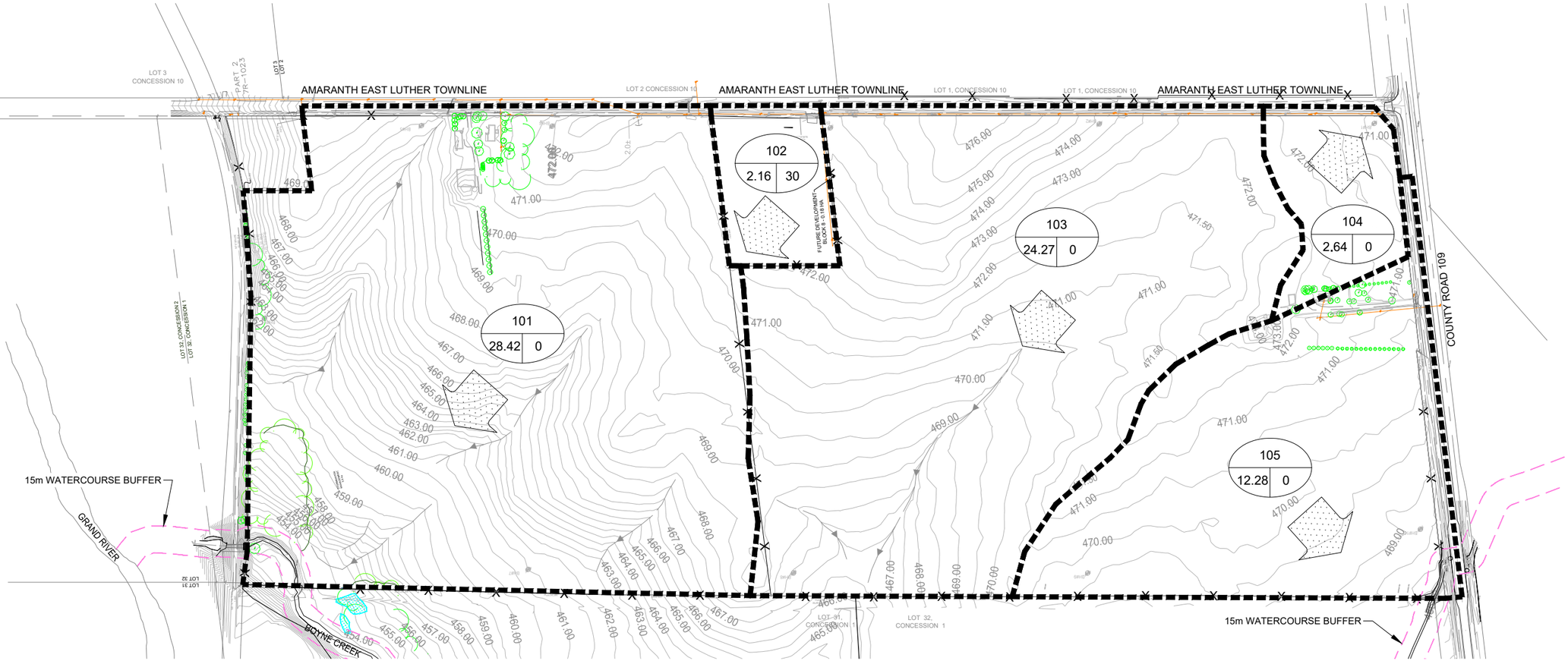
DRAFT PLAN OF SUBDIVISION
Figure No. 2

BluePlan ENGINEERING

117184
DECEMBER 2021
Scale: N.T.S. | NAD 1983 UTM Zone 17N

117184
THOMASFIELD INDUSTRIAL LANDS

FUNCTIONAL SERVICING REPORT



LEGEND

AREA IN HECTARES — 105 / 17.18 | 0 — CATCHMENT NUMBER / PERCENT IMPERVIOUS

CATCHMENT BOUNDARY

75 0 50 100 200
1:5000 (m)

PRE DEVELOPMENT
DRAINAGE PLAN

Figure No. 3

BluePlan ENGINEERING

117184
DECEMBER 2021
Scale: 1:5000 | NAD 1983 UTM Zone 17N

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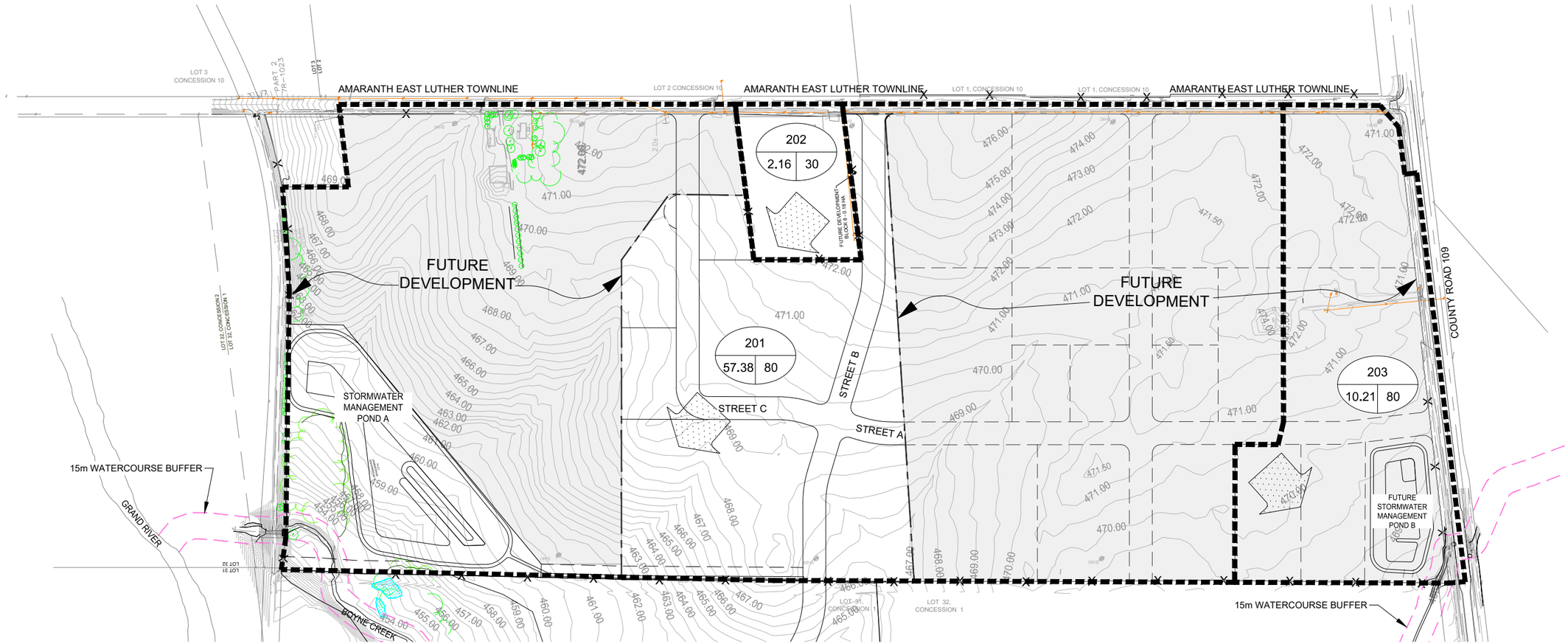
THOMASFIELD INDUSTRIAL LANDS

FUNCTIONAL SERVICING REPORT



LEGEND

AREA IN HECTARES — 105 (CATCHMENT NUMBER) / 17.18 | 73 (PERCENT IMPERVIOUS)

CATCHMENT BOUNDARY

75 0 50 100 200
1:5000 (m)

POST DEVELOPMENT DRAINAGE PLAN

Figure No. 4

BluePlan ENGINEERING

117184
DECEMBER 2021
Scale: 1:5000 | NAD 1983 UTM Zone 17N

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APPENDIX A

Sanitary Sewer Design

q = average daily per capita flow (450 L/cap/d

i = unit of peak extraneous flow (0.20 L/ha/s)

A = Tributary area in gross hectares

M = Peaking factor

Qp = peak population flow (L/s)

Qi = peak extraneous flow (L/s)

Qd = peak design flow (m^3/s)

PPU = 4 people per unit for singles, on-street towns and semi-detached units

SANITARY SEWER DESIGN

GRAND VALLEY BUSINESS PARK

Town of Grand Valley

$M = 1 + \frac{14}{4 + (P)^{1/2}}$ where P is population in 1000's

$Q(p) = \frac{PqM}{86.4}$ (L/s)

Qi = iA

Qd = Qp + Qi + Qc + Qin (m^3/s)

				Residential								Commercial (25 m^3/ha/d)										
Location																Proposed Sewer						
Street	Catchment	From	To	Indiv. Pop'n	Cumul. Pop'n	Area (ha)	Cumul. Area	Calculated Peaking Factor (M)	Actual Peaking Factor (M)	Pop. Flow Qp (L/s)	Res. Infilt. Flow Qi (L/s)	Comm. Area (ha)	Cumul. Area	Comm. Flow Qc (L/s)	Peak Design Flow Q (m^3/s)	Length (m)	Pipe Size (mm)	Type of Pipe	Grade %	Capacity (m^3/s)	Full Flow Velocity (m/s)	Actual velocity at Q(d)
Street A	100	MH18A	MH17A	0	0	0.00	0.00	4.500	4.0	0.00	0.00	9.30	9.30	2.69	**0.003**	95.0	200	0.010	1.00	0.043	1.357	0.312
Street A	101	MH17A	MH16A	0	0	0.00	0.00	4.500	4.0	0.00	0.00	2.70	12.00	3.47	**0.003**	96.4	200	0.010	0.50	0.030	0.960	0.221
Future External Area (SW)	102	Ext Pipe	MH31A	0	0	0.00	0.00	4.500	4.0	0.00	0.00	10.12	10.12	2.93	**0.003**	90.0	200	0.010	0.50	0.030	0.960	0.221
Street D	NA	MH31A	MH30A	0	0	0.00	0.00	4.500	4.0	0.00	0.00	0.00	10.12	2.93	**0.003**	64.8	200	0.010	1.20	0.047	1.487	0.342
Street D	NA	MH30A	MH16A	0	0	0.00	0.00	4.500	4.0	0.00	0.00	0.00	10.12	2.93	**0.003**	94.2	200	0.010	1.18	0.046	1.474	0.339
Street D	103	MH28A	MH27A	0	0	0.00	0.00	4.500	4.0	0.00	0.00	6.41	6.41	1.85	**0.002**	90.0	200	0.010	1.01	0.043	1.364	0.314
Street D	104	MH27A	MH26A	0	0	0.00	0.00	4.500	4.0	0.00	0.00	2.06	8.47	2.45	**0.002**	89.8	200	0.010	1.16	0.046	1.462	0.336
Street D	NA	MH26A	MH16A	0	0	0.00	0.00	4.500	4.0	0.00	0.00	0.00	8.47	2.45	**0.002**	88.7	200	0.010	1.33	0.049	1.565	0.360
Street A	105	MH16A	MH15A	0	0	0.00	0.00	4.500	4.0	0.00	0.00	2.79	33.38	9.66	**0.010**	88.7	200	0.010	1.33	0.049	1.565	0.360
Street A	106	MH15A	MH14A	0	0	0.00	0.00	4.500	4.0	0.00	0.00	3.09	36.47	10.55	**0.011**	100.0	200	0.010	0.50	0.030	0.960	0.221
Street A	107	MH14A	MH13A	0	0	0.00	0.00	4.500	4.0	0.00	0.00	2.69	39.16	11.33	**0.011**	100.3	200	0.010	0.50	0.030	0.960	0.221
Street A	NA	MH13A	MH8A	0	0	0.00	0.00	4.500	4.0	0.00	0.00	0.00	39.16	11.33	**0.011**	51.2	200	0.010	0.50	0.030	0.960	0.221
Street B	108	MH11A	MH10A	0	0	0.00	0.00	4.500	4.0	0.00	0.00	5.56	5.56	1.61	**0.002**	99.5	200	0.010	1.60	0.054	1.717	0.395
Street B	109	MH10A	MH9A	0	0	0.00	0.00	4.500	4.0	0.00	0.00	1.32	6.88	1.99	**0.002**	77.6	200	0.010	1.61	0.054	1.722	0.396
Street B	110	MH9A	MH8A	0	0	0.00	0.00	4.500	4.0	0.00	0.00	1.07	7.95	2.30	**0.002**	76.3	200	0.010	1.50	0.052	1.662	0.382
Street C	111	MH24A	MH23A	0	0	0.00	0.00	4.500	4.0	0.00	0.00	1.51	1.51	0.44	**0.000**	100.0	200	0.010	1.00	0.043	1.357	0.312
Street C	112	MH23A	MH22A	0	0	0.00	0.00	4.500	4.0	0.00	0.00	1.96	3.47	1.00	**0.001**	100.0	200	0.010	0.55	0.032	1.007	0.232
Street C	NA	MH22A	MH21A	0	0	0.00	0.00	4.500	4.0	0.00	0.00	0.00	3.47	1.00	**0.001**	23.2	200	0.010	0.73	0.036	1.160	0.267
Street C	113	MH21A	MH21A	0	0	0.00	0.00	4.500	4.0	0.00	0.00	3.44	6.91	2.00	**0.002**	100.0	200	0.010	0.68	0.035	1.119	0.257
Street C	NA	MH21A	MH8A	0	0	0.00	0.00	4.500	4.0	0.00	0.00	0.00	6.91	2.00	**0.002**	48.8	200	0.010	0.61	0.033	1.060	0.244
Street A	114	MH8A	MH7A	0	0	0.00	0.00	4.500	4.0	0.00	0.00	1.29	55.31	16.00	**0.016**	83.9	200	0.010	0.46	0.029	0.921	0.212
Street A	115	MH7A	MH6A	0	0	0.00	0.00	4.500	4.0	0.00	0.00	1.63	56.94	16.48	**0.016**	100.0	200	0.010	0.53	0.031	0.988	0.227
Future External Area (NW)	116	Ext Pipe	MH6A	0	0	0.00	0.00	4.500	4.0	0.00	0.00	10.80	10.80	3.13	**0.003**	90.0	200	0.010	0.50	0.030	0.960	0.221
Utiity Easement	NA	MH6A	MH5A	0	0	0.00	0.00	4.500	4.0	0.00	0.00	0.00	67.74	19.60	**0.020**	87.6	200	0.010	0.51	0.030	0.969	0.223
Utiity Easement	NA	MH5A	MH4A	0	0	0.00	0.00	4.500	4.0	0.00	0.00	0.00	67.74	19.60	**0.020**	90.0	200	0.010	1.50	0.052	1.662	0.382
Utiity Easement	NA	MH4A	MH3A	0	0	0.00	0.00	4.500	4.0	0.00	0.00	0.00	67.74	19.60	**0.020**	90.0	200	0.010	2.46	0.067	2.129	0.490
Utiity Easement	NA	MH3A	MH2A	0	0	0.00	0.00	4.500	4.0	0.00	0.00	0.00	67.74	19.60	**0.020**	90.0	200	0.010	2.46	0.067	2.129	0.490

q = average daily per capita flow (450 L/cap/d

i = unit of peak extraneous flow (0.20 L/ha/s)

A = Tributary area in gross hectares

M = Peaking factor

Qp = peak population flow (L/s)

Qi = peak extraneous flow (L/s)

Qd = peak design flow (m^3/s)

PPU = 4 people per unit for singles, on-street towns and semi-detached units

SANITARY SEWER DESIGN

GRAND VALLEY BUSINESS PARK

Town of Grand Valley

$M = 1 + \frac{14}{4 + (P)^{1/2}}$ where P is population in 1000's

$Q(p) = \frac{PqM}{86.4}$ (L/s)

Qi = iA

Qd = Qp + Qi + Qc + Qin (m^3/s)

Location				Residential								Commercial (25 m^3/ha/d)				Proposed Sewer						
Street	Catchment	From	To	Indiv. Pop'n	Cumul. Pop'n	Area (ha)	Cumul. Area	Calculated Peaking Factor (M)	Actual Peaking Factor (M)	Pop. Flow Qp (L/s)	Res. Infilt. Flow Qi (L/s)	Comm. Area (ha)	Cumul. Area	Comm. Flow Qc (L/s)	Peak Design Flow Q (m^3/s)	Length (m)	Pipe Size (mm)	Type of Pipe	Grade %	Capacity (m^3/s)	Full Flow Velocity (m/s)	Actual velocity at Q(d)
Future Residential	NA	MH3A	MH2A	100	100	15.69	15.69	4.244	4.0	2.21	3.14	0.00	0.00	0.00	**0.005**	100.0	200	0.010	0.50	0.030	0.960	0.221
Boyne Ck Crossing	NA	MH2A	MH1A	0	100	0.00	15.69	4.244	4.0	2.21	3.14	0.00	67.74	19.60	**0.025**	100.3	200	0.010	4.43	0.090	2.857	0.657
Boyne Ck Crossing	NA	MH1A	Ext Stub	0	100	0.00	15.69	4.244	4.0	2.21	3.14	0.00	67.74	19.60	**0.025**	100.0	200	0.010	0.50	0.030	0.960	0.221

Minimum diameter = 200 mm
Minimum acceptable velocity = 0.6 m/s
Maximum acceptable velocity = 3.0 m/s
Roughness Coefficient for PVC pipe = 0.010

Date:	December 22, 2021	Project:	GRAND VALLEY BUSINESS PARK
Designed By:	RPM	File:	117184
Checked By:	AEK		

APPENDIX B

Storm Sewer Design

Fergus Shand Dam Chicago Storm Parameters

A = 1459.072

B = 13.69

C = 0.85

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

$Q = CiA (m^3/s)$

STORM SEWER DESIGN

5 Year Design

GRAND VALLEY BUSINESS PARK Name

Town of Grand Valley

Street	Catchment	From	To	Area (ha)	Runoff Coefficient	A x C	Cumulative A x C	Time of Conc. (min.)	Intensity (mm/hr)	Flow (m^3/s)	Proposed Sewer						
											Length (m)	Pipe Size (mm)	Type of Pipe	Grade %	Capacity (m^3/s)	Full Flow Velocity (m/s)	Time of Flow (min.)
Future SWM Pond B																	
Street A	200B	MH130	MH131	2.98	0.86	2.98	2.98	10.00	99.01	**0.820**	40.4	750	0.013	1.00	1.113	2.52	0.27
Street A	201B	MH131	MH132	1.62	0.86	1.39	4.37	10.27	98.07	**1.191**	37.1	975	0.013	0.60	1.736	2.33	0.27
Street A to SWM Pond B	203B	MH132	SWM B	1.83	0.86	1.57	5.95	10.53	97.16	**1.605**	36.0	975	0.013	1.00	2.241	3.00	0.20
SWM Pond A																	
Street A	200A	MH 100	MH101	2.63	0.86	2.26	2.26	10.00	99.01	**0.622**	60.0	675	0.013	1.00	0.841	2.35	0.43
Street A	201A	MH101	**MH102**	1.90	0.86	1.63	3.90	10.43	97.53	**1.055**	38.3	900	0.013	0.50	1.280	2.01	0.32
Street D	202A	MH133	MH134	2.26	0.86	1.94	1.94	10.00	99.01	**0.535**	68.5	675	0.013	1.00	0.841	2.35	0.49
Street D	203A	MH134	MH135	1.85	0.86	1.59	3.53	10.49	97.32	**0.956**	71.5	825	0.013	1.10	1.505	2.82	0.42
Street D	204A	MH135	MH136	1.69	0.86	1.45	4.99	10.91	95.89	**1.329**	68.5	900	0.013	1.10	1.899	2.98	0.38
Street D	205A	MH136	MH137	1.23	0.86	1.06	6.05	11.29	94.65	**1.589**	52.3	975	0.013	1.00	2.241	3.00	0.29
Street D	206A	MH137	**MH102**	0.71	0.86	0.61	6.66	11.58	93.72	**1.733**	22.9	1050	0.013	0.90	2.591	2.99	0.13
Street A		**MH102**	MH113	0.00	0.86	0.00	10.55	11.71	93.32	**2.735**	55.9	1350	0.013	0.50	3.774	2.64	0.35
Street A	207A	MH113	MH103	1.00	0.86	0.86	11.41	12.06	92.23	**2.924**	55.8	1500	0.013	0.41	4.526	2.56	0.36
Street A	208A	MH103	MH114	5.52	0.86	4.75	16.16	12.43	91.14	**4.091**	74.7	1500	0.013	0.50	4.998	2.83	0.44
Street A	209A	MH114	MH104	1.44	0.86	1.24	17.40	12.87	89.85	**4.342**	75.3	1650	0.013	0.50	6.445	3.01	0.42
Street A	210A	MH104	MH105	2.75	0.86	2.37	19.76	13.28	88.67	**4.868**	40.6	1650	0.013	0.50	6.445	3.01	0.22
Street A	NA	MH105	MH106	0.00	0.86	0.00	19.76	13.51	88.05	**4.834**	31.2	1650	0.013	0.50	6.445	3.01	0.17
Street A	211A	MH106	**MH107**	0.64	0.86	0.55	20.31	13.68	87.58	**4.942**	17.4	1650	0.013	0.50	6.445	3.01	0.10
Street B	212A	MH108	MH109	1.43	0.86	1.23	1.23	10.00	99.01	**0.338**	64.9	525	0.013	1.71	0.562	2.60	0.42
Street B	213A	MH109	MH110	1.13	0.86	0.97	2.20	10.42	97.56	**0.597**	60.0	600	0.013	1.66	0.791	2.80	0.36
Street B	214A	MH110	MH111	1.46	0.86	1.26	3.46	10.77	96.35	**0.925**	71.3	750	0.013	1.71	1.456	3.30	0.36
Street B	215A	MH111	MH112	1.47	0.86	1.26	4.72	11.13	95.15	**1.248**	65.0	825	0.013	1.60	1.816	3.40	0.32
Street B	216A	MH112	**MH107**	0.48	0.86	0.41	5.13	11.45	94.13	**1.342**	21.1	900	0.013	1.23	2.008	3.16	0.11
Street C	217A	MH115	MH116	1.09	0.86	0.94	0.94	10.00	99.01	**0.258**	65.1	525	0.013	1.00	0.430	1.99	0.55
Street C	218A	MH116	MH117	1.09	0.86	0.94	1.87	10.55	97.11	**0.506**	64.6	750	0.013	0.50	0.787	1.78	0.60
Street C	219A	MH117	MH118	1.15	0.86	0.99	2.86	11.15	95.10	**0.757**	65.4	825	0.013	0.58	1.093	2.05	0.53

Fergus Shand Dam Chicago Storm Parameters

A = 1459.072

B = 13.69

C = 0.85

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

Q = CiA (m^3/s)

STORM SEWER DESIGN

5 Year Design

GRAND VALLEY BUSINESS PARK Name

Town of Grand Valley

Street	Catchment	From	To	Area (ha)	Runoff Coefficient	A x C	Cumulative A x C	Time of Conc. (min.)	Intensity (mm/hr)	Flow (m^3/s)	Proposed Sewer						
											Length (m)	Pipe Size (mm)	Type of Pipe	Grade %	Capacity (m^3/s)	Full Flow Velocity (m/s)	Time of Flow (min.)
Street C	220A	MH118	MH119	1.29	0.86	1.11	3.97	11.68	93.40	**1.031**	56.5	900	0.013	0.70	1.515	2.38	0.40
Street C	NA	MH119	MH120	0.00	0.86	0.00	3.97	12.08	92.18	**1.017**	26.3	900	0.013	0.49	1.267	1.99	0.22
Street C	221A	MH120	MH121	3.16	0.86	2.72	6.69	12.30	91.52	**1.701**	63.3	1050	0.013	0.64	2.185	2.52	0.42
Street C	222A	MH121	MH122	1.68	0.86	1.44	8.14	12.72	90.28	**2.040**	36.5	1200	0.013	0.56	2.918	2.58	0.24
Street C	NA	MH122	MH125	0.00	0.86	0.00	8.14	12.95	89.60	**2.025**	30.0	1200	0.013	0.61	3.045	2.69	0.19
Street C	223A	MH125	**MH107**	0.67	0.86	0.58	8.71	13.14	89.08	**2.156**	20.9	1200	0.013	0.63	3.095	2.74	0.13
Street A		**MH107**	MH123	0.00	0.86	0.00	34.16	13.78	87.32	**8.285**	77.6	1950	0.013	0.50	10.062	3.37	0.38
Street A	224A	MH123	MH126	0.57	0.86	0.49	34.65	14.16	86.29	**8.306**	47.8	1950	0.013	0.78	12.567	4.21	0.19
Street A	225A	MH126	MH124	0.57	0.86	0.49	35.14	14.35	85.80	**8.375**	48.8	1950	0.013	0.96	13.942	4.67	0.17
UTILITY EASEMENT	226A	MH124	MH127	1.44	0.86	1.24	36.38	14.52	85.35	**8.624**	149.3	1950	0.013	1.59	17.943	6.01	0.41
UTILITY EASEMENT	NA	MH127	MH128	0.00	0.86	0.00	36.38	14.94	84.30	**8.518**	125.3	1950	0.013	1.86	19.407	6.50	0.32
UTILITY EASEMENT	NA	MH128	MH129	0.00	0.86	0.00	36.38	15.26	83.50	**8.438**	42.1	1950	0.013	1.30	16.224	5.43	0.13
SWM Pond A	NA	MH129	HW1	0.00	0.86	0.00	36.38	15.39	83.19	**8.406**	57.0	1950	0.013	1.10	14.924	5.00	0.19

Minimum diameter = 250 mm

Minimum acceptable velocity = 0.75 m/s, Maximum acceptable velocity = 4.5 m/s

Date: December 22, 2021

Designed By: RPM

Checked By: AEK

Project: GRAND VALLEY BUSINESS PARK

File: 117184

APPENDIX C
Geotechnical Investigation Report

V.A. WOOD (GUELPH) INCORPORATED
CONSULTING GEOTECHNICAL ENGINEERS

405 YORK ROAD, GUELPH, ONTARIO N1E 3H3
TELEPHONE: 519-763-3101

PRELIMINARY GEOTECHNICAL INVESTIGATION
GRAND VALLEY EMPLOYMENT LANDS
PART OF LOT 32, CONCESSION 1
(GEOGRAPHIC TOWNSHIP OF EAST LUTHER)
TOWN OF GRAND VALLEY, ONTARIO

Ref. No. G4411-21-4
July, 2021

Prepared for:

Thomasfield Homes Ltd.
295 Southgate Drive
Guelph, Ontario

CONTENTS

APPENDIX

ENCLOSURES

1.0 INTRODUCTION:

V. A. Wood (Guelph) Inc. was retained by Thomasfield Homes Ltd. to carry out a preliminary geotechnical investigation for the proposed Grand Valley Employment Lands in the Town of Grand Valley, Ontario.

It is noted details concerning the proposed development were not available at the time of this report.

The purpose of the investigation was to reveal the subsurface conditions and to determine the relevant soil properties for preliminary recommendations concerning the design and construction of the site services, building foundations, pavement areas and storm water management systems.

2.0 FIELD WORK:

The fieldwork was carried out over the period of May 31 to June 1 2021 and consisted of ten (10) boreholes at the locations shown on Enclosure 1. The boreholes were advanced to the sampling depths by means of a track-mounted, power-auger machine equipped for soil sampling. Standard Penetration tests were carried out at frequent intervals of depth and the results are shown on the Borehole Logs as N-values. The subsurface soils were visually inspected, logged and sampled at the borehole locations by a soils technician. All of the boreholes (MWs 1 to 10, inclusive) had monitoring wells installed in them.

The boreholes were laid out by personnel from our Office and GM BluePlan Engineering Ltd. provided the ground elevation at each borehole/monitoring well location.

3.0 SUBSURFACE CONDITIONS:

Full details of the soils encountered in each borehole are given on the Borehole/Monitoring Well Logs, Enclosures 2 to 11, inclusive and the following notes are intended to summarize this data.

*The boreholes encountered a surficial deposit of **topsoil** ranging between 200m and 760mm thick.*

*The topsoil at Boreholes 1 to 3, inclusive was underlain by deposits **fill** to depths ranging between 0.8 and 1.6 metres below grade. These materials generally consisted of clayey silt, sandy silt and/or silty sand matrices. A Standard Penetration test in the fill gave an N-values of 2 blows/300mm and the natural moisture content was found to be about 21%.*

Based on visual and tactile examination, the deposits of fill are considered to be in a generally loose condition.

*The topsoil at Borehole 4 was underlain by a deposit of brown **silty sand** to a depth of 1.5 metres below grade. A Standard Penetration test in this deposit gave an N-value of 20 blows/300mm and the natural moisture content was found to be about 17%.*

Based on visual and tactile examination, the deposit of silty sand is considered to have a generally compact relative density.

*The fill at Borehole 3 and topsoil at Boreholes 6 to 10, inclusive were underlain by a deposit of brown **sandy silt till** to depths ranging between 1.2 and 3.0 metres below grade and the full depth of the investigation (i.e. 6.4 metres below grade). Standard Penetration tests in this deposit gave N-values ranging between 9 and greater than 100 blows/300mm and the natural moisture content was found to range from 7 to 19%. Pocket penetrometer tests indicated it has an undrained shear strength varying from 300 to 450 kPa. A typical grain size distribution curve for this material can be found on Enclosure 12.*

Based on visual and tactile examination, the deposit of sandy silt till is considered to have a generally loose to very dense relative density, although It is noted that the presence of gravel, cobbles and boulders in this deposit may have resulted in high N-values and these may not accurately represent the relative density of the soil.

*The sandy silt till at Borehole 3 was underlain by a deposit of brown **silt and sand till** to the full depth of the investigation (i.e. 6.4 to 6.7 metres below grade). Standard Penetration tests in this deposit gave N-values of greater than 100 blows/300mm and the natural moisture content was found be about 5%. A typical grain size distribution curve for this material can be found on Enclosure 13.*

Based on visual and tactile examination, the deposit of silt and sand till is considered to have a generally very dense relative density, although It is noted that the presence of gravel, cobbles and boulders in this deposit may have resulted in high N-values and these may not accurately represent the relative density of the soil.

*The topsoil at Boreholes 1, fill at Boreholes 2 and 5, silty sand at Borehole 4, and sandy silt till at Boreholes 7 to 10, inclusive were underlain by a deposit of grey **clayey silt till** to the full depth of the investigation (i.e. 5.2 metres below grade). Standard Penetration tests in this deposit gave N-values ranging between 8 and greater than 100 blows/300mm and the natural moisture content was found to range from 12 to 57%. Pocket penetrometer tests indicated it has an undrained shear strength varying from 200 to 450 kPa. Typical grain size distribution curves for this material can be found on Enclosures 14 to 15, inclusive.*

Based on visual and tactile examination, the deposit of clayey silt till is considered to have a generally medium to hard consistency, although It is noted that the presence of gravel, cobbles and boulders in this deposit may have resulted in high N-values and these may not accurately represent the relative density of the soil.

4.0 GROUNDWATER CONDITIONS:

Boreholes 1 to 3 encountered free water surfaces at elevations ranging between 393.3m± and 395.5m± (i.e. 1.4± to 4.0± metres below grade). Boreholes 1 and 3 encountered cave-in at depths of 5.5± and 4.3± metres below grade, respectively.

Monitoring wells were installed in all the boreholes and groundwater levels were recorded at the elevations noted in the chart below.

Borehole No.	Monitoring Well No.	Ground Elev. (m)[1]	June 3, 2021[2]		July 7/9, 2021[1]	
			Depth Below Existing Grade (m±)	Water Level El. (m±)	Depth Below Existing Grade (m±)	Water Level El. (m±)
1	100	407.842	DRY	-	0.835	470.007
2	101	473.826	2.5	471.3	1.952	471.874
3	102	474.308	4.2	470.7	1.183	473.125
4	103	471.872	2.0	469.9	2.199	469.673
5	104	468.534	DRY	-	DRY	-
6	105	462.424	DRY	-	DRY	-
7	106	461.486	2.2	459.3	2.343	459.143
8	107	467.361	DRY	-	4.556	462.805
9	108	469.767	1.3	468.5	2.164	467.603
10	109	468.691	1.1	467.6	1.279	467.412

[1] *Provided by GM BluePlan Engineering Ltd.*
[2] *Measured by V.A. Wood (Guelph) Inc.*

An examination of the soil samples indicated that they were generally wet to saturated.

It is noted that no sub-artesian water pressures were encountered in any of the boreholes.

A colour change from brown to grey was noted in the samples in Monitoring Well 1 at El. 392.7m± (i.e. 4.6± metres below grade).

Based on the foregoing, the groundwater table is considered to be located at depths ranging between 459.1m± and 473.1m±, although a perched groundwater table can be expected in the upper zones underlain by the less permeable till.

5.0 DISCUSSION AND RECOMMENDATIONS:

5.1 General:

The boreholes generally encountered surficial deposits of topsoil underlain by loose fill on loose to compact sandy silt, silty sand and/or silt and sand tills on medium to hard clayey silt till.

The general grading of the lands fall in a northerly/northwesterly direction towards the Grand River with the groundwater table generally following the same gradient with the groundwater table ranging from 459.1m± to 473.1m±, although a perched groundwater table can be expected in the upper zones underlain by the less permeable tills.

Details concerning the proposed development were not available at the time of this report and the following discussion is therefore considered preliminary. It should be reviewed when more details are available.

5.2 Sewers:

Assuming that the sewer inverts will be located at depths ranging between 3 and 4 metres below the existing grades, reference to the Borehole Logs indicates that the subgrade will generally consist of competent deposits of glacial till which will generally provide adequate support for the pipes and allow the use of normal Class 'B' bedding using Granular 'A' material. Clear crushed stone should not be used as bedding as fines may migrate into the voids of the stone and cause undesirable settlements. Where the exposed subgrade is less competent than the materials identified in the Borehole Logs, the bedding thickness may have to be increased and it may be necessary to protect the excavation with a skim coat of concrete immediately after it has been exposed.

Where sewer trench grades are more than 600mm below the groundwater table, well-points or closed sheeting may be required. The sides of the excavation to a depth of more than 1.2 metres (and above the water table) should either be cut back at a side slope of 1 to 1 or supported using adequately braced closed sheeting.

The excavated materials will be generally suitable for use as trench backfill provided that they are free of topsoil and boulders. If the on-site materials become wet, they should be air dried prior to re-use as trench backfill. The trench backfill should be placed in 150 to 200mm thick layers and uniformly compacted to at least 95% of its Standard Proctor maximum dry density.

The backfill around manholes should consist of well-graded and well-compacted granular material.

To minimize potential problems and wetting of the subgrade material, backfilling operations should follow closely after excavations, so that only a minimal length of trench is exposed at a time. Should construction be carried out in the winter season, particular attention should be given to make sure no frozen material is used for backfill.

5.3 Foundations:

The boreholes encountered deposits of topsoil, fill and loose upper soils which are not considered to be a suitable bearing stratum. Therefore, the foundations for the proposed structures should extend to below the surface of underlying native soils. It is anticipated that an adequate stratum for building foundations will be located at the elevations indicated in the following chart:

Borehole No.	Borehole Ground Elev. (m±)	Bearing Stratum	Suitable Bearing Stratum Elev. (m±)	Depth to Suitable Bearing Stratum (m±)	Allowable Bearing Pressure (kPa)
1	470.8	Clayey Silt Till	469.2	1.6	200
2	473.8	Clayey Silt Till	473.0	0.9	200
3	474.3	Sandy Silt Till	473.4	0.9	200
4	471.9	Silty Sand	471.4	0.5	150
5	468.5	Clayey Silt Till	467.8	0.8	200
6	462.4	Sandy Silt Till	461.5	0.9	200
7	461.5	Clayey Silt Till	460.6	0.9	200
8	467.4	Sandy Silt Till	466.5	0.9	200
9	469.8	Sandy Silt Till	468.3	1.5	200
10	468.7	Sandy Silt Till	467.8	0.9	200

If basements are constructed, the basement floors should be located at least 0.5 metres above the observed high groundwater levels otherwise sub-floor drainage systems together with continual pumping from the drainage systems will be required.

As well, some consideration should be given to waterproofing the basement walls if located within 0.5m of the groundwater table.

If there are requirements for cut and fill grading, the foundation grade could be raised using "engineered fill", which would be suitable for supporting normal spread footings designed to an allowable bearing pressure of up to 150 kPa S.L.S./225 kPa U.L.S.

The procedure for "engineered fill" construction would consist of the following:

1. *The total removal of topsoil, fill and loose native materials from beneath the proposed development envelopes.*

2. *Geotechnical personnel from V.A. Wood (Guelph) Inc. prior to placement of "engineered fill" should inspect the exposed subgrade. Any loose or soft zones which are encountered should be removed and replaced with approved on-site or approved imported granular material, compacted to at least 98% Standard Proctor maximum dry density.*

3. *The areas should then be brought up to the final subgrade level with approved on-site or approved imported granular material placed in maximum 200mm thick lifts and compacted to at least 98% Standard Proctor maximum dry density.*

4. *The "engineered fill" under all structures to be supported should extend to at least 0.6 metres laterally beyond the edge of their perimeter at the founding level and at least a distance equal to the depths of the fill pad, at the level of the approved subgrade.*

The "engineered fill" should be in place at least one month prior to loading it to minimize settlement.

This "engineered fill" will satisfy the raising of the founding levels to the proposed grades and provide a suitable subgrade for the proposed structures.

All exterior house footings or footings in unheated areas should be located at least 1.2 metres below finished grade for adequate frost protection.

Elevation differences between adjacent footings should not be more than a half of the horizontal distance between them.

It is estimated that the total and differential settlements of the footings designed to the above stated bearing pressures will be less than 25 and 20mm respectively, which are normally considered to be acceptable for the proposed structures.

It is recommended that all foundation excavations be inspected by geotechnical personnel from V.A. Wood (Guelph) Inc. to ensure that the founding soils are similar to those identified in the Borehole Logs and that the founding soils are capable of supporting the design loads.

5.4 Excavation and Groundwater Control:

No major construction problems due to water are anticipated with excavations above El. 471.3m±. However, provision should be made for the control of any surface water run-off and minor seepage from any wet sand seams by pumping from local sumps on an as and where required basis. If, however, excavations are extended below the groundwater table, then provisions may be required to lower the groundwater table through more extensive pumping from local sumps as and where required or through the use of well-points.

Excavations to a depth of more than 1.2 metres below grade should be cut back to a side slope of 1 to 1 or, supported using adequately braced sheeting.

Sub-drains will probably be required for basements less than 0.5m above the water table.

5.5 Floor Slabs:

All topsoil and any deleterious materials encountered should be stripped from the building areas and the proposed subgrade should be re-compacted from the surface to at least 98% of its Standard Proctor maximum dry density. Any loose/wet material encountered should be sub-excavated and replaced with approved fill.

The fill may consist of approved on-site materials free of cobbles/boulders or approved imported fill. All fill materials should be placed in 150 to 200mm thick lifts and compacted to at least 98% of its Standard Proctor maximum dry density. It is recommended the underfloor fill be placed at least one month prior to floor construction in order to minimize settlement.

A layer of well-graded, free-draining material, at least 150mm thick and compacted to 100% of it Standard Proctor maximum dry density, should be placed under the floor slabs to provide a uniform bearing surface and to act as a vapour barrier.

Frequent inspections by geotechnical personnel from V.A. Wood (Guelph) Inc. should be carried out during construction to verify compaction of the subgrade and base courses by in-situ density testing using nuclear gauges.

5.6 Storm Water Management:

The grain size distribution curves prepared for the representative soil samples obtained at the boreholes were compared to the family of curves presented in the Supplementary Standard SB-6 of the 2012 Building Code Compendium. Based on the Unified Soils Classification System, the soils are considered to have the following properties:

Material	*Unified Soils Classification Group*	*Estimated Co-efficient of Permeability (k) (cm/sec)*
Sandy Silt Till	*(CL-ML)*	10^{-5} - $<10^{-6}$
Silt and Sand Till	*(CL-ML)*	10^{-3} - $<10^{-6}$
Clayey Silt Till	*(CL)*	$<10^{-6}$

5.7 Pavement Designs:

All topsoil and any deleterious materials encountered should be stripped from the paved areas. The proposed subgrade should then be re-compacted from the surface to at least 98% of its Standard Proctor maximum dry density prior to the road construction. Any loose areas which are detected should be sub-excavated and backfilled with suitable on-site material or approved imported fill. All fill should be placed in 150 to 200mm thick lifts and compacted to at least 98% of its Standard Proctor maximum dry density.

It is understood that the Town of Grand Valley Pavement Designs are as follows:

Material	*Minimum Depths (mm)*	
	Local Streets	*Collector Roads*
HL-3 Surface Course Asphalt	*40*	*50*
HL-8 Base Course Asphalt	*50*	*60*
Granular 'A' Base Course	*150*	*150*
Granular 'B' Sub-base Course	*450*	*600*

The base and sub-base granular materials should be compacted to at least 100% Standard Proctor maximum dry density. The asphalt should be compacted to OPS Specifications.

Frequent inspections by geotechnical personnel from V. A. Wood (Guelph) Inc. should be carried out during construction to verify the compaction of the subgrade, base courses and asphaltic concrete by in-situ density testing using nuclear gauges.

7.0 STATEMENT OF LIMITATIONS:

The Statement of Limitations presented on Appendix 'A' is an integral part of this report.

V. A. WOOD (GUELPH) INC.

J. Broad, B.A.
President & General Manager

V. Wood, M.Eng., P. Eng.
Geotechnical Engineer

JB:sm

Encls.

APPENDIX

STATEMENT OF LIMITATIONS:

The conclusions and recommendations in this report are based on information determined at the borehole locations and on geological data of a general nature, which may be available, for the area investigated. Soil and groundwater conditions between and beyond the boreholes may differ from those encountered at the borehole locations and conditions may become apparent during construction, which would not be detected or anticipated at the time of the soil investigation.

We recommend that we be retained to ensure that all necessary stripping, subgrade preparation and compaction requirements are met, and to confirm that the soil conditions do not deviate materially from those encountered in the boreholes. ***In cases where this recommendation is not followed the company's responsibility is limited to interpreting accurately the information encountered at the boreholes.***

This report is applicable only to the project described in the introduction, constructed substantially in accordance with details of alignment and elevations quoted in the text.

This report was prepared by V. A. Wood (Guelph) Inc. for Thomasfield Homes Ltd. The material in it reflects V.A. Wood (Guelph) Inc. judgment in light of the information available to it at the time of preparation. Any use which a Third Party makes of this report, or any reliance on decisions to be made based on it, is the responsibility of such Third Parties. V. A. Wood (Guelph) Inc. accepts no responsibility for damages, if any, suffered by any Third Party as a result of decisions made or actions based on this report.

ENCLOSURES

Notes:

1. Borehole ground elevations supplied by GM BluePlan Engineering Ltd.

2. The stratigraphy referred to in the report is based on the data from the boreholes supplemented by geological data where available. The actual stratigraphy between and beyond the boreholes may vary. The topsoil thicknesses quoted in the report are used for discussion purposes only and should not be used for estimating purposes.

V.A. WOOD (GUELPH) INC.
Consulting Geotechnical Engineers
405 York Road, Guelph, Ontario N1E 3H3
Ph. (519) 763-3101 Fax. (519) 763-5912

Borehole Location Plan
Grand Valley Employment Lands
Pt of Lot 32, Amaranth East Luther Townline
Town of Grand Valley, Ontario

Scale: As Noted	Ref. No. G4411-21-5
Date: May 25, 2021	Enclosure 1

REFERENCE No: G4411-21-5

BOREHOLE No: 1

V.A. WOOD (GUELPH) INC.
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CLIENT: Thomasfield Homes Ltd.

PROJECT: Grand Valley Employment Lands

ENCLOSURE No: 1

LOCATION: Pt. Lot 32, Con 1, Grand Valley, ON

SUPERVISOR: MO

SUBSURFACE PROFILE					SAMPLE					
DEPTH (m)	DESCRIPTION	ELEVATION	SYMBOL	MONITORING	NUMBER	TYPE	N-VALUE	PENETRATION RESISTANCE 20 40 60 80	WATER CONTENT % 5 10 15 20 25	UNIT WEIGHT
0.0	Ground Surface	470.8		Well Casing Protector						
	760mm Topsoil			Concrete						
0.8		470.1								
	mottled grey/brown, very loose Clayey Silt FILL moist			Soil Cuttings	1	SS	2			
1.6		469.2		DRY (3-JUNE-2021)						
	mottled grey/brown, stiff to hard CLAYEY SILT TILL trace sand, trace gravel moist				2	SS	13			
				PVC Pipe						
					3	AS	25			
	Grey @ 2.3m									
				Bentonite	4	SS	20			
				Well Sand						
					5	AS	36			
				PVC Screen						
					6	SS	25			
6.7		464.1								
	End of Borehole									

DRILLED BY: London Soil Test Ltd.

HOLE DIAMETER: 200mm

DRILL METHOD: Hollow Stem Auger

DATUM: Geodetic

DRILL DATE: May 31, 2021

SHEET: 1 of 1

REFERENCE No: G4411-21-5

CLIENT: Thomasfield Homes Ltd.

PROJECT: Grand Valley Employment Lands

LOCATION: Pt. Lot 32, Con 1, Grand Valley, ON

BOREHOLE No: 2

ENCLOSURE No: 3

SUPERVISOR: MO

V.A. WOOD (GUELPH) INC.
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SUBSURFACE PROFILE					SAMPLE			PENETRATION RESISTANCE	WATER CONTENT %	
DEPTH (m)	DESCRIPTION	ELEVATION	SYMBOL	MONITORING	NUMBER	TYPE	N-VALUE	20 40 60 80	5 10 15 20 25	UNIT WEIGHT
0.0	Ground Surface	473.8								
0.3	250mm Topsoil	473.6								
0.9	brown, compact Sandy Silt FILL some gravel moist	473.0								
	grey, very stiff to hard CLAYEY SILT TILL trace sand, trace gravel, moist			Concrete; Well Casing Protector; Soil Cuttings; PVC Pipe; W.L. @ El. 471.3m (3-JUN-2021); Bentonite; Well Sand; PVC Screen	1	SS	20			
					2	SS	18			
					3	AS	23			
					4	SS	27			
					5	AS	51			
					6	SS	55			
6.7	End of Borehole	467.1								

DRILLED BY: London Soil Test Ltd.

DRILL METHOD: Solid Stem Auger

DRILL DATE: May 31, 2021

HOLE DIAMETER: 200mm

DATUM: Geodetic

SHEET: 1of 1l

REFERENCE No: G4411-21-5

BOREHOLE No: 3

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CLIENT: Thomasfield Homes Ltd

PROJECT: Grand Valley Employment Lands

ENCLOSURE No: 4

LOCATION: Pt. Lot 32, Con 1, Grand Valley, ON

SUPERVISOR: MO

SUBSURFACE PROFILE					SAMPLE					
DEPTH (m)	DESCRIPTION	ELEVATION	SYMBOL	MONITORING	NUMBER	TYPE	N-VALUE	PENETRATION RESISTANCE 20 40 60 80	WATER CONTENT % 5 10 15 20 25	UNIT WEIGHT
0.0	Ground Surface	474.3								
0.3	250mm Topsoil	474.1								
0.8	mottled grey/brown, compact Sandy Silt FILL moist	473.5								
3.0	brown, compact to very dense SANDY SILT TILL some gravel, some clay moist	471.3			1	SS	17	Rock		
					2	SS	42	Rock		
					3	AS	50	Rock		
					4	SS	50	Rock		
5.2	brown, very dense SILT AND SAND TILL some clay, trace gravel, occ. cobbles and/or boulders, moist	469.1			5	SS	50	Rock		
	End of Borehole									

Concrete
Bentonite
Well Sand
PVC Screen
PVC Pipe
Soil Cuttings
Well Casing Protector
W.L @ El. 470.7m (3-JUN-2021)

DRILLED BY: London Soil Test Ltd.

DRILL METHOD: Solid Stem Auger

DRILL DATE: May 31, 2021

HOLE DIAMETER: 200mm

DATUM: Geodetic

SHEET: 1 of 1

REFERENCE No: G4411-21-5

BOREHOLE No: 4

V.A. WOOD (GUELPH) INC.
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CLIENT: Thomasfield Homes Ltd.

PROJECT: Grand Valley Employment Lands

ENCLOSURE No: 5

LOCATION: Pt. Lot 32, Con 1, Grand Valley, ON

SUPERVISOR: MO

SUBSURFACE PROFILE					SAMPLE					
DEPTH (m)	DESCRIPTION	ELEVATION	SYMBOL	MONITORING	NUMBER	TYPE	N-VALUE	PENETRATION RESISTANCE 20 40 60 80	WATER CONTENT % 5 10 15 20 25	UNIT WEIGHT
0.0	Ground Surface	471.9		Well Casing Protector						
0.5	500mm Topsoil	471.4		Concrete						
1.5	brown, compact SILTY SAND moist	470.4		Soil Cuttings	1	SS	20	○	●	
	grey/brown, very stiff to hard CLAYEY SILT TILL trace sand, trace gravel, occ.cobbles and/or boulders moist			W.L. @ El. 469.9m (3-JUN-2021)	2	SS	22	○		
				Bentonite	3	SS	30	○	●	
				PVC Pipe	4	SS/AS	24	○		
				PVC Screen	5	SS	18	○	●	
6.4		465.5		Well Sand	6	SS	50	○ Rock		
	End of Borehole									

DRILLED BY: London Soil Test Ltd.

HOLE DIAMETER: 200mm

DRILL METHOD: Solid Stem Auger

DATUM: Geodetic

DRILL DATE: May 31, 2021

SHEET: 1 of 1

REFERENCE No: G4411-21-5

CLIENT: Thomasfield Homes Ltd.

PROJECT: Grand Valley Employment Lands

LOCATION: Pt. Lot 32, Con 1, Grand Valley, ON

BOREHOLE No: 5

ENCLOSURE No: 6

SUPERVISOR: MO

V.A. WOOD (GUELPH) INC.
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SUBSURFACE PROFILE					SAMPLE			PENETRATION RESISTANCE	WATER CONTENT %	UNIT WEIGHT
DEPTH (m)	DESCRIPTION	ELEVATION	SYMBOL	MONITORING	NUMBER	TYPE	N-VALUE	20 40 60 80	5 10 15 20 25	
0.0	Ground Surface	468.5								
0.2	200mm Topsoil	468.3								
0.8	brown, compact Silty Sand and Gravel FILL moist	467.8								
	mottled brown/grey, stiff to hard CLAYEY SILT TILL trace sand, trace gravel, occ. cobbles and/or boulders moist				1	SS	11			
					2	SS	21			
					3	SS	27			
					4	SS	30			
					5	SS	12			
					6	SS	52			
6.4	End of Borehole	462.1								

MONITORING: Concrete; Bentonite; PVC Screen; Well Sand; PVC Pipe; Soil Cuttings; Well Casing Protector; DRY (3-JUNE-2021)

DRILLED BY: London Soil Test Ltd.

DRILL METHOD: Solid Stem Auger

DRILL DATE: May 31, 2021

HOLE DIAMETER: 200mm

DATUM: Geodetic

SHEET: 1 of 1

REFERENCE No: G4411-21-5

CLIENT: Thomasfield Homes Ltd.

PROJECT: Grand Valley Employment Lands

LOCATION: Pt. Lot 32, Con 1, Grand Valley, ON

BOREHOLE No: 6

ENCLOSURE No: 7

SUPERVISOR: MO

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SUBSURFACE PROFILE					SAMPLE			PENETRATION RESISTANCE	WATER CONTENT %	UNIT WEIGHT
DEPTH (m)	DESCRIPTION	ELEVATION	SYMBOL	MONITORING	NUMBER	TYPE	N-VALUE	20 40 60 80	5 10 15 20 25	
0.0	Ground Surface	462.4		Well Protector						
0.4	400mm Topsoil	462.0		Concrete						
1.5	brown, loose to very dense, SANDY SILT TILL some gravel, some clay, occ. cobbles and/or boulders moist	460.9		Soil Cuttings	1	SS	11			
2.3	moist to saturated	460.1		PVC Pipe DRY (3-JUNE-2021)	2	SS	8			
6.4	moist	456.0		Bentonite Well Sand PVC Screen	3	SS	27			
					4	SS	24			
					5	SS	52			
	End of Borehole				6	SS	50	100mm		

DRILLED BY: London Soil Test Ltd.

DRILL METHOD: Solid Stem Auger

DRILL DATE: June 1, 2021

HOLE DIAMETER: 200mm

DATUM: Geodetic

SHEET: 1 of 1

REFERENCE No: G4411-21-5

CLIENT: Thomasfield Homes Ltd.

PROJECT: Grand Valley Employment Lands

LOCATION: Pt. Lot 32, Con 1, Grand Valley, ON

BOREHOLE No: 7

ENCLOSURE No: 8

SUPERVISOR: MO

V.A. WOOD (GUELPH) INC.
CONSULTING GEOTECHNICAL ENGINEERS

405 YORK ROAD, GUELPH, ONTARIO N1E 3H3
PH. (519) 763-3101 FAX (519) 763-5912

DEPTH (m)	DESCRIPTION	ELEVATION	SYMBOL	MONITORING	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE N-VALUE	PENETRATION RESISTANCE 20 40 60 80	WATER CONTENT % 5 10 15 20 25	UNIT WEIGHT
0.0	Ground Surface	461.5		Protective Cover						
0.5	500mm Topsoil	461.0		Concrete						
1.2	brown, compact, SANDY SILT TILL some gravel, some clay, moist to saturated	460.3		Soil Cuttings	1	SS	20			
3.0	brown, very stiff to hard CLAYEY SILT TILL trace sand, trace gravel, moist	458.4		W.L. @ El. 459.3 (3-JUNE-2021) Bentonite PVC Pipe	2 3	SS SS	23 31			
4.6	saturated to wet	456.9		Well Sand	4	SS	13			
6.5	grey, wet	454.9		PVC screen	5 6	SS SS	8 10			
	End of Borehole									

DRILLED BY: London Soil Test Ltd.

DRILL METHOD: Solid Stem Auger

DRILL DATE: June 1, 2021

HOLE DIAMETER: 200mm

DATUM: Geodetic

SHEET: 1 of 1

REFERENCE No: G4411-21-5

CLIENT: Thomasfield Homes Ltd.

PROJECT: Grand Valley Employment Lands

LOCATION: Pt. Lot 32, Con 1, Grand Valley, ON

BOREHOLE No: 8

ENCLOSURE No: 9

SUPERVISOR: MO

V.A. WOOD (GUELPH) INC.
CONSULTING GEOTECHNICAL ENGINEERS

405 YORK ROAD, GUELPH, ONTARIO N1E 3H3
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SUBSURFACE PROFILE					SAMPLE			PENETRATION RESISTANCE	WATER CONTENT %	
DEPTH (m)	DESCRIPTION	ELEVATION	SYMBOL	MONITORING	NUMBER	TYPE	N-VALUE	20 40 60 80	5 10 15 20 25	UNIT WEIGHT
0.0	Ground Surface	467.4								
0.5	500mm topsoil	466.9								
	brown, compact SANDY SILT TILL some gravel, some clay, moist				1	SS	16			
					2	SS	11			
					3	SS	28			
3.0		464.3								
	grey, stiff to very stiff CLAYEY SILT TILL trace sand, trace gravel, moist				4	SS	24			
					5	SS	30			
6.5		460.8			6	SS	14			
	End of Borehole									

Protective Cover
Concrete
DRY (3-JUNE-2021)
Soil Cuttings
Bentonite
PVC pipe
PVC screen
Well Sand

DRILLED BY: London Soil Test Ltd.

DRILL METHOD: Solid Stem Auger

DRILL DATE: June 1, 2021

HOLE DIAMETER: 200mm

DATUM: Geodetic

SHEET: 1 of 1

REFERENCE No: G4411-21-5

CLIENT: Thomasfield Homes Ltd.

PROJECT: Grand Valley Employment Lands

LOCATION: Pt. Lot 32, Con 1, Grand Valley, ON

BOREHOLE No: 9

ENCLOSURE No: 10

SUPERVISOR: MO

V.A. WOOD (GUELPH) INC.
CONSULTING GEOTECHNICAL ENGINEERS

405 YORK ROAD, GUELPH, ONTARIO N1E 3H3
PH. (519) 763-3101 FAX (519) 763-5912

SUBSURFACE PROFILE					SAMPLE			PENETRATION RESISTANCE	WATER CONTENT %	UNIT WEIGHT
DEPTH (m)	DESCRIPTION	ELEVATION	SYMBOL	MONITORING	NUMBER	TYPE	N-VALUE	20 40 60 80	5 10 15 20 25	
0.0	Ground Surface	469.8		Concrete; Well Protector; W.L. @ El. 468.5m (3-JUN-2021)						
0.5	500mm Topsoil	469.3								
	brown, loose to compact, SANDY SILT TILL some gravel, some clay, moist			Soil Cuttings; Bentonite; PVC Pipe	1	SS	9			
					2	SS	18			
3.0		466.7			3	SS	22			
	grey, very stiff to hard, CLAYEY SILT TILL trace sand, trace gravel, saturated to wet			Well Sand; PVC Screen	4	SS	32			
					5	SS	23			
6.5		463.2			6	SS	16			
	End of Borehole									

DRILLED BY: London Soil Test Ltd.

DRILL METHOD: Solid Stem Auger

DRILL DATE: June 1, 2021

HOLE DIAMETER: 200mm

DATUM: Geodetic

SHEET: 1 of 1

REFERENCE No: G4411-21-5

CLIENT: Thomasfield Homes Ltd.

PROJECT: Grand Valley Employment Lands

LOCATION: Pt. Lot 32, Con 1, Grand Valley, ON

BOREHOLE No: 10

ENCLOSURE No: 11

SUPERVISOR: MO

V.A. WOOD (GUELPH) INC.
CONSULTING GEOTECHNICAL ENGINEERS

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PH. (519) 763-3101 FAX (519) 763-5912

SUBSURFACE PROFILE					SAMPLE			PENETRATION RESISTANCE	WATER CONTENT %	UNIT WEIGHT
DEPTH (m)	DESCRIPTION	ELEVATION	SYMBOL	MONITORING	NUMBER	TYPE	N-VALUE	20 40 60 80	5 10 15 20 25	
0.0	Ground Surface	468.7		Concrete; Well Protector; W.L. @ El. 467.6m (3-JUN-2021)						
0.5	500mm Topsoil	468.2								
	brown, compact, SANDY SILT TILL some gravel, some clay moist			Bentonite; Soil Cuttings; PVC Pipe	1	SS	18			
					2	SS	23			
2.3		466.4								
	grey, very stiff to hard CLAYEY SILT TILL trace sand, trace gravel, occ. cobbles and/or boulders wet			Well Screen; Well Sand	3	AS	50	Rock		
					4	SS	23			
					5	SS	36			
				Soil Cuttings	6	SS	39			
6.7		462.0								
	End of Borehole									

DRILLED BY: London Soil Test Ltd.

DRILL METHOD: Solid Stem Auger

DRILL DATE: June 1, 2021

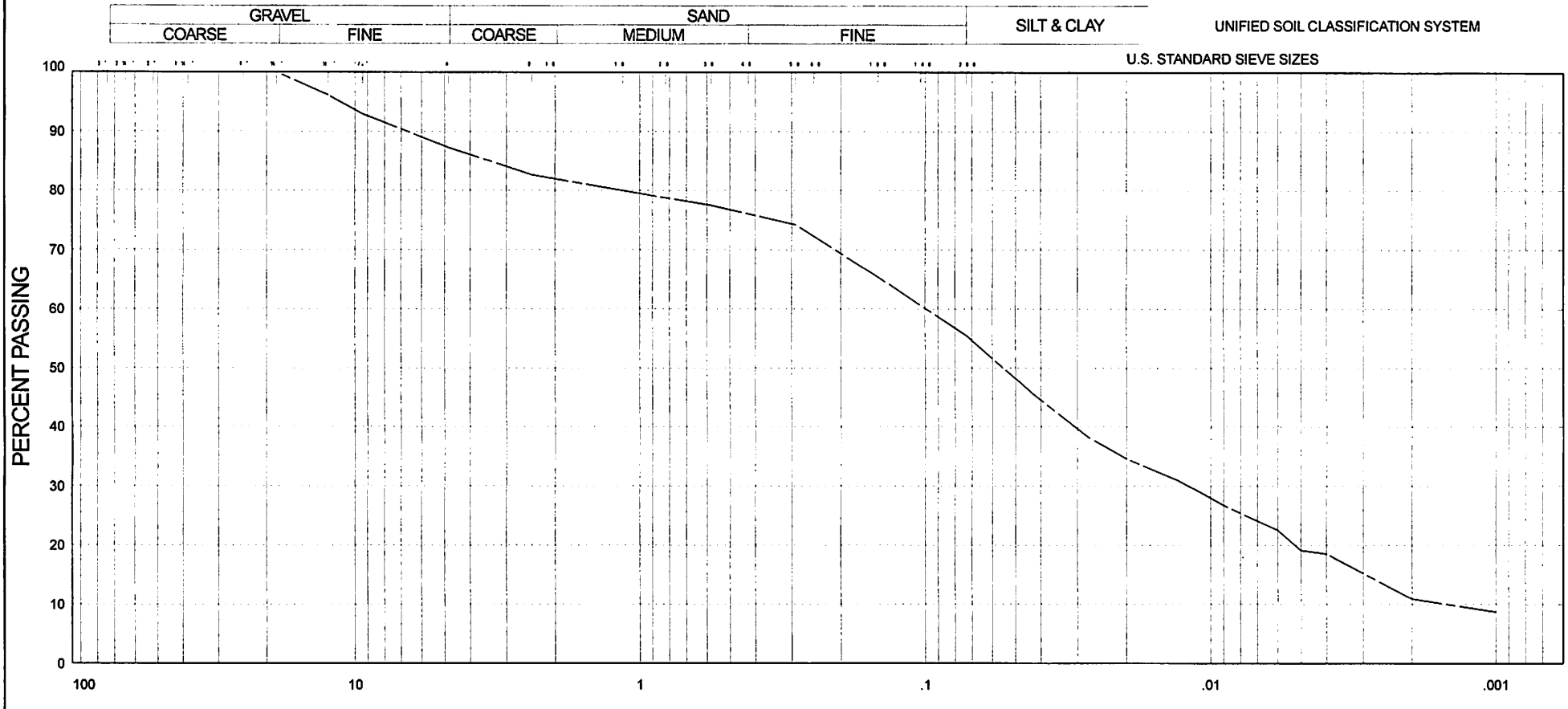
HOLE DIAMETER: 200mm

DATUM: Geodetic

SHEET: 1 of 1

GRAIN SIZE DISTRIBUTION

OUR REFERENCE N° G4411-21-5



PROJECT: Grand Valley Employment Lands
LOCATION: Pt of Lot 32, Con. 1, Grand Valley, ON
BOREHOLE N°: 6
SAMPLE N°: 3
DEPTH: 2.3 - 2.7m±
ELEVATION: 460.1 - 459.7m±

COEFFICIENT OF UNIFORMITY:
COEFFICIENT OF CURVATURE:

Classification of Sample and Group Symbol:

SANDY SILT TILL, some gravel, some clay (CL-ML)

PLASTIC PROPERTIES

LIQUID LIMIT	% = 18.0
PLASTIC LIMIT	% = 13.6
PLASTICITY INDEX	% = 4.4
MOISTURE CONTENT	% = 10.2

ENCLOSURE N° 12

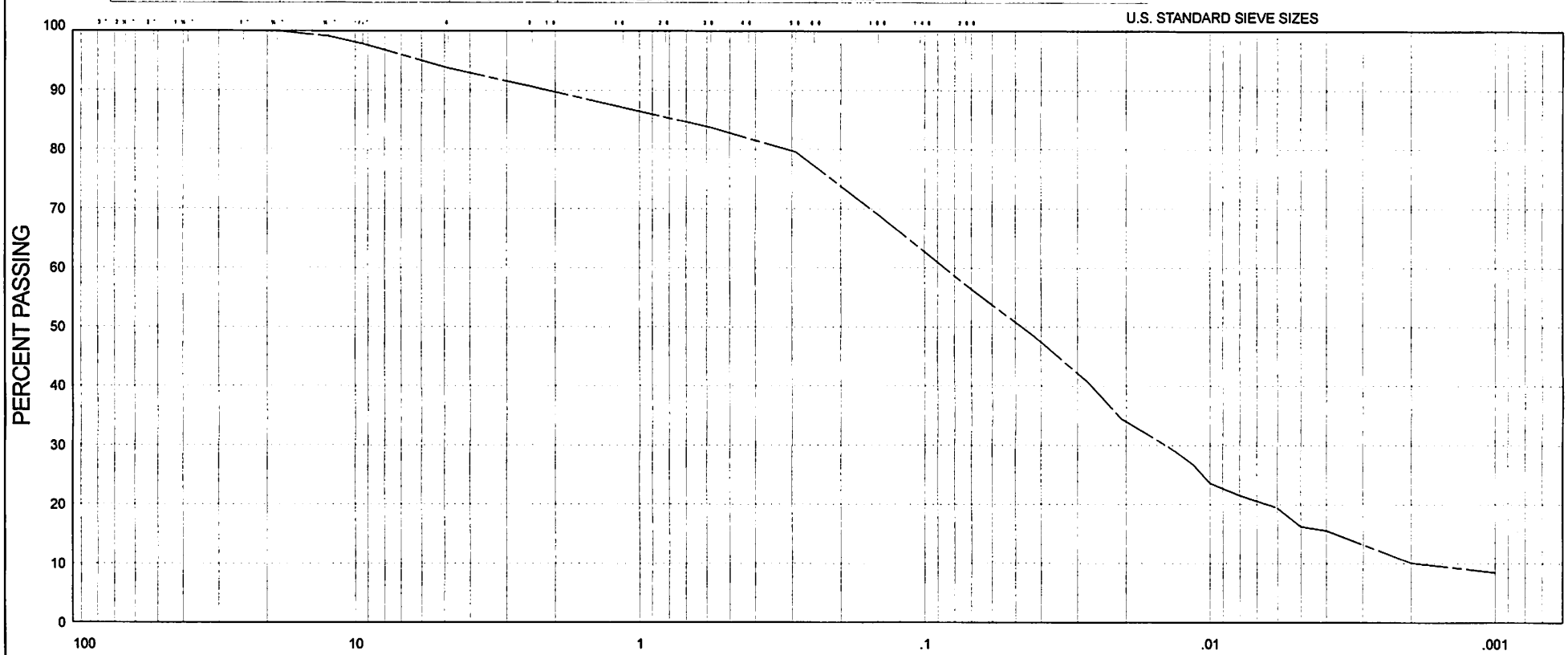
V. A. WOOD (GUELPH) INCORPORATED

GRAIN SIZE DISTRIBUTION

OUR REFERENCE N° G4411-21-5

UNIFIED SOIL CLASSIFICATION SYSTEM

U.S. STANDARD SIEVE SIZES



PROJECT: Grand Valley Employment Lands

LOCATION: Pt. of Lot 32, Con. 1, Grand Valley, ON

BOREHOLE N°: 3

SAMPLE N°: 5

DEPTH: 4.6 - 5.0m±

ELEVATION: 469.7 - 469.3m±

COEFFICIENT OF UNIFORMITY:

COEFFICIENT OF CURVATURE:

Classification of Sample and Group Symbol:

SILT AND SAND TILL, some clay, trace gravel (CL-ML)

PLASTIC PROPERTIES

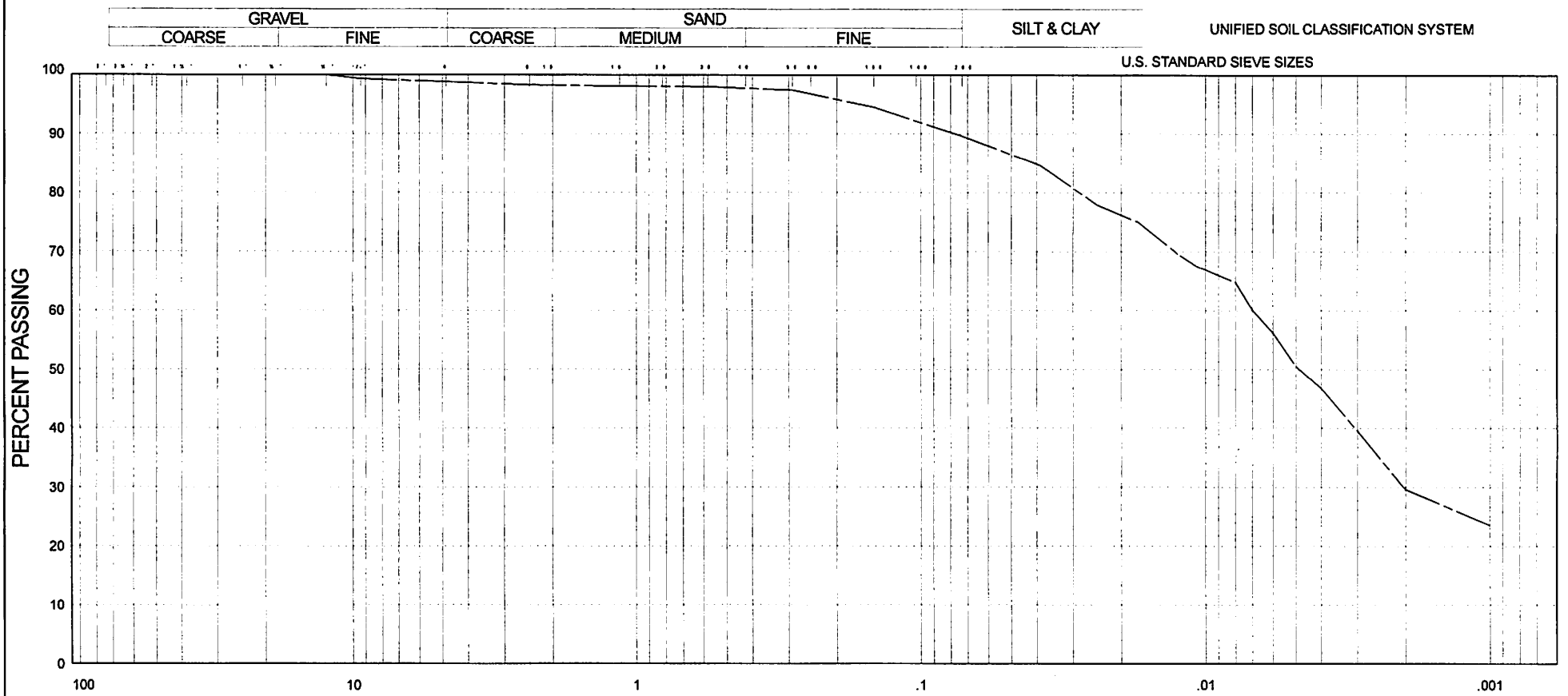
LIQUID LIMIT	% = 17.0
PLASTIC LIMIT	% = 12.7
PLASTICITY INDEX	% = 4.3
MOISTURE CONTENT	% = 4.9

ENCLOSURE N° 13

V. A. WOOD (GUELPH) INCORPORATED

GRAIN SIZE DISTRIBUTION

OUR REFERENCE N° G4411-21-5



PROJECT: Grand Valley Employment Lands

LOCATION: Pt. of Lot 32, Con. 1, Grand Valley, ON

BOREHOLE N°: 1

SAMPLE N°: 6

DEPTH: 6.1 - 6.6m±

ELEVATION: 464.7 - 464.2m±

COEFFICIENT OF UNIFORMITY:

COEFFICIENT OF CURVATURE:

Classification of Sample and Group Symbol:

CLAYEY SILT TILL, trace sand, trace gravel (CL)

PLASTIC PROPERTIES

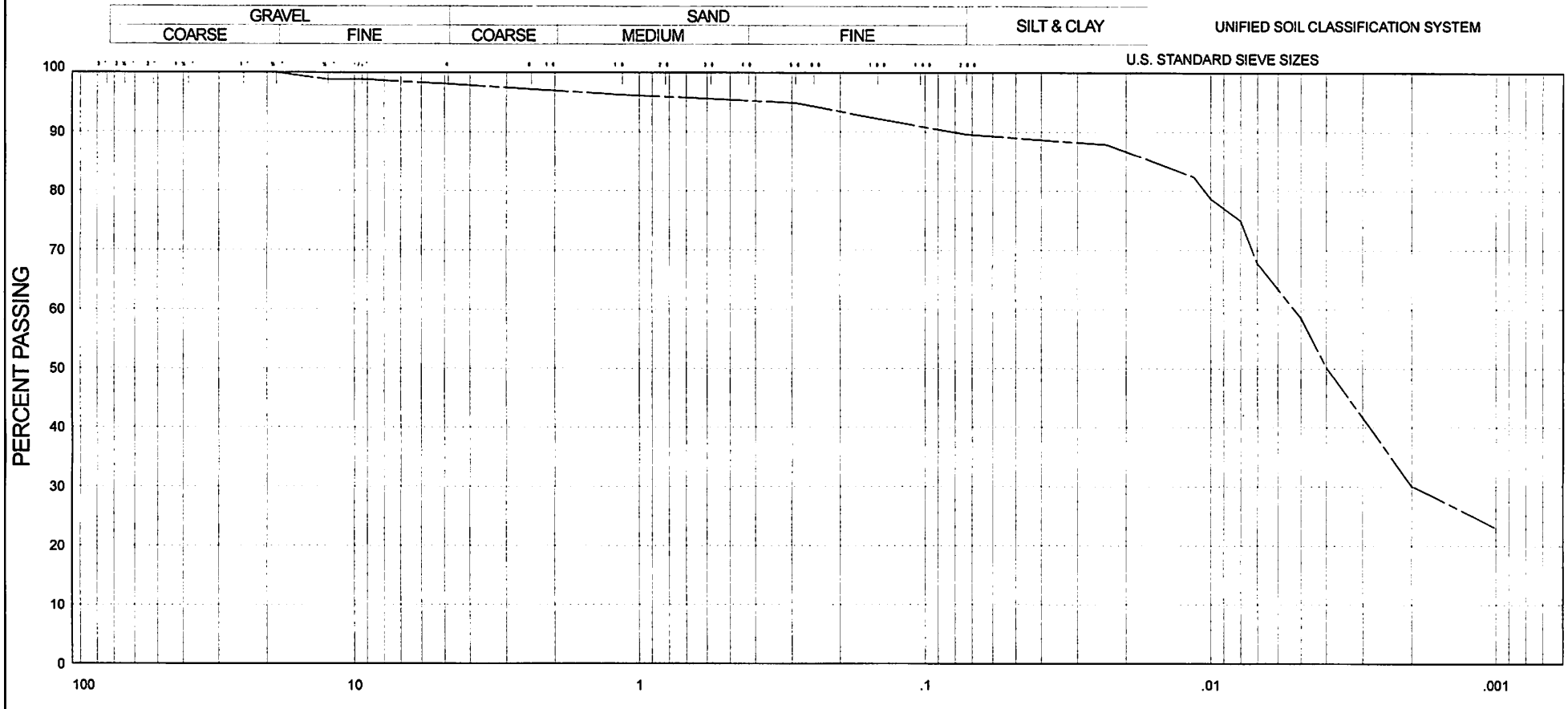
LIQUID LIMIT	% = 29.2
PLASTIC LIMIT	% = 16.8
PLASTICITY INDEX	% = 12.4
MOISTURE CONTENT	% = 13.3

ENCLOSURE N° 14

V. A. WOOD (GUELPH) INCORPORATED

GRAIN SIZE DISTRIBUTION

OUR REFERENCE N° G4411-21-5



PROJECT: Grand Valley Employment Lands

LOCATION: Pt. of Lot 32, Con. 1, Grand Valley, ON

BOREHOLE N°: 10

SAMPLE N°: 4

DEPTH: 3.0 - 3.5m±

ELEVATION: 465.7 - 465.2m±

COEFFICIENT OF UNIFORMITY:

COEFFICIENT OF CURVATURE:

Classification of Sample and Group Symbol:

CLAYEY SILT TILL, trace sand, trace gravel (CL)

PLASTIC PROPERTIES

LIQUID LIMIT	% = 24.8
PLASTIC LIMIT	% = 10.4
PLASTICITY INDEX	% = 14.4
MOISTURE CONTENT	% = 19.7

ENCLOSURE N° 15

V. A. WOOD (GUELPH) INCORPORATED

APPENDIX D
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:                              W:\Guelph\117-2017\"
"                117184  Thomasfield Industrial Lands Pre-Engineering\5 Work in
Progress\Design Calcs\Modelling Files"
"                Output filename:                                  Pre_2yr.out"
"                Licensee name:                                           gmbp"
"                Company                                                  gmbp"
"                Date & Time last used:             11/18/2021 at 10:15:30 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      240.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"      695.047   Coefficient A"
"        6.387   Constant B"
"        0.793   Exponent C"
"        0.380   Fraction R"
"      240.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity            99.088    mm/hr"
"             Total depth                  35.279    mm"
"            6   002hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 101"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          101   No description"
"        0.000   % Impervious"
"       28.420   Total Area"
"      255.000   Flow length"
"        7.500   Overland Slope"
"       28.420   Pervious Area"
"      255.000   Pervious length"
"        7.500   Pervious slope"
"        0.000   Impervious Area"
"      255.000   Impervious length"
"        7.500   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"
"                     0.072     0.000     0.000     0.000 c.m/sec"
"             Catchment 101          Pervious   Impervious Total Area "
"             Surface Area           28.420     0.000      28.420     hectare"
"             Time of concentration  72.341     5.408      72.341     minutes"
"             Time to Centroid       160.381    0.000      160.381    minutes"
"             Rainfall depth         35.279     35.279     35.279     mm"
"             Rainfall volume        1.0026     0.0000     1.0026     ha-m"
"             Rainfall losses        34.200     35.279     34.200     mm"
"             Runoff depth           1.079      0.000      1.079      mm"
"             Runoff volume          306.75     0.00       306.75     c.m"
"             Runoff coefficient     0.031      0.000      0.031      "
"             Maximum flow           0.072      0.000      0.072      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.072     0.072     0.000     0.000"
" 33          CATCHMENT 102"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          102   Catchment 102"
"       30.000   % Impervious"
"        2.160   Total Area"
"       70.000   Flow length"
"        5.000   Overland Slope"
"        1.512   Pervious Area"
"       70.000   Pervious length"
"        5.000   Pervious slope"
"        0.648   Impervious Area"
"       70.000   Impervious length"
"        5.000   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"
"                     0.140     0.072     0.000     0.000 c.m/sec"
"             Catchment 102          Pervious   Impervious Total Area "
"             Surface Area           1.512      0.648      2.160      hectare"
"             Time of concentration  37.614     2.812      5.264      minutes"
"             Time to Centroid       131.152    114.444    115.621    minutes"
"             Rainfall depth         35.279     35.279     35.279     mm"
"             Rainfall volume        533.42     228.61     762.04     c.m"
"             Rainfall losses        34.201     2.061      24.559     mm"
"             Runoff depth           1.079      33.218     10.721     mm"
```

```
"             Runoff volume          16.31      215.26     231.57     c.m"
"             Runoff coefficient     0.031      0.942      0.304      "
"             Maximum flow           0.007      0.140      0.140      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.140     0.140     0.000     0.000"
" 33          CATCHMENT 103"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          103   Catchment 103"
"        0.000   % Impervious"
"       24.270   Total Area"
"      300.000   Flow length"
"        3.000   Overland Slope"
"       24.270   Pervious Area"
"      300.000   Pervious length"
"        3.000   Pervious slope"
"        0.000   Impervious Area"
"      300.000   Impervious length"
"        3.000   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"
"                     0.043     0.140     0.000     0.000 c.m/sec"
"             Catchment 103          Pervious   Impervious Total Area "
"             Surface Area           24.270     0.000      24.270     hectare"
"             Time of concentration  104.982    7.849      104.982    minutes"
"             Time to Centroid       187.877    0.000      187.877    minutes"
"             Rainfall depth         35.279     35.279     35.279     mm"
"             Rainfall volume        8562.31    0.00       8562.31    c.m"
"             Rainfall losses        34.200     35.279     34.200     mm"
"             Runoff depth           1.080      0.000      1.080      mm"
"             Runoff volume          262.09     0.00       262.09     c.m"
"             Runoff coefficient     0.031      0.000      0.031      "
"             Maximum flow           0.043      0.000      0.043      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.043     0.140     0.000     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.043     0.140     0.140     0.000"
" 40          HYDROGRAPH   Combine    1"
```

```
"            6   Combine "
"            1   Node #"
"                Combined Outflow - To Creek"
"             Maximum flow                  0.140    c.m/sec"
"             Hydrograph volume           800.408    c.m"
"                    0.043     0.140     0.140     0.140"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.043     0.000     0.140     0.140"
" 33          CATCHMENT 104"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          104   Catchment 104"
"        0.000   % Impervious"
"        2.640   Total Area"
"       65.000   Flow length"
"        2.000   Overland Slope"
"        2.640   Pervious Area"
"       65.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       65.000   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     0.140     0.140 c.m/sec"
"             Catchment 104          Pervious   Impervious Total Area "
"             Surface Area           2.640      0.000      2.640      hectare"
"             Time of concentration  47.361     3.541      47.361     minutes"
"             Time to Centroid       139.339    0.000      139.339    minutes"
"             Rainfall depth         35.279     35.279     35.279     mm"
"             Rainfall volume        931.38     0.00       931.38     c.m"
"             Rainfall losses        34.201     35.279     34.201     mm"
"             Runoff depth           1.079      0.000      1.079      mm"
"             Runoff volume          28.48      0.00       28.48      c.m"
"             Runoff coefficient     0.031      0.000      0.031      "
"             Maximum flow           0.010      0.000      0.010      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.010     0.010     0.140     0.140"
" 33          CATCHMENT 105"
```

```
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          105   Catchment 105"
"        0.000   % Impervious"
"       12.280   Total Area"
"      140.000   Flow length"
"        3.000   Overland Slope"
"       12.280   Pervious Area"
"      140.000   Pervious length"
"        3.000   Pervious slope"
"        0.000   Impervious Area"
"      140.000   Impervious length"
"        3.000   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"
"                    0.034     0.010     0.140     0.140 c.m/sec"
"             Catchment 105          Pervious   Impervious Total Area "
"             Surface Area           12.280     0.000      12.280     hectare"
"             Time of concentration  66.454     4.968      66.452     minutes"
"             Time to Centroid       155.440    117.832    155.439    minutes"
"             Rainfall depth         35.279     35.279     35.279     mm"
"             Rainfall volume        4332.31    0.00       4332.31    c.m"
"             Rainfall losses        34.200     1.762      34.200     mm"
"             Runoff depth           1.079      33.517     1.079      mm"
"             Runoff volume          132.56     0.00       132.56     c.m"
"             Runoff coefficient     0.031      0.000      0.031      "
"             Maximum flow           0.034      0.000      0.034      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.034     0.043     0.140     0.140"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.034     0.043     0.043     0.140"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Combined Outflow - To Creek"
"             Maximum flow                  0.158    c.m/sec"
"             Hydrograph volume           961.445    c.m"
"                    0.034     0.043     0.043     0.158"
" 38          START/RE-START TOTALS 105"
```

```
"            3   Runoff Totals on EXIT"
"             Total Catchment area                      69.770    hectare"
"             Total Impervious area                      0.648    hectare"
"             Total % impervious                         0.929"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                            Version 2.25  rev. 473"
"                MIDUSS created                         Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:                                W:\Guelph\117-2017\"
"                117184  Thomasfield Industrial Lands Pre-Engineering\5 Work in
Progress\Design Calcs\Modelling Files"
"                Output filename:                                    Pre_5yr.out"
"                Licensee name:                                             gmbp"
"                Company                                                    gmbp"
"                Date & Time last used:              11/18/2021 at 10:33:12 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      240.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     1459.072   Coefficient A"
"       13.690   Constant B"
"        0.850   Exponent C"
"        0.380   Fraction R"
"      240.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           119.322    mm/hr"
"             Total depth                  52.781    mm"
"            6   005hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 101"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          101   No description"
"        0.000   % Impervious"
"       28.420   Total Area"
"      255.000   Flow length"
"        7.500   Overland Slope"
"       28.420   Pervious Area"
"      255.000   Pervious length"
"        7.500   Pervious slope"
"        0.000   Impervious Area"
"      255.000   Impervious length"
"        7.500   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"
"                     1.171     0.000     0.000     0.000 c.m/sec"
"             Catchment 101          Pervious   Impervious Total Area "
"             Surface Area           28.420     0.000      28.420     hectare"
"             Time of concentration  34.768     5.021      34.768     minutes"
"             Time to Centroid       134.075    116.016    134.075    minutes"
"             Rainfall depth         52.781     52.781     52.781     mm"
"             Rainfall volume        1.5000     0.0000     1.5000     ha-m"
"             Rainfall losses        41.167     1.848      41.167     mm"
"             Runoff depth           11.614     50.933     11.614     mm"
"             Runoff volume          3300.64    0.01       3300.65    c.m"
"             Runoff coefficient     0.220      0.000      0.220      "
"             Maximum flow           1.171      0.000      1.171      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     1.171     1.171     0.000     0.000"
" 33          CATCHMENT 102"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          102   Catchment 102"
"       30.000   % Impervious"
"        2.160   Total Area"
"       70.000   Flow length"
"        5.000   Overland Slope"
"        1.512   Pervious Area"
"       70.000   Pervious length"
"        5.000   Pervious slope"
"        0.648   Impervious Area"
"       70.000   Impervious length"
"        5.000   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"
"                     0.199     1.171     0.000     0.000 c.m/sec"
"             Catchment 102          Pervious   Impervious Total Area "
"             Surface Area           1.512      0.648      2.160      hectare"
"             Time of concentration  18.077     2.611      8.021      minutes"
"             Time to Centroid       117.872    112.483    114.368    minutes"
"             Rainfall depth         52.781     52.781     52.781     mm"
"             Rainfall volume        798.05     342.02     1140.07    c.m"
"             Rainfall losses        41.167     2.414      29.541     mm"
"             Runoff depth           11.614     50.367     23.240     mm"
```

```
"             Runoff volume          175.61     326.38     501.99     c.m"
"             Runoff coefficient     0.220      0.954      0.440      "
"             Maximum flow           0.100      0.182      0.199      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.199     1.280     0.000     0.000"
" 33          CATCHMENT 103"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          103   Catchment 103"
"        0.000   % Impervious"
"       24.270   Total Area"
"      300.000   Flow length"
"        3.000   Overland Slope"
"       24.270   Pervious Area"
"      300.000   Pervious length"
"        3.000   Pervious slope"
"        0.000   Impervious Area"
"      300.000   Impervious length"
"        3.000   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"
"                     0.734     1.280     0.000     0.000 c.m/sec"
"             Catchment 103          Pervious   Impervious Total Area "
"             Surface Area           24.270     0.000      24.270     hectare"
"             Time of concentration  50.455     7.286      50.455     minutes"
"             Time to Centroid       149.309    119.323    149.309    minutes"
"             Rainfall depth         52.781     52.781     52.781     mm"
"             Rainfall volume        1.2810     0.0000     1.2810     ha-m"
"             Rainfall losses        41.161     1.789      41.161     mm"
"             Runoff depth           11.620     50.992     11.620     mm"
"             Runoff volume          2820.16    0.01       2820.18    c.m"
"             Runoff coefficient     0.220      0.000      0.220      "
"             Maximum flow           0.734      0.000      0.734      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.734     1.956     0.000     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.734     1.956     1.956     0.000"
" 40          HYDROGRAPH   Combine    1"
```

```
"            6   Combine "
"            1   Node #"
"                Combined Outflow - To Creek"
"             Maximum flow                  1.956    c.m/sec"
"             Hydrograph volume          6622.820    c.m"
"                    0.734     1.956     1.956     1.956"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.734     0.000     1.956     1.956"
" 33          CATCHMENT 104"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          104   Catchment 104"
"        0.000   % Impervious"
"        2.640   Total Area"
"       65.000   Flow length"
"        2.000   Overland Slope"
"        2.640   Pervious Area"
"       65.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       65.000   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     0.000     1.956     1.956 c.m/sec"
"             Catchment 104          Pervious   Impervious Total Area "
"             Surface Area           2.640      0.000      2.640      hectare"
"             Time of concentration  22.762     3.287      22.762     minutes"
"             Time to Centroid       122.435    113.541    122.435    minutes"
"             Rainfall depth         52.781     52.781     52.781     mm"
"             Rainfall volume        1393.42    0.00       1393.42    c.m"
"             Rainfall losses        41.172     2.425      41.172     mm"
"             Runoff depth           11.609     50.356     11.609     mm"
"             Runoff volume          306.48     0.00       306.49     c.m"
"             Runoff coefficient     0.220      0.000      0.220      "
"             Maximum flow           0.150      0.000      0.150      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.150     0.150     1.956     1.956"
" 33          CATCHMENT 105"
```

```
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          105   Catchment 105"
"        0.000   % Impervious"
"       12.280   Total Area"
"      140.000   Flow length"
"        3.000   Overland Slope"
"       12.280   Pervious Area"
"      140.000   Pervious length"
"        3.000   Pervious slope"
"        0.000   Impervious Area"
"      140.000   Impervious length"
"        3.000   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"
"                    0.541     0.150     1.956     1.956 c.m/sec"
"             Catchment 105          Pervious   Impervious Total Area "
"             Surface Area           12.280     0.000      12.280     hectare"
"             Time of concentration  31.938     4.612      31.938     minutes"
"             Time to Centroid       131.338    115.425    131.338    minutes"
"             Rainfall depth         52.781     52.781     52.781     mm"
"             Rainfall volume        6481.52    0.01       6481.53    c.m"
"             Rainfall losses        41.169     1.820      41.169     mm"
"             Runoff depth           11.612     50.961     11.612     mm"
"             Runoff volume          1425.93    0.01       1425.93    c.m"
"             Runoff coefficient     0.220      0.000      0.220      "
"             Maximum flow           0.541      0.000      0.541      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.541     0.690     1.956     1.956"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.541     0.690     0.690     1.956"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Combined Outflow - To Creek"
"             Maximum flow                  2.587    c.m/sec"
"             Hydrograph volume          8355.235    c.m"
"                    0.541     0.690     0.690     2.587"
" 38          START/RE-START TOTALS 105"
```

```
"            3   Runoff Totals on EXIT"
"             Total Catchment area                      69.770    hectare"
"             Total Impervious area                      0.648    hectare"
"             Total % impervious                         0.929"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                        ie METRIC"
"                Job folder:                              W:\Guelph\117-2017\"
"                117184  Thomasfield Industrial Lands Pre-Engineering\5 Work in
Progress\Design Calcs\Modelling Files"
"                Output filename:                                 Pre_100yr.out"
"                Licensee name:                                           gmbp"
"                Company                                                  gmbp"
"                Date & Time last used:              11/18/2021 at 10:34:45 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      240.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     6933.019   Coefficient A"
"       34.669   Constant B"
"        0.998   Exponent C"
"        0.380   Fraction R"
"      240.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           174.421    mm/hr"
"             Total depth                 102.106    mm"
"            6   100hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 101"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          101   No description"
"        0.000   % Impervious"
"       28.420   Total Area"
"      255.000   Flow length"
"        7.500   Overland Slope"
"       28.420   Pervious Area"
"      255.000   Pervious length"
"        7.500   Pervious slope"
"        0.000   Impervious Area"
"      255.000   Impervious length"
"        7.500   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"
"                     5.558     0.000     0.000     0.000 c.m/sec"
"             Catchment 101          Pervious   Impervious Total Area "
"             Surface Area           28.420     0.000      28.420     hectare"
"             Time of concentration  24.409     4.314      24.409     minutes"
"             Time to Centroid       129.989    112.778    129.989    minutes"
"             Rainfall depth         102.106    102.106    102.106    mm"
"             Rainfall volume        2.9018     0.0000     2.9018     ha-m"
"             Rainfall losses        50.165     2.324      50.165     mm"
"             Runoff depth           51.941     99.782     51.941     mm"
"             Runoff volume          1.4762     0.0000     1.4762     ha-m"
"             Runoff coefficient     0.509      0.000      0.509      "
"             Maximum flow           5.558      0.000      5.558      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     5.558     5.558     0.000     0.000"
" 33          CATCHMENT 102"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          102   Catchment 102"
"       30.000   % Impervious"
"        2.160   Total Area"
"       70.000   Flow length"
"        5.000   Overland Slope"
"        1.512   Pervious Area"
"       70.000   Pervious length"
"        5.000   Pervious slope"
"        0.648   Impervious Area"
"       70.000   Impervious length"
"        5.000   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"
"                     0.601     5.558     0.000     0.000 c.m/sec"
"             Catchment 102          Pervious   Impervious Total Area "
"             Surface Area           1.512      0.648      2.160      hectare"
"             Time of concentration  12.691     2.243      7.994      minutes"
"             Time to Centroid       117.432    109.901    114.046    minutes"
"             Rainfall depth         102.106    102.106    102.106    mm"
"             Rainfall volume        1543.84    661.65     2205.48    c.m"
"             Rainfall losses        50.253     3.270      36.158     mm"
"             Runoff depth           51.853     98.836     65.948     mm"
```

```
"             Runoff volume          784.01     640.46     1424.47    c.m"
"             Runoff coefficient     0.508      0.968      0.646      "
"             Maximum flow           0.419      0.284      0.601      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.601     6.032     0.000     0.000"
" 33          CATCHMENT 103"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          103   Catchment 103"
"        0.000   % Impervious"
"       24.270   Total Area"
"      300.000   Flow length"
"        3.000   Overland Slope"
"       24.270   Pervious Area"
"      300.000   Pervious length"
"        3.000   Pervious slope"
"        0.000   Impervious Area"
"      300.000   Impervious length"
"        3.000   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"
"                     3.719     6.032     0.000     0.000 c.m/sec"
"             Catchment 103          Pervious   Impervious Total Area "
"             Surface Area           24.270     0.000      24.270     hectare"
"             Time of concentration  35.423     6.260      35.423     minutes"
"             Time to Centroid       141.784    115.382    141.784    minutes"
"             Rainfall depth         102.106    102.106    102.106    mm"
"             Rainfall volume        2.4781     0.0000     2.4781     ha-m"
"             Rainfall losses        50.126     2.328      50.126     mm"
"             Runoff depth           51.980     99.778     51.980     mm"
"             Runoff volume          1.2615     0.0000     1.2615     ha-m"
"             Runoff coefficient     0.509      0.000      0.509      "
"             Maximum flow           3.719      0.000      3.719      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     3.719     9.428     0.000     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     3.719     9.428     9.428     0.000"
" 40          HYDROGRAPH   Combine    1"
```

```
"            6   Combine "
"            1   Node #"
"                Combined Outflow - To Creek"
"             Maximum flow                  9.428    c.m/sec"
"             Hydrograph volume         28801.568    c.m"
"                    3.719     9.428     9.428     9.428"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    3.719     0.000     9.428     9.428"
" 33          CATCHMENT 104"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          104   Catchment 104"
"        0.000   % Impervious"
"        2.640   Total Area"
"       65.000   Flow length"
"        2.000   Overland Slope"
"        2.640   Pervious Area"
"       65.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       65.000   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"
"                    0.663     0.000     9.428     9.428 c.m/sec"
"             Catchment 104          Pervious   Impervious Total Area "
"             Surface Area           2.640      0.000      2.640      hectare"
"             Time of concentration  15.980     2.824      15.980     minutes"
"             Time to Centroid       120.952    110.780    120.953    minutes"
"             Rainfall depth         102.106    102.106    102.106    mm"
"             Rainfall volume        2695.59    0.00       2695.59    c.m"
"             Rainfall losses        50.283     3.708      50.283     mm"
"             Runoff depth           51.822     98.398     51.822     mm"
"             Runoff volume          1368.11    0.00       1368.11    c.m"
"             Runoff coefficient     0.508      0.000      0.508      "
"             Maximum flow           0.663      0.000      0.663      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.663     0.663     9.428     9.428"
" 33          CATCHMENT 105"
```

```
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          105   Catchment 105"
"        0.000   % Impervious"
"       12.280   Total Area"
"      140.000   Flow length"
"        3.000   Overland Slope"
"       12.280   Pervious Area"
"      140.000   Pervious length"
"        3.000   Pervious slope"
"        0.000   Impervious Area"
"      140.000   Impervious length"
"        3.000   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"
"                     2.524     0.663     9.428     9.428 c.m/sec"
"             Catchment 105          Pervious   Impervious Total Area "
"             Surface Area           12.280     0.000      12.280     hectare"
"             Time of concentration  22.423     3.963      22.422     minutes"
"             Time to Centroid       127.851    112.330    127.851    minutes"
"             Rainfall depth         102.106    102.106    102.106    mm"
"             Rainfall volume        1.2539     0.0000     1.2539     ha-m"
"             Rainfall losses        50.191     2.737      50.191     mm"
"             Runoff depth           51.915     99.369     51.915     mm"
"             Runoff volume          6375.11    0.01       6375.12    c.m"
"             Runoff coefficient     0.508      0.000      0.508      "
"             Maximum flow           2.524      0.000      2.524      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     2.524     3.168     9.428     9.428"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     2.524     3.168     3.168     9.428"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Combined Outflow - To Creek"
"             Maximum flow                 12.532    c.m/sec"
"             Hydrograph volume         36544.793    c.m"
"                     2.524     3.168     3.168    12.532"
" 38          START/RE-START TOTALS 105"
```

```
"            3   Runoff Totals on EXIT"
"             Total Catchment area                      69.770    hectare"
"             Total Impervious area                      0.648    hectare"
"             Total % impervious                         0.929"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                            Version 2.25  rev. 473"
"                MIDUSS created                          Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:                                W:\Guelph\117-2017\"
"                117184  Thomasfield Industrial Lands Pre-Engineering\5 Work in
Progress\Design Calcs\Modelling Files"
"                Output filename:                                   Pre_REG.out"
"                Licensee name:                                             gmbp"
"                Company                                                    gmbp"
"                Date & Time last used:                 11/19/2021 at 3:45:47 PM"
" 31          TIME PARAMETERS"
"       60.000   Time Step"
"     2880.000   Max. Storm length"
"     3600.000   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"
"            6   000hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 101"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          101   No description"
"        0.000   % Impervious"
"       28.420   Total Area"
"      255.000   Flow length"
"        7.500   Overland Slope"
"       28.420   Pervious Area"
"      255.000   Pervious length"
"        7.500   Pervious slope"
"        0.000   Impervious Area"
"      255.000   Impervious length"
"        7.500   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"
"                    2.391     0.000     0.000     0.000 c.m/sec"
"             Catchment 101          Pervious   Impervious Total Area "
"             Surface Area           28.420     0.000      28.420     hectare"
"             Time of concentration  41.841     6.946      41.841     minutes"
"             Time to Centroid       2796.168   2243.051   2796.166   minutes"
"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        8.0997     0.0000     8.0997     ha-m"
"             Rainfall losses        209.377    23.961     209.377    mm"
"             Runoff depth           75.623     261.039    75.623     mm"
"             Runoff volume          2.1492     0.0000     2.1492     ha-m"
"             Runoff coefficient     0.265      0.000      0.265      "
"             Maximum flow           2.391      0.000      2.391      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    2.391     2.391     0.000     0.000"
" 33          CATCHMENT 102"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          102   Catchment 102"
"       30.000   % Impervious"
"        2.160   Total Area"
"       70.000   Flow length"
"        5.000   Overland Slope"
"        1.512   Pervious Area"
"       70.000   Pervious length"
"        5.000   Pervious slope"
"        0.648   Impervious Area"
"       70.000   Impervious length"
"        5.000   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"
"                    0.191     2.391     0.000     0.000 c.m/sec"
"             Catchment 102          Pervious   Impervious Total Area "
"             Surface Area           1.512      0.648      2.160      hectare"
```

```
"             Time of concentration  21.755     3.612      11.322     minutes"
"             Time to Centroid       2780.027   2237.302   2467.941   minutes"
"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        4309.20    1846.80    6156.00    c.m"
"             Rainfall losses        206.990    38.697     156.503    mm"
"             Runoff depth           78.010     246.303    128.497    mm"
"             Runoff volume          1179.50    1596.04    2775.55    c.m"
"             Runoff coefficient     0.274      0.864      0.451      "
"             Maximum flow           0.125      0.082      0.191      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.191     2.574     0.000     0.000"
" 33          CATCHMENT 103"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          103   Catchment 103"
"        0.000   % Impervious"
"       24.270   Total Area"
"      300.000   Flow length"
"        3.000   Overland Slope"
"       24.270   Pervious Area"
"      300.000   Pervious length"
"        3.000   Pervious slope"
"        0.000   Impervious Area"
"      300.000   Impervious length"
"        3.000   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"
"                     1.860     2.574     0.000     0.000 c.m/sec"
"             Catchment 103          Pervious   Impervious Total Area "
"             Surface Area           24.270     0.000      24.270     hectare"
"             Time of concentration  60.720     10.081     60.720     minutes"
"             Time to Centroid       2817.500   2276.640   2817.498   minutes"
"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        6.9169     0.0000     6.9169     ha-m"
"             Rainfall losses        206.832    14.688     206.832    mm"
"             Runoff depth           78.168     270.312    78.168     mm"
"             Runoff volume          1.8971     0.0000     1.8971     ha-m"
"             Runoff coefficient     0.274      0.000      0.274      "
"             Maximum flow           1.860      0.000      1.860      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
```

```
"            4   Add Runoff "
"                     1.860     4.434     0.000     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     1.860     4.434     4.434     0.000"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Combined Outflow - To Creek"
"             Maximum flow                  4.434    c.m/sec"
"             Hydrograph volume         43239.008    c.m"
"                     1.860     4.434     4.434     4.434"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     1.860     0.000     4.434     4.434"
" 33          CATCHMENT 104"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          104   Catchment 104"
"        0.000   % Impervious"
"        2.640   Total Area"
"       65.000   Flow length"
"        2.000   Overland Slope"
"        2.640   Pervious Area"
"       65.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       65.000   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"
"                     0.225     0.000     4.434     4.434 c.m/sec"
"             Catchment 104          Pervious   Impervious Total Area "
"             Surface Area           2.640      0.000      2.640      hectare"
"             Time of concentration  27.393     4.548      27.393     minutes"
"             Time to Centroid       2784.591   2231.748   2784.589   minutes"
"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        7523.99    0.01       7524.00    c.m"
"             Rainfall losses        207.385    34.674     207.385    mm"
"             Runoff depth           77.615     250.326    77.615     mm"
"             Runoff volume          2049.02    0.01       2049.03    c.m"
```

```
"             Runoff coefficient     0.272      0.000      0.272      "
"             Maximum flow           0.225      0.000      0.225      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.225     0.225     4.434     4.434"
" 33          CATCHMENT 105"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          105   Catchment 105"
"        0.000   % Impervious"
"       12.280   Total Area"
"      140.000   Flow length"
"        3.000   Overland Slope"
"       12.280   Pervious Area"
"      140.000   Pervious length"
"        3.000   Pervious slope"
"        0.000   Impervious Area"
"      140.000   Impervious length"
"        3.000   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"
"                     1.043     0.225     4.434     4.434 c.m/sec"
"             Catchment 105          Pervious   Impervious Total Area "
"             Surface Area           12.280     0.000      12.280     hectare"
"             Time of concentration  38.436     6.381      38.436     minutes"
"             Time to Centroid       2792.162   2236.981   2792.160   minutes"
"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        3.4998     0.0000     3.4998     ha-m"
"             Rainfall losses        209.178    26.846     209.178    mm"
"             Runoff depth           75.822     258.154    75.822     mm"
"             Runoff volume          9310.88    0.03       9310.92    c.m"
"             Runoff coefficient     0.266      0.000      0.266      "
"             Maximum flow           1.043      0.000      1.043      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     1.043     1.268     4.434     4.434"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     1.043     1.268     1.268     4.434"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
```

```
"            1   Node #"
"                Combined Outflow - To Creek"
"             Maximum flow                  5.702    c.m/sec"
"             Hydrograph volume         54598.949    c.m"
"                    1.043     1.268     1.268     5.702"
" 38          START/RE-START TOTALS 105"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                     69.770    hectare"
"             Total Impervious area                     0.648    hectare"
"             Total % impervious                        0.929"
" 19          EXIT"
```

GRAND VALLEY BUSINESS PARK
TOWN OF GRAND VALLEY
Our File: 117184
December 14, 2021

Proposed Stormwater Management Facility - Pond A

Quality Storage Volume Calculations

Elevation (m)	Depth (m)	Surface Area Forebay (m^2)	Forebay Volume (m^3)	Surface Area Permanent Pool (m^2)	Permanent Pool Volume (m^3)	Accum. Quality Volume (m^3)	
453.80	0.00	1350.0	0.0	0.0	0.0	0.0	Bottom of Forebay
455.30	1.50	3750.0	3,825.0	10,700.0	0.0	3,825.0	Top of Forebay / Bottom of P.Pool
455.60	1.80			11,644.2	3,351.6	7,176.6	
455.80	2.00			12,451.2	2,409.5	9,586.2	
456.00	2.20			13,265.6	2,571.7	12,157.8	Top of P. Pool

Active Storage Volume Calculations

ELEV (m)	INC. DEPTH (m)	SURFACE AREA (m^2)	INCREASE ACTIVE VOLUME (m^3)	ACCUM STORAGE VOL (m^3)	
456.00	0.00	13,266	0.0	0.0	Knockout Invert
456.20	0.20	14,088	2,735.4	2,735.4	
456.40	0.40	14,923	2,901.1	5,636.5	
456.60	0.60	15,769	3,069.2	8,705.7	Catchbasin Inlet
456.80	0.80	16,627	3,239.6	11,945.3	
457.00	1.00	17,383	3,401.0	15,346.3	
457.20	1.20	18,109	3,549.2	18,895.5	
457.40	1.40	18,474	3,658.3	22,553.7	
457.60	1.60	19,580	3,805.4	26,359.2	
457.80	1.80	20,326	3,990.6	30,349.8	
458.00	2.00	21,079	4,140.5	34,490.3	
458.20	2.20	21,838	4,291.7	38,782.0	
458.30	2.30	22,240	2,203.9	40,985.9	Weir
458.45	2.45	22,800	3,378.0	44,363.9	
458.60	2.60	23,094	3,442.0	47,805.9	Top of Pond

MINOR CONTROL 1

Invert =	455.00	m
Q =	0.116	m^3/s
Cd =	0.6	
H =	1.60	m
2g =	19.62	
A =	0.035	m^2
D=	0.210	m

MAJOR CONTROL 1

Invert =	455.00	m
Q =	0.732	m^3/s
Cd =	0.6	
H =	3.60	m
2g =	19.62	
A =	0.145	m^2
D=	0.430	m

MAJOR CONTROL 2

Invert =	455.50	m
Q =	1.032	m^3/s
Cd =	0.6	
H =	3.10	m
2g =	19.62	
A =	0.221	m^2
D=	0.530	m

MAJOR CONTROL 3

Invert =	455.50	m
Q =	1.032	m^3/s
Cd =	0.6	
H =	3.10	m
2g =	19.62	
A =	0.221	m^2
D=	0.530	m

OVERFLOW WEIR

Q =	2.296	cu m/s
d1 =	2.600	m
h =	2.300	m
H =	0.300	m
2g =	19.620	
L =	10.000	m

Stormwater Management Facility (continued)

ELEVATION	STAGE (m)	STORAGE (cu m)	MINOR CONTROL 1 (cu m/s)	MAJOR CONTROL 1 (cu m/s)	MAJOR CONTROL 2 (cu m/s)	MAJOR CONTROL 3 (cu m/s)	WEIR DISCHARGE (cu m/s)	TOTAL DISCHARGE (cu m/s)	
456.00	0.000	0.0	0.000	0.000	0.000	0.000	0.000	0.000	Knockout Invert
456.20	0.200	2,735.4	0.101	0.000	0.000	0.000	0.000	0.101	
456.40	0.400	5,636.5	0.109	0.000	0.000	0.000	0.000	0.109	
456.60	0.600	8,705.7	0.116	0.000	0.000	0.000	0.000	0.116	
456.80	0.800	11,945.3	0.123	0.000	0.000	0.000	0.000	0.123	
457.00	1.000	15,346.3	0.130	0.000	0.000	0.000	0.000	0.130	Catchbasin Inlet
457.20	1.200	18,895.5	0.000	0.572	0.764	0.764	0.000	2.101	
457.40	1.400	22,553.7	0.000	0.598	0.808	0.808	0.000	2.214	
457.60	1.600	26,359.2	0.000	0.622	0.850	0.850	0.000	2.322	
457.80	1.800	30,349.8	0.000	0.646	0.889	0.889	0.000	2.424	
458.00	2.000	34,490.3	0.000	0.668	0.927	0.927	0.000	2.523	
458.20	2.200	38,782.0	0.000	0.690	0.963	0.963	0.000	2.617	
458.30	2.300	40,985.9	0.000	0.701	0.981	0.981	0.000	2.663	Weir
458.45	2.450	44,363.9	0.000	0.717	1.007	1.007	0.800	3.531	
458.60	2.600	47,805.9	0.000	0.732	1.032	1.032	2.296	5.093	Top of Pond

GRAND VALLEY BUSINESS PARK
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Proposed Stormwater Management Facility - Pond B

Quality Storage Volume Calculations

Elevation (m)	Depth (m)	Surface Area Forebay (m^2)	Forebay Volume (m^3)	Surface Area Permanent Pool (m^2)	Permanent Pool Volume (m^3)	Accum. Quality Volume (m^3)	
465.70	0.00	12.8	0.0	0.0	0.0	0.0	Bottom of Forebay
467.20	1.50	328.0	255.6	5,241.7	0.0	255.6	Top of Forebay / Bottom of P.Pool
467.30	1.60			5,405.1	532.3	787.9	
467.40	1.70			5,570.2	548.8	1,336.7	Top of P. Pool

Active Storage Volume Calculations

Elevation (m)	Depth (m)	Surface Area (m^2)	Increase Active Volume (m^3)	Accum. Active Volume (m^3)	
467.40	0.00	5,570	0.0	0.0	Knockout Invert
467.50	0.10	5,737	565.3	565.3	
467.70	0.30	6,075	1,181.1	1,746.5	
467.90	0.50	6,419	1,249.3	2,995.8	Catchbasin Inlet
468.10	0.70	6,769	1,318.8	4,314.6	
468.30	0.90	7,126	1,389.5	5,704.1	
468.40	1.00	7,306	721.6	6,425.7	Weir
468.50	1.10	7,489	739.8	7,165.4	
468.60	1.20	7,673	758.1	7,923.5	
468.70	1.30	7,858	776.5	8,700.0	Top of Pond

Minor Control

Invert =	467.00	m
Q =	0.039	m^3/s
Cd =	0.6	
H =	0.90	m
2g =	19.62	
A =	0.015	m^2
D=	0.140	m

Major Control

Invert =	467.00	m
Q =	0.680	m^3/s
Cd =	0.6	
H =	1.70	m
2g =	19.62	
A =	0.196	m^2
D=	0.500	m

Major Control

Invert =	467.00	m
Q =	0.680	m^3/s
Cd =	0.6	
H =	1.70	m
2g =	19.62	
A =	0.196	m^2
D=	0.500	m

Overflow Weir

Q =	0.633	cu m/s
d1 =	1.200	m
h =	1.000	m
H =	0.200	m
2g =	19.620	
L =	5.000	m

Stormwater Management Facility (continued)

Elevation	Stage (m)	Storage (cu m)	Minor Control (cu m/s)	Major Control 1 (cu m/s)	Major Control 2 (cu m/s)	Weir Discharge (cu m/s)	Total Discharge (cu m/s)	
467.40	0.000	0.0	0.000	0.000	0.000	0.000	0.000	Knockout Invert
467.50	0.100	565.3	0.029	0.000	0.000	0.000	0.029	
467.70	0.300	1,746.5	0.034	0.000	0.000	0.000	0.034	
467.90	0.500	2,995.8	0.039	0.000	0.000	0.000	0.039	Catchbasin Inlet
468.10	0.700	4,314.6	0.000	0.547	0.547	0.000	1.095	
468.30	0.900	5,704.1	0.000	0.595	0.595	0.000	1.190	
468.40	1.000	6,425.7	0.000	0.617	0.617	0.000	1.235	Weir
468.50	1.100	7,165.4	0.000	0.639	0.639	0.220	1.498	
468.60	1.200	7,923.5	0.000	0.660	0.660	0.636	1.956	
468.70	1.300	8,700.0	0.000	0.680	0.680	1.191	2.552	Top of Pond

GRAND VALLEY BUSINESS PARK
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Forebay - Pond A

Forebay Length =	135.0	m	(Dist)
Forebay Width =	25.0	m	
Forebay Depth =	1.5	m	(d)
Forebay Bottom Width =	10.0	m	

Approximate Permanent Forebay Pool Volume = 2328 cu m

Length Width Ratio = 5 :1 (r)

2 Year Design Storm Peak Flowrate = 0.140 cu m/s (Qp)

5 Year Design Storm Inflow Rate = 12.280 cu m/s (Q5)

Desired Forebay Velocity = 0.500 m/s (Vf)

Desired Settling Velocity (recommended) = 0.0003 m/s (Vs)

Settling Length

Dist = ((r x Qp)/Vs)^.5 = 50.2 m

Forebay length (135 m) is greater than the settling length (50.2 m).

Dispersion Length

Dist = (8 x Q5)/(d x Vf) = 131.0 m

Forebay length (135 m) meets dispersion length (131 m).

Flow Velocity in Forebay

Cross-sectional Area =	26.25	sq m
Q5 =	12.28	cu m/s

Velocity = Q5/A = 0.47 m/s

The average flow velocity through the forebay is less than the allowable velocity of 0.5 m/s.

GRAND VALLEY BUSINESS PARK
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Forebay - Pond B

Forebay Length =	25.5	m	(Dist)
Forebay Width =	9.5	m	
Forebay Depth =	1.5	m	(d)
Forebay Bottom Width =	0.5	m	

Approximate Permanent Forebay Pool Volume = 72.1 cu m

Length Width Ratio = 3 :1 (r)

2 Year Design Storm Peak Flowrate = 0.039 cu m/s (Qp)

5 Year Design Storm Inflow Rate = 2.357 cu m/s (Q5)

Desired Forebay Velocity = 0.500 m/s (Vf)

Desired Settling Velocity (recommended) = 0.0003 m/s (Vs)

Settling Length

Dist = ((r x Qp)/Vs)^.5 = 18.7 m

Forebay length (12 m) is greater than the settling length (11.5 m).

Dispersion Length

Dist = (8 x Q5)/(d x Vf) = 25.1 m

Forebay length (12 m) exceeds dispersion length (1.8 m).

Flow Velocity in Forebay

Cross-sectional Area =	7.5	sq m
Q5 =	2.357	cu m/s

Velocity = Q5/A = 0.31 m/s

The average flow velocity through the forebay is less than the allowable velocity of 0.5 m/s.

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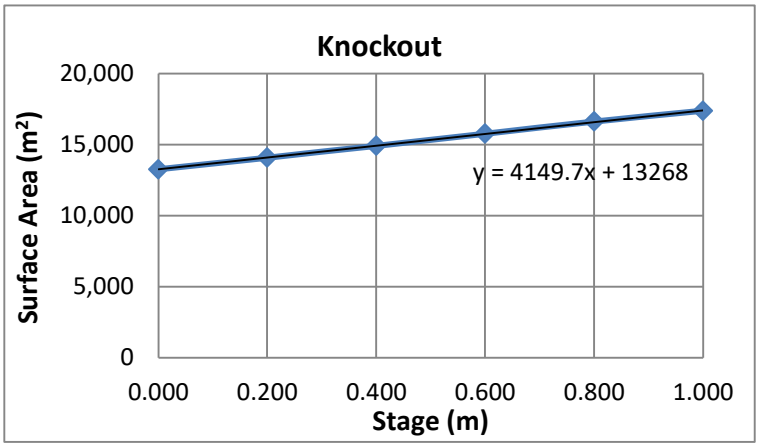
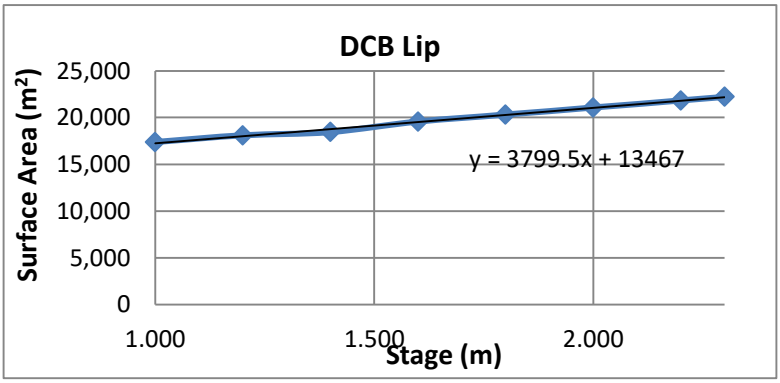
Stormwater Management Facility - Pond A

Drawdown Calculations

Elevation	Stage (m)	Surface area (m^2)	
456.00	0.000	13,266	Bottom of Active Storage
456.20	0.200	14,088	
456.40	0.400	14,923	
456.60	0.600	15,769	
456.80	0.800	16,627	
457.00	1.000	17,383	Catchbasin Inlet
457.20	1.200	18,109	
457.40	1.400	18,474	
457.60	1.600	19,580	
457.80	1.800	20,326	
458.00	2.000	21,079	
458.20	2.200	21,838	
458.30	2.300	22,240	Weir
458.45	2.450	22,800	
458.60	2.600	23,094	Top of Pond





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$$t = \frac{0.66C_2h^{1.5} + 2C_3h^{0.5}}{2.75A_o}$$

Eq. 4.11 (MOE, 2003)

Minor Control			Major Controls		
Given: d =	0.210	m	Given: d =	1.490	m
A_o =	0.035	m	A_o =	0.586	m
C_2 =	3604.7		C_2 =	3821.7	
C_3 =	14098		C_3 =	13876	

Storm	Ponding Depth	Minor Control (m)	Minor Control Drawdown (hr)	Major Controls h (m)	Major Controls Drawdown (hr)	Total Drawdown (hr)
2-Year	456.94	0.94	86	0.00	0	86.0
5-Year	457.14	1.00	89	0.14	0	89.2
100-Year	458.12	1.00	89	1.12	6	94.7
Regional	458.41	1.00	89	1.30	6	95.3

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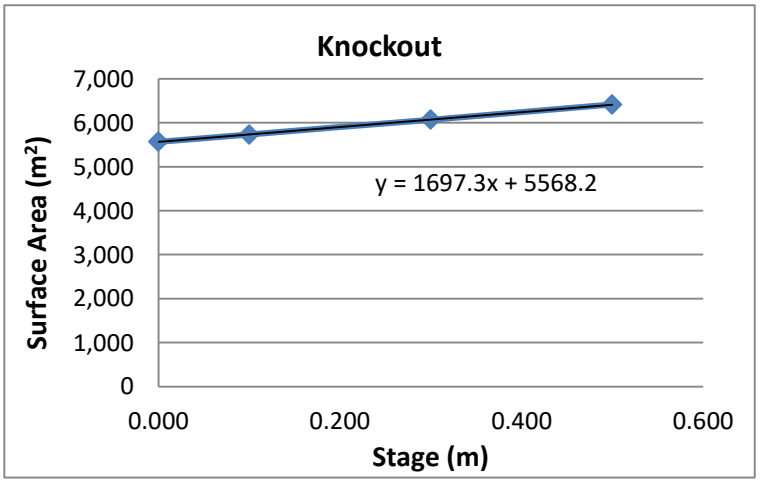
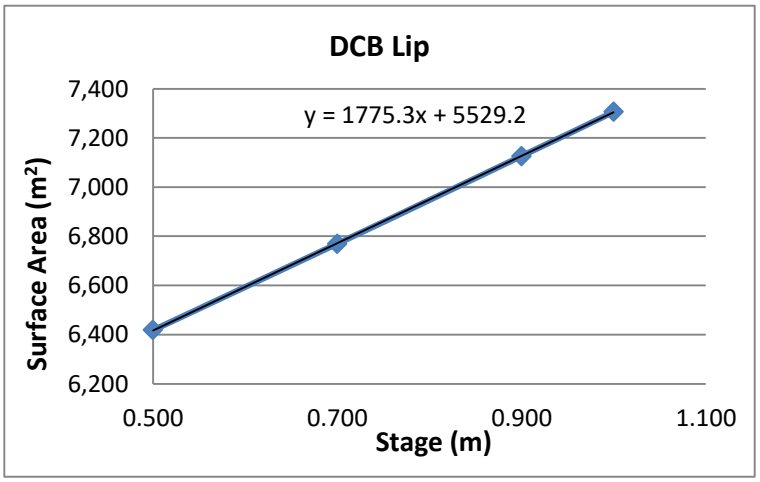
Stormwater Management Facility - Pond B

Drawdown Calculations

Elevation	Stage (m)	Surface area (m^2)	
467.40	0.000	5,570	Knockout Invert
467.50	0.100	5,737	
467.70	0.300	6,075	
467.90	0.500	6,419	Catchbasin Inlet
468.10	0.700	6,769	
468.30	0.900	7,126	
468.40	1.000	7,306	Weir
468.50	1.100	7,489	
468.60	1.200	7,673	
468.70	1.300	7,858	Top of Pond





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$$t = \frac{0.66C_2h^{1.5} + 2C_3h^{0.5}}{2.75A_o}$$

Eq. 4.11 (MOE, 2003)

Knockout			**Major Controls**		
Given: d =	0.140	m	Given: d =	0.500	m x 2
A_o =	0.015	m	A_o =	0.393	m
C_2 =	1697.3		C_2 =	1775.3	
C_3 =	5568.2		C_3 =	5529.2	

Storm	Ponding Depth	Knockout h (m)	Knockout Drawdown (hr)	Major Controls h (m)	Major Controls Drawdown (hr)	Total Drawdown (hr)
2-Year	467.80	0.40	48	0.00	0	48.1
5-Year	467.94	0.50	54	0.04	1	54.8
100-Year	468.18	0.50	54	0.28	2	55.8
Regional	468.09	0.50	54	0.19	1	55.5

```
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"                MIDUSS created                       Sunday, February 07, 2010"
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"                Company                                                   gmbp"
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"            1   Chicago storm"
"      695.047   Coefficient A"
"        6.387   Constant B"
"        0.793   Exponent C"
"        0.380   Fraction R"
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"        1.000   Time step multiplier"
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"             Total depth                  35.279    mm"
"            6   002hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 202"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          202   Catchment 202"
"       30.000   % Impervious"
"        2.160   Total Area"
"       70.000   Flow length"
"        5.000   Overland Slope"
"        1.512   Pervious Area"
"       70.000   Pervious length"
"        5.000   Pervious slope"
"        0.648   Impervious Area"
"       70.000   Impervious length"
"        5.000   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"
"                     0.140     0.000     0.000     0.000 c.m/sec"
"             Catchment 202          Pervious   Impervious Total Area "
"             Surface Area           1.512      0.648      2.160      hectare"
"             Time of concentration  37.614     2.812      5.264      minutes"
"             Time to Centroid       131.152    114.444    115.621    minutes"
"             Rainfall depth         35.279     35.279     35.279     mm"
"             Rainfall volume        533.42     228.61     762.04     c.m"
"             Rainfall losses        34.201     2.061      24.559     mm"
"             Runoff depth           1.079      33.218     10.721     mm"
"             Runoff volume          16.31      215.26     231.57     c.m"
"             Runoff coefficient     0.031      0.942      0.304      "
"             Maximum flow           0.007      0.140      0.140      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.140     0.140     0.000     0.000"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          201   Catchment 201"
"       80.000   % Impervious"
"       57.380   Total Area"
"      500.000   Flow length"
"        5.000   Overland Slope"
"       11.476   Pervious Area"
"      500.000   Pervious length"
"        5.000   Pervious slope"
"       45.904   Impervious Area"
"      500.000   Impervious length"
"        5.000   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"
"                     8.564     0.140     0.000     0.000 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           11.476     45.904     57.380     hectare"
"             Time of concentration  122.368    9.149      10.050     minutes"
"             Time to Centroid       202.490    124.306    124.928    minutes"
"             Rainfall depth         35.279     35.279     35.279     mm"
"             Rainfall volume        0.4049     1.6195     2.0243     ha-m"
"             Rainfall losses        34.200     1.646      8.156      mm"
"             Runoff depth           1.080      33.634     27.123     mm"
```

```
"             Runoff volume          0.0124     1.5439     1.5563     ha-m"
"             Runoff coefficient     0.031      0.953      0.769      "
"             Maximum flow           0.018      8.563      8.564      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    8.564     8.679     0.000     0.000"
" 54          POND DESIGN"
"         8.679   Current peak flow    c.m/sec"
"         3.965   Target outflow    c.m/sec"
"       15794.8   Hydrograph volume    c.m"
"          15.    Number of stages"
"       456.000   Minimum water level    metre"
"       458.600   Maximum water level    metre"
"       456.000   Starting water level    metre"
"             0   Keep Design Data: 1 = True; 0 = False"
"                   Level Discharge    Volume"
"                 456.000     0.000     0.000"
"                 456.200    0.1010  2735.400"
"                 456.400    0.1090  5636.500"
"                 456.600    0.1160  8705.700"
"                 456.800    0.1230  11945.30"
"                 457.000    0.1300  15346.30"
"                 457.200     2.101  18895.50"
"                 457.400     2.214  22553.70"
"                 457.600     2.322  26359.20"
"                 457.800     2.424  30349.80"
"                 458.000     2.523  34490.30"
"                 458.200     2.617  38782.00"
"                 458.300     2.663  40985.90"
"                 458.450     3.531  44363.90"
"                 458.600     5.093  47805.90"
"             Peak outflow                  0.128    c.m/sec"
"             Maximum level               456.939    metre"
"             Maximum storage           14302.301    c.m"
"             Centroidal lag               20.754   hours"
"                  8.564     8.679     0.128     0.000 c.m/sec"
" 40          HYDROGRAPH   Combine    5"
"            6   Combine "
"            5   Node #"
"                Outflow"
"             Maximum flow                  0.128    c.m/sec"
"             Hydrograph volume         10117.271    c.m"
"                    8.564     8.679     0.128     0.128"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    8.564     0.000     0.128     0.128"
" 33          CATCHMENT 203"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
```

```
"          203   Catchment 203"
"       80.000   % Impervious"
"       10.210   Total Area"
"      230.000   Flow length"
"        2.000   Overland Slope"
"        2.042   Pervious Area"
"      230.000   Pervious length"
"        2.000   Pervious slope"
"        8.168   Impervious Area"
"      230.000   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"
"                     1.764     0.000     0.128     0.128 c.m/sec"
"             Catchment 203          Pervious   Impervious Total Area "
"             Surface Area           2.042      8.168      10.210     hectare"
"             Time of concentration  101.090    7.558      8.302      minutes"
"             Time to Centroid       184.593    121.886    122.385    minutes"
"             Rainfall depth         35.279     35.279     35.279     mm"
"             Rainfall volume        720.41     2881.62    3602.03    c.m"
"             Rainfall losses        34.200     1.633      8.147      mm"
"             Runoff depth           1.080      33.646     27.133     mm"
"             Runoff volume          22.05      2748.20    2770.25    c.m"
"             Runoff coefficient     0.031      0.954      0.769      "
"             Maximum flow           0.004      1.764      1.764      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     1.764     1.764     0.128     0.128"
" 54          POND DESIGN"
"        1.764   Current peak flow    c.m/sec"
"        3.965   Target outflow    c.m/sec"
"       2770.3   Hydrograph volume    c.m"
"          18.   Number of stages"
"      468.300   Minimum water level    metre"
"      470.000   Maximum water level    metre"
"      468.300   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                468.300     0.000     0.000"
"                468.400   0.01910   441.900"
"                468.500   0.02700   902.700"
"                468.600   0.03300  1382.600"
```

```
"               468.700   0.03820  1881.900"
"               468.800   0.04270  2400.100"
"               468.900   0.04670  2936.500"
"               469.000    0.9038  3491.200"
"               469.100    0.9622  4064.500"
"               469.200     1.017  4656.600"
"               469.300     1.069  5267.800"
"               469.400     1.119  5898.200"
"               469.500     1.167  6548.100"
"               469.600     1.213  7217.700"
"               469.700     1.257  7907.200"
"               469.800     1.299  8616.800"
"               469.900     1.565  9346.800"
"               470.000     2.014  10097.30"
"             Peak outflow                  0.042    c.m/sec"
"             Maximum level               468.787    metre"
"             Maximum storage            2334.794    c.m"
"             Centroidal lag               12.948   hours"
"                  1.764     1.764     0.042     0.128 c.m/sec"
" 40          HYDROGRAPH   Combine    5"
"            6   Combine "
"            5   Node #"
"               Outflow"
"             Maximum flow                  0.170    c.m/sec"
"             Hydrograph volume         12627.605    c.m"
"                     1.764     1.764     0.042     0.170"
" 38          START/RE-START TOTALS 203"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                     69.750    hectare"
"             Total Impervious area                    54.720    hectare"
"             Total % impervious                       78.452"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:                              W:\Guelph\117-2017\"
"                117184  Thomasfield Industrial Lands Pre-Engineering\5 Work in
Progress\Design Calcs\Modelling Files\2021-12-16"
"                Output filename:                                  Post__5yr.out"
"                Licensee name:                                            gmbp"
"                Company                                                   gmbp"
"                Date & Time last used:                12/16/2021 at 1:42:52 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      240.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     1459.072   Coefficient A"
"       13.690   Constant B"
"        0.850   Exponent C"
"        0.380   Fraction R"
"      240.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           119.322    mm/hr"
"             Total depth                  52.781    mm"
"            6   005hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 202"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          202   Catchment 202"
"       30.000   % Impervious"
"        2.160   Total Area"
"       70.000   Flow length"
"        5.000   Overland Slope"
"        1.512   Pervious Area"
"       70.000   Pervious length"
"        5.000   Pervious slope"
"        0.648   Impervious Area"
"       70.000   Impervious length"
"        5.000   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"
"                     0.199     0.000     0.000     0.000 c.m/sec"
"             Catchment 202          Pervious   Impervious Total Area "
"             Surface Area           1.512      0.648      2.160      hectare"
"             Time of concentration  18.077     2.611      8.021      minutes"
"             Time to Centroid       117.872    112.483    114.368    minutes"
"             Rainfall depth         52.781     52.781     52.781     mm"
"             Rainfall volume        798.05     342.02     1140.07    c.m"
"             Rainfall losses        41.167     2.414      29.541     mm"
"             Runoff depth           11.614     50.367     23.240     mm"
"             Runoff volume          175.61     326.38     501.99     c.m"
"             Runoff coefficient     0.220      0.954      0.440      "
"             Maximum flow           0.100      0.182      0.199      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.199     0.199     0.000     0.000"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          201   Catchment 201"
"       80.000   % Impervious"
"       57.380   Total Area"
"      500.000   Flow length"
"        5.000   Overland Slope"
"       11.476   Pervious Area"
"      500.000   Pervious length"
"        5.000   Pervious slope"
"       45.904   Impervious Area"
"      500.000   Impervious length"
"        5.000   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"
"                    12.081     0.199     0.000     0.000 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           11.476     45.904     57.380     hectare"
"             Time of concentration  58.811     8.493      11.199     minutes"
"             Time to Centroid       157.443    121.024    122.982    minutes"
"             Rainfall depth         52.781     52.781     52.781     mm"
"             Rainfall volume        0.6057     2.4229     3.0286     ha-m"
"             Rainfall losses        41.154     1.623      9.529      mm"
"             Runoff depth           11.627     51.158     43.252     mm"
```

```
"             Runoff volume          0.1334     2.3484     2.4818     ha-m"
"             Runoff coefficient     0.220      0.969      0.819      "
"             Maximum flow           0.304      12.035     12.081     c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    12.081    12.280     0.000     0.000"
" 54          POND DESIGN"
"       12.280   Current peak flow    c.m/sec"
"        3.965   Target outflow    c.m/sec"
"      25320.1   Hydrograph volume    c.m"
"         15.    Number of stages"
"      456.000   Minimum water level    metre"
"      458.600   Maximum water level    metre"
"      456.000   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                456.000     0.000     0.000"
"                456.200    0.1010  2735.400"
"                456.400    0.1090  5636.500"
"                456.600    0.1160  8705.700"
"                456.800    0.1230  11945.30"
"                457.000    0.1300  15346.30"
"                457.200     2.101  18895.50"
"                457.400     2.214  22553.70"
"                457.600     2.322  26359.20"
"                457.800     2.424  30349.80"
"                458.000     2.523  34490.30"
"                458.200     2.617  38782.00"
"                458.300     2.663  40985.90"
"                458.450     3.531  44363.90"
"                458.600     5.093  47805.90"
"             Peak outflow                  1.521    c.m/sec"
"             Maximum level               457.141    metre"
"             Maximum storage           17851.188    c.m"
"             Centroidal lag               15.909   hours"
"                 12.081    12.280     1.521     0.000 c.m/sec"
" 40          HYDROGRAPH   Combine    5"
"            6   Combine "
"            5   Node #"
"                Outflow"
"             Maximum flow                  1.521    c.m/sec"
"             Hydrograph volume         18582.266    c.m"
"                    12.081    12.280     1.521     1.521"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    12.081     0.000     1.521     1.521"
" 33          CATCHMENT 203"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
```

```
"          203   Catchment 203"
"       80.000   % Impervious"
"       10.210   Total Area"
"      230.000   Flow length"
"        2.000   Overland Slope"
"        2.042   Pervious Area"
"      230.000   Pervious length"
"        2.000   Pervious slope"
"        8.168   Impervious Area"
"      230.000   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"
"                     2.357     0.000     1.521     1.521 c.m/sec"
"             Catchment 203          Pervious   Impervious Total Area "
"             Surface Area           2.042      8.168      10.210     hectare"
"             Time of concentration  48.584     7.016      9.259      minutes"
"             Time to Centroid       147.514    118.940    120.482    minutes"
"             Rainfall depth         52.781     52.781     52.781     mm"
"             Rainfall volume        1077.79    4311.17    5388.96    c.m"
"             Rainfall losses        41.155     1.823      9.690      mm"
"             Runoff depth           11.626     50.958     43.092     mm"
"             Runoff volume          237.40     4162.25    4399.66    c.m"
"             Runoff coefficient     0.220      0.965      0.816      "
"             Maximum flow           0.064      2.345      2.357      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     2.357     2.357     1.521     1.521"
" 54          POND DESIGN"
"        2.357   Current peak flow    c.m/sec"
"        3.965   Target outflow    c.m/sec"
"       4399.7   Hydrograph volume    c.m"
"          18.   Number of stages"
"      468.300   Minimum water level    metre"
"      470.000   Maximum water level    metre"
"      468.300   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                468.300     0.000     0.000"
"                468.400   0.01910   441.900"
"                468.500   0.02700   902.700"
"                468.600   0.03300  1382.600"
```

```
"               468.700   0.03820  1881.900"
"               468.800   0.04270  2400.100"
"               468.900   0.04670  2936.500"
"               469.000    0.9038  3491.200"
"               469.100    0.9622  4064.500"
"               469.200     1.017  4656.600"
"               469.300     1.069  5267.800"
"               469.400     1.119  5898.200"
"               469.500     1.167  6548.100"
"               469.600     1.213  7217.700"
"               469.700     1.257  7907.200"
"               469.800     1.299  8616.800"
"               469.900     1.565  9346.800"
"               470.000     2.014  10097.30"
"             Peak outflow                  0.314    c.m/sec"
"             Maximum level               468.931    metre"
"             Maximum storage            3109.653    c.m"
"             Centroidal lag               11.583   hours"
"                  2.357     2.357     0.314     1.521 c.m/sec"
" 40          HYDROGRAPH   Combine    5"
"            6   Combine "
"            5   Node #"
"                Outflow"
"             Maximum flow                  1.823    c.m/sec"
"             Hydrograph volume         22516.049    c.m"
"                     2.357     2.357     0.314     1.823"
" 38          START/RE-START TOTALS 203"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                     69.750    hectare"
"             Total Impervious area                    54.720    hectare"
"             Total % impervious                       78.452"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:                              W:\Guelph\117-2017\"
"                117184  Thomasfield Industrial Lands Pre-Engineering\5 Work in
Progress\Design Calcs\Modelling Files\2021-12-16"
"                Output filename:                              Post__100yr.out"
"                Licensee name:                                           gmbp"
"                Company                                                  gmbp"
"                Date & Time last used:              12/16/2021 at 1:44:16 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      240.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     6933.019   Coefficient A"
"       34.699   Constant B"
"        0.998   Exponent C"
"        0.380   Fraction R"
"      240.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           174.290    mm/hr"
"             Total depth                 102.095    mm"
"            6   100hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 202"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          202   Catchment 202"
"       30.000   % Impervious"
"        2.160   Total Area"
"       70.000   Flow length"
"        5.000   Overland Slope"
"        1.512   Pervious Area"
"       70.000   Pervious length"
"        5.000   Pervious slope"
"        0.648   Impervious Area"
"       70.000   Impervious length"
"        5.000   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"
"                     0.600     0.000     0.000     0.000 c.m/sec"
"             Catchment 202          Pervious   Impervious Total Area "
"             Surface Area           1.512      0.648      2.160      hectare"
"             Time of concentration  12.696     2.244      7.996      minutes"
"             Time to Centroid       117.442    109.907    114.054    minutes"
"             Rainfall depth         102.095    102.095    102.095    mm"
"             Rainfall volume        1543.67    661.57     2205.24    c.m"
"             Rainfall losses        50.261     3.271      36.164     mm"
"             Runoff depth           51.834     98.824     65.931     mm"
"             Runoff volume          783.73     640.38     1424.11    c.m"
"             Runoff coefficient     0.508      0.968      0.646      "
"             Maximum flow           0.419      0.284      0.600      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.600     0.600     0.000     0.000"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          201   Catchment 201"
"       80.000   % Impervious"
"       57.380   Total Area"
"      500.000   Flow length"
"        5.000   Overland Slope"
"       11.476   Pervious Area"
"      500.000   Pervious length"
"        5.000   Pervious slope"
"       45.904   Impervious Area"
"      500.000   Impervious length"
"        5.000   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"
"                    21.414     0.600     0.000     0.000 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           11.476     45.904     57.380     hectare"
"             Time of concentration  41.302     7.299      11.206     minutes"
"             Time to Centroid       148.088    116.712    120.317    minutes"
"             Rainfall depth         102.095    102.095    102.095    mm"
"             Rainfall volume        1.1716     4.6866     5.8582     ha-m"
"             Rainfall losses        50.124     2.018      11.639     mm"
"             Runoff depth           51.971     100.077    90.456     mm"
```

```
"             Runoff volume          0.5964     4.5939     5.1903     ha-m"
"             Runoff coefficient     0.509      0.980      0.886      "
"             Maximum flow           1.556      21.035     21.414     c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    21.414    22.014     0.000     0.000"
" 54          POND DESIGN"
"       22.014   Current peak flow    c.m/sec"
"        3.965   Target outflow    c.m/sec"
"      53327.5   Hydrograph volume    c.m"
"          15.   Number of stages"
"      456.000   Minimum water level    metre"
"      458.600   Maximum water level    metre"
"      456.000   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                456.000     0.000     0.000"
"                456.200    0.1010  2735.400"
"                456.400    0.1090  5636.500"
"                456.600    0.1160  8705.700"
"                456.800    0.1230  11945.30"
"                457.000    0.1300  15346.30"
"                457.200     2.101  18895.50"
"                457.400     2.214  22553.70"
"                457.600     2.322  26359.20"
"                457.800     2.424  30349.80"
"                458.000     2.523  34490.30"
"                458.200     2.617  38782.00"
"                458.300     2.663  40985.90"
"                458.450     3.531  44363.90"
"                458.600     5.093  47805.90"
"             Peak outflow                  2.579    c.m/sec"
"             Maximum level               458.119    metre"
"             Maximum storage           37042.898    c.m"
"             Centroidal lag               10.253   hours"
"                 21.414    22.014     2.579     0.000 c.m/sec"
" 40          HYDROGRAPH   Combine    5"
"            6   Combine "
"            5   Node #"
"                Outflow"
"             Maximum flow                  2.579    c.m/sec"
"             Hydrograph volume         45870.086    c.m"
"                    21.414    22.014     2.579     2.579"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    21.414     0.000     2.579     2.579"
" 33          CATCHMENT 203"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
```

```
"          203   Catchment 203"
"       80.000   % Impervious"
"       10.210   Total Area"
"      230.000   Flow length"
"        2.000   Overland Slope"
"        2.042   Pervious Area"
"      230.000   Pervious length"
"        2.000   Pervious slope"
"        8.168   Impervious Area"
"      230.000   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"
"                     3.607     0.000     2.579     2.579 c.m/sec"
"             Catchment 203          Pervious   Impervious Total Area "
"             Surface Area           2.042      8.168      10.210     hectare"
"             Time of concentration  34.120     6.030      9.271      minutes"
"             Time to Centroid       140.393    115.076    117.997    minutes"
"             Rainfall depth         102.095    102.095    102.095    mm"
"             Rainfall volume        0.2085     0.8339     1.0424     ha-m"
"             Rainfall losses        50.115     2.480      12.007     mm"
"             Runoff depth           51.980     99.614     90.087     mm"
"             Runoff volume          1061.43    8136.50    9197.92    c.m"
"             Runoff coefficient     0.509      0.976      0.882      "
"             Maximum flow           0.318      3.512      3.607      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     3.607     3.607     2.579     2.579"
" 54          POND DESIGN"
"        3.607   Current peak flow    c.m/sec"
"        3.965   Target outflow    c.m/sec"
"       9197.9   Hydrograph volume    c.m"
"          18.   Number of stages"
"      468.300   Minimum water level    metre"
"      470.000   Maximum water level    metre"
"      468.300   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                468.300     0.000     0.000"
"                468.400   0.01910   441.900"
"                468.500   0.02700   902.700"
"                468.600   0.03300  1382.600"
```

```
"               468.700   0.03820  1881.900"
"               468.800   0.04270  2400.100"
"               468.900   0.04670  2936.500"
"               469.000    0.9038  3491.200"
"               469.100    0.9622  4064.500"
"               469.200     1.017  4656.600"
"               469.300     1.069  5267.800"
"               469.400     1.119  5898.200"
"               469.500     1.167  6548.100"
"               469.600     1.213  7217.700"
"               469.700     1.257  7907.200"
"               469.800     1.299  8616.800"
"               469.900     1.565  9346.800"
"               470.000     2.014  10097.30"
"             Peak outflow                  1.040    c.m/sec"
"             Maximum level               469.244    metre"
"             Maximum storage            4928.045    c.m"
"             Centroidal lag                6.916   hours"
"                  3.607     3.607     1.040     2.579 c.m/sec"
" 40          HYDROGRAPH   Combine    5"
"            6   Combine "
"            5   Node #"
"               Outflow"
"             Maximum flow                  3.588    c.m/sec"
"             Hydrograph volume          54581.332    c.m"
"                     3.607     3.607     1.040     3.588"
" 38          START/RE-START TOTALS 203"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                     69.750    hectare"
"             Total Impervious area                    54.720    hectare"
"             Total % impervious                       78.452"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                            Version 2.25  rev. 473"
"                MIDUSS created                          Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:                                W:\Guelph\117-2017\"
"                117184  Thomasfield Industrial Lands Pre-Engineering\5 Work in
Progress\Design Calcs\Modelling Files\2021-12-16"
"                Output filename:                                  Post__REG.out"
"                Licensee name:                                            gmbp"
"                Company                                                   gmbp"
"                Date & Time last used:                 12/16/2021 at 1:49:28 PM"
" 31          TIME PARAMETERS"
"       60.000   Time Step"
"     2880.000   Max. Storm length"
"     3600.000   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"
"            6   000hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 202"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          202   Catchment 202"
"       30.000   % Impervious"
"        2.160   Total Area"
"       70.000   Flow length"
"        5.000   Overland Slope"
"        1.512   Pervious Area"
"       70.000   Pervious length"
"        5.000   Pervious slope"
"        0.648   Impervious Area"
"       70.000   Impervious length"
"        5.000   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"
"                     0.191     0.000     0.000     0.000 c.m/sec"
"             Catchment 202          Pervious   Impervious Total Area "
"             Surface Area           1.512      0.648      2.160      hectare"
"             Time of concentration  21.755     3.612      11.322     minutes"
"             Time to Centroid       2780.027   2237.302   2467.941   minutes"
"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        4309.20    1846.80    6156.00    c.m"
"             Rainfall losses        206.990    38.697     156.503    mm"
"             Runoff depth           78.010     246.303    128.497    mm"
"             Runoff volume          1179.50    1596.04    2775.55    c.m"
"             Runoff coefficient     0.274      0.864      0.451      "
"             Maximum flow           0.125      0.082      0.191      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.191     0.191     0.000     0.000"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          201   Catchment 201"
"       80.000   % Impervious"
"       57.380   Total Area"
"      500.000   Flow length"
"        5.000   Overland Slope"
"       11.476   Pervious Area"
"      500.000   Pervious length"
"        5.000   Pervious slope"
"       45.904   Impervious Area"
"      500.000   Impervious length"
"        5.000   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"
"                     6.032     0.191     0.000     0.000 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           11.476     45.904     57.380     hectare"
```

```
"             Time of concentration  70.776     11.750     15.680     minutes"
"             Time to Centroid       2826.834   2294.164   2329.628   minutes"
"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        3.2707     13.0826    16.3533    ha-m"
"             Rainfall losses        207.445    13.174     52.028     mm"
"             Runoff depth           77.555     271.826    232.972    mm"
"             Runoff volume          0.8900     12.4779    13.3679    ha-m"
"             Runoff coefficient     0.272      0.954      0.817      "
"             Maximum flow           0.829      5.663      6.032      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     6.032     6.223     0.000     0.000"
" 54          POND DESIGN"
"        6.223   Current peak flow    c.m/sec"
"        3.965   Target outflow    c.m/sec"
"     136454.6   Hydrograph volume    c.m"
"          15.   Number of stages"
"      456.000   Minimum water level    metre"
"      458.600   Maximum water level    metre"
"      456.000   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                456.000     0.000     0.000"
"                456.200    0.1010  2735.400"
"                456.400    0.1090  5636.500"
"                456.600    0.1160  8705.700"
"                456.800    0.1230  11945.30"
"                457.000    0.1300  15346.30"
"                457.200     2.101  18895.50"
"                457.400     2.214  22553.70"
"                457.600     2.322  26359.20"
"                457.800     2.424  30349.80"
"                458.000     2.523  34490.30"
"                458.200     2.617  38782.00"
"                458.300     2.663  40985.90"
"                458.450     3.531  44363.90"
"                458.600     5.093  47805.90"
"             Peak outflow                  3.273    c.m/sec"
"             Maximum level               458.405    metre"
"             Maximum storage           43358.977    c.m"
"             Centroidal lag               46.557   hours"
"                  6.032     6.223     3.273     0.000 c.m/sec"
" 40          HYDROGRAPH   Combine    5"
"            6   Combine "
"            5   Node #"
"                Outflow"
"             Maximum flow                  3.273    c.m/sec"
"             Hydrograph volume        123744.688    c.m"
"                     6.032     6.223     3.273     3.273"
" 40          HYDROGRAPH Start - New Tributary"
```

```
"            2   Start - New Tributary"
"                     6.032     0.000     3.273     3.273"
" 33          CATCHMENT 203"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          203   Catchment 203"
"       80.000   % Impervious"
"       10.210   Total Area"
"      230.000   Flow length"
"        2.000   Overland Slope"
"        2.042   Pervious Area"
"      230.000   Pervious length"
"        2.000   Pervious slope"
"        8.168   Impervious Area"
"      230.000   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"
"                     1.101     0.000     3.273     3.273 c.m/sec"
"             Catchment 203          Pervious   Impervious Total Area "
"             Surface Area           2.042      8.168      10.210     hectare"
"             Time of concentration  58.469     9.707      13.004     minutes"
"             Time to Centroid       2815.490   2272.646   2309.351   minutes"
"             Rainfall depth         285.000    285.000    285.000    mm"
"             Rainfall volume        0.5820     2.3279     2.9099     ha-m"
"             Rainfall losses        206.768    15.299     53.593     mm"
"             Runoff depth           78.232     269.701    231.407    mm"
"             Runoff volume          0.1598     2.2029     2.3627     ha-m"
"             Runoff coefficient     0.274      0.946      0.812      "
"             Maximum flow           0.159      1.021      1.101      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     1.101     1.101     3.273     3.273"
" 54          POND DESIGN"
"        1.101   Current peak flow    c.m/sec"
"        3.965   Target outflow    c.m/sec"
"      23626.7   Hydrograph volume    c.m"
"          18.   Number of stages"
"      468.300   Minimum water level    metre"
"      470.000   Maximum water level    metre"
"      468.300   Starting water level    metre"
```

```
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                468.300     0.000     0.000"
"                468.400   0.01910   441.900"
"                468.500   0.02700   902.700"
"                468.600   0.03300  1382.600"
"                468.700   0.03820  1881.900"
"                468.800   0.04270  2400.100"
"                468.900   0.04670  2936.500"
"                469.000    0.9038  3491.200"
"                469.100    0.9622  4064.500"
"                469.200     1.017  4656.600"
"                469.300     1.069  5267.800"
"                469.400     1.119  5898.200"
"                469.500     1.167  6548.100"
"                469.600     1.213  7217.700"
"                469.700     1.257  7907.200"
"                469.800     1.299  8616.800"
"                469.900     1.565  9346.800"
"                470.000     2.014  10097.30"
"             Peak outflow                  0.945    c.m/sec"
"             Maximum level               469.071    metre"
"             Maximum storage            3897.736    c.m"
"             Centroidal lag               43.622   hours"
"                  1.101     1.101     0.945     3.273 c.m/sec"
" 40          HYDROGRAPH   Combine    5"
"            6   Combine "
"            5   Node #"
"                Outflow"
"             Maximum flow                  3.865    c.m/sec"
"             Hydrograph volume        145778.516    c.m"
"                     1.101     1.101     0.945     3.865"
" 38          START/RE-START TOTALS 203"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                     69.750    hectare"
"             Total Impervious area                    54.720    hectare"
"             Total % impervious                       78.452"
" 19          EXIT"
```