Vant Spyker + Schulz
Proposed Warehouse / Storage
Stormwater Management Report

120 Pillsbury Drive
Midland ON
22-6506

September 26, 2024

Submitted By:

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Record of Revisions

Revision	Date	Description
1.0	December 2023	Initial Submission to Town
1.1	February 2024	Pre-Consultation Resubmission to Town
1.2	September 2024	Revised per Town Pre-Consultation Comments

Prepared By:

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Reviewed By:

David W. Lalonde, P. Eng.

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Appendices

1.0 Introduction

Quantum Engineering Inc. (Quantum) has been retained by Eric Vant Spyker and Lindsay Schultz (1793925 Ontario Inc.) to provide engineering services related to the site plan design; including but not limited to, site servicing; grading; and stormwater management design for the proposed Vant Spyker + Schultz warehouse and office development. The proposed development is to be located at 120 Pillsbury Drive in the Town of Midland and consists of a private business facility complete with a one-storey warehouse area and a two-storey professional office area within a single building.

This Stormwater Management (SWM) Report has been prepared in support of an application for Site Plan Approval from the Town of Midland for the proposed Vant Spyker + Schultz development at 120 Pillsbury Drive and is submitted for Town approval of the Stormwater Management Design for the subject property.

2.0 Site Conditions

A hydrogeological assessment has been completed by Ian D. Wilson Associates Ltd, dated November 23, 2023, and provided under separate cover.

As per the hydrogeological assessment, the subject lands occupy a 0.68 ha "L" shaped parcel located on the west side of Pillsbury Drive, approximately 280 m north of the intersection with William Street. The site is currently undeveloped and is mostly forested. The site exhibits a steep topography with a total site relief of approximately 15m to 18m. The proposed development is to be located within the lower, relatively moderate sloped, eastern half of the site. The site location can be seen below in Figure 1.

Figure 1: Site Location

The native soil profile consists of a lightly compact stony sand to stony sandy silt (estimated T-time of 15 to 25min/cm) overlying a sandy silt till (estimated T-time of 30min/cm).

Please refer to above-referenced hydrogeological assessment, provided under separate cover, for additional details.

3.0 Hydrology

Pre-development conditions for the purposes of this SWM Report are taken to be existing site conditions as of December 2023. No existing SWM facilities are currently on-site.

Soils on the subject site consist of a lightly compact stony sand to stony sandy silt overlying a sandy silt till, based on grain-size analyses completed by Ian D. Wilson and included in the hydrogeological assessment. The soil sample testing identified T-times between 15 to 30 min/cm. For the purposes of our calculations, the more conservative value of 30 min/cm was used, and is equal to a permeability 'k'-value of 5.56×10^{-6} m/s.

Peak flows and storage requirements were calculated using the Rational Method (Q = C x I x A). This method calculates peak flows based on drainage area, runoff coefficient, and rainfall intensity. The drainage areas for pre-development and post-development conditions can be found on Drawing SW1 and SW2 in Appendix A. Runoff coefficients are as noted in Table 1 below, and rainfall intensity data are determined based on intensity-duration frequency (IDF) curves provided in the Town of Midland Engineering Development Design Standards, Revised December 2012.

Table 1 : Land Use Categories and Runoff Coefficient Table

Land Use	Runoff Coefficient
Grass	0.20
Paved	0.90
Building	0.90
Trees	0.10

Tables 2 through 6 below summarize the results of the stormwater management analysis with more detailed calculations found in Appendix B.

Table 2: Pre-Development Weighted Runoff Coefficients

Catchment Area	Total Area	Grass	Paved	Building	Trees	Gravel	Weighted C
	[m^2]	[m^2]	[m^2]	[m^2]	[m^2]	[m^2]	
101	6749	0	0	0	6749	0	0.10

Table 3: Pre-Development Peak Flows

Catchment Area	2 Year	5 Year	25 Year	100 Year
	m^3/s	m^3/s	m^3/s	m^3/s
101	0.0084	0.0112	0.0178	0.0196

Table 4: Post-Development Weighted Runoff Coefficient

Catchment Area	Total Area	Grass	Paved	Building	Trees	Gravel	Weighted C
	[m^2]	[m^2]	[m^2]	[m^2]	[m^2]	[m^2]	
201	4258	477	246	0	3535	0	0.16
202	1067	241	0	417	409	0	0.44
203	507	0	507	0	0	0	0.90
204	907	388	519	0	0	0	0.61

Table 5: Uncontrolled Post-Development Peak Flows

Catchment Area	2 Year	5 Year	25 Year	100 Year
	m^3/s	m^3/s	m^3/s	m^3/s
201	0.0083	0.0112	0.0176	0.0195
202	0.0058	0.0077	0.0122	0.0135
203	0.0057	0.0076	0.0120	0.0133
204	0.0068	0.0091	0.0143	0.0158
Total	**0.0266**	**0.0356**	**0.0561**	**0.0621**

Table 6: Pre vs. Uncontrolled Post Development Peak Flow Comparison

Development Area	2 Year	5 Year	25 Year	100 Year
	m^3/s	m^3/s	m^3/s	m^3/s
Pre	0.0084	0.0112	0.0178	0.0196
Post (Uncontrolled)	0.0266	0.0356	0.0561	0.0621
Difference	**0.0182**	**0.0244**	**0.0383**	**0.0425**

As can be seen above in Table 6, the uncontrolled post-development peak flows for all catchment areas (201 to 204) cumulatively are higher than the pre-development conditions (catchment area 101).

In general, the stormwater management approach utilized for this site is to design stormwater facilities through the implementation of LID (i.e. infiltration trenches/basins). For catchment areas 202, 203 and 204, the peak flow rates for up to the 100-year storm event will be contained and infiltrated through infiltration basins as detailed in Section 4.0 below. Catchment area 201, which is mainly forested area to remain in its existing condition, will remain uncontrolled and enter the Town's nearby ditch system. This approach is consistent with its existing condition. A summary of the controlled post-development peak flows, through the implementation of the above-noted proposed LID's, can be seen in Table 7 below. As can be seen below in Table 8, the total controlled post-development peak flow will be significantly lower than the pre-development condition.

Table 7: Controlled Post-Development Peak Flows

Catchment Area	2 Year	5 Year	25 Year	100 Year
	m^3/s	m^3/s	m^3/s	m^3/s
201	0.0083	0.0112	0.0176	0.0195
202	0.0000	0.0000	0.0000	0.0000
203	0.0000	0.0000	0.0000	0.0000
204	0.0000	0.0000	0.0000	0.0000
Total	**0.0083**	**0.0112**	**0.0176**	**0.0195**

Table 8: Pre vs. Controlled Post Development Peak Flow Comparison

Development Area	2 Year	5 Year	25 Year	100 Year
	m^3/s	m^3/s	m^3/s	m^3/s
Pre	0.0084	0.0112	0.0178	0.0196
Post (Uncontrolled)	0.0083	0.0112	0.0176	0.0195
Difference	**≤ 0.0**	**≤ 0.0**	**≤ 0.0**	**≤ 0.0**

Pre-development site conditions are shown on Drawing SW1 in Appendix A. The proposed infiltration trenches and post-development site conditions are shown schematically on Drawing SW2 in Appendix A. Construction details are included within the complete Site Plan Application – Issued for Approval Drawings (Project No. 22-6506, Drawings C1 to C5 by Quantum Engineering Inc., dated September 25, 2024).

4.0 Stormwater Management Plan

The following stormwater management plan has been prepared to address both stormwater quality control, and stormwater quantity control. The intent of this plan is to address stormwater in an environmentally friendly manner. The following sections will address how a combination of catch basins and infiltration trench are being utilized for stormwater management purposes.

.1 Quality Control

Quality control is being provided through the use of standard goss traps at the outlets of catch basins, allowing for the settlement of particles for removal. Catch basins should have a minimum 0.6m deep sump area. Additionally, the catch basins will discharge to the proposed infiltration trench, which will have a 150mm layer of filter sand along its bottom.

For the system to function as intended, it is critical that the system not be clogged with sediment and debris. Our office recommends that catch basins be cleaned-out once or twice per year to ensure the continued removal of silt and oil from the stormwater runoff.

.2 Quantity Control

Several below-grade infiltration trenches or basins are proposed to provide quantity control, to control the 100-year storm event at a minimum, for the subject site. See Table 9 below for details regarding the infiltration systems for each catchment area.

Table 9: Infiltration System Summary

Catchment Area	Total Volume	Effective Storage	Footprint	Length	Width	Depth*
	m^3	m^3	m^2	m	m	m
201	-	-	-	-	-	-
202	42.0	16.8	28.0	28.0	1.0	1.5
203	42.0	16.8	28.0	28.0	1.0	1.5
204	49.5	19.8	33.0	22.0	1.5	1.5
Total	**133.5**	**53.4**	**89.0**	**-**	**-**	**-**

The infiltration trench/basins will cover a total footprint of 89.0m^2, a total storage volume of 133.5 m^3, resulting in an effective storage volume of 53.4 m^3 based on the assumption that it will be filled with 50mm diameter stone with an approximate void space of 40%.

As previously noted, the infiltration calculations are completed utilizing the values determined by Ian D. Wilson within the hydrogeological assessment. This report concluded that a conservative value for infiltration of 30 min/cm was to be carried for SWM design (equal to a permeability 'k'-value of 5.56 x 10^{-6} m/s). It should also be noted that the hydrogeological and water balance analysis report concluded that a total of at least 24.8 m^2 footprint should be allocated to LID measures for infiltration purposes. Our design has met and exceeded that requirement based on our site-specific analysis using the Rational Method.

.3 Operational Maintenance Plan

To reiterate from section 4.1 above, catch basin sumps are to be inspected and cleaned-out once or twice per year to ensure the continued removal of silt and oil from stormwater runoff.

In addition to these annual inspections, it is recommended that approximately every five years, the 200mm perforated pipe in the infiltration trench should receive a CCTV inspection and be cleaned-out if any build-up of sedimentation is found.

5.0 Conclusions

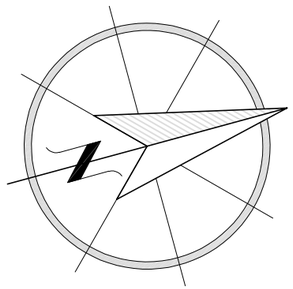
It is the recommendation of our office that the infiltration trenches be implemented as per Drawings SW1, SW2, and C1 to C5 to satisfy SWM quantity and quality control requirements, creating a net reduction in total surface stormwater runoff from pre to post-development.

We trust this SWM Report meets the requirements of the Town of Midland. Should you have any questions, feel free to contact our office.

Appendix A – Drawings

SW1 – Stormwater – Pre Development

SW2 – Stormwater – Post Development



PRE-DEVELOPMENT AREAS

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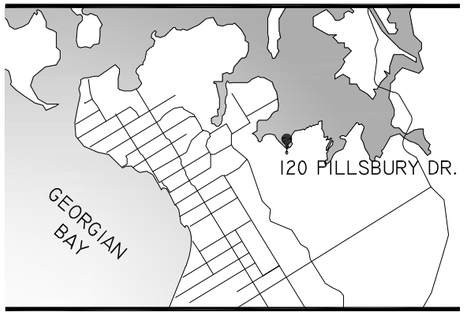

No.	Description	Date
1	FIRST SUBMISSION	DEC 22, 2023
2	FOR PRE-CONSULT	FEB 14, 2024
3	SITE PLAN SUBMISSION	SEPT 25, 2024
4		
5		

QUANTUM ENGINEERING

97 COPELAND CREEK DR
TINY ONTARIO L9M 0M2

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WWW.QENG.CA

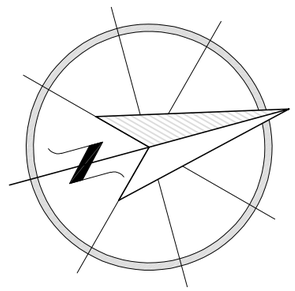
PROJECT
NEW COMMERCIAL FACILITY

LOCATION
120 PILLSBURY DR.
MIDLAND, ONTARIO

FOR
SCHULTZ - VANT SPYKER

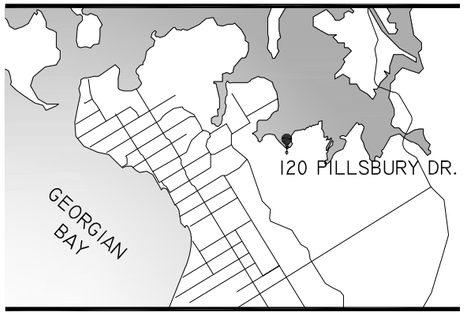
DRAWING
STORM WATER - PRE DEV

DATE	PROJECT NO	PAGE ID
DEC. 2023	6506	SWI
DRAWN BY D.L.W.		
SCALE SEE PLOT		



0.123 ha — CATCHMENT AREA (HECTARES)
001 0.50 — RUN OFF COEFFICIENT
AREA HYDROGRAPH NUMBER

2 POST-DEVELOPMENT AREAS
SCALE: 1:500



No.	Description	Date
1	FIRST SUBMISSION	DEC 22, 2023
2	FOR PRE-CONSULT	FEB 14, 2024
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PROJECT: NEW COMMERCIAL FACILITY

LOCATION: 120 PILLSBURY DR.
MIDLAND, ONTARIO

FOR: SCHULTZ - VANT SPYKER

DRAWING: STORM WATER - POST DEV

DATE	PROJECT NO	PAGE ID
DEC. 2023	5364	SW2
DRAWN BY: D.L.W.		
SCALE: SEE PLOT		

Appendix B – Design Calculations

Pre Development – Catchment 101

2 Year
Catchment Area – 6,739 m^2
Post-development Runoff Coefficient – 0.10
Required Storage – 0 m^3
Provided Storage – 0 m^3
A = 807.44
B = 6.75
C = 0.828

Duration	IDF Intensity	Post Development Peak Q	Inflow Volume	Outflow Volume	Required Storage
[min]	[mm/hr]	[m^3/s]	[m^3]	[m^3]	[m^3]
15	44.84	0.0084			
30	26.54	0.0050			
60	14.61	0.0027			
120	7.69	0.0014			
130	7.13	0.0013			
140	6.65	0.0012			
150	6.22	0.0012			
160	5.85	0.0011			
170	5.52	0.0010			
180	5.22	0.0010			

5 Year
Catchment Area – 6,739 m^2
Post-development Runoff Coefficient – 0.10
Required Storage – 0 m^3
Provided Storage – 0 m^3
A = 1135.4
B = 7.5
C = 0.841

Duration	IDF Intensity	Post Development Peak Q	Inflow Volume	Outflow Volume	Required Storage
[min]	[mm/hr]	[m^3/s]	[m^3]	[m^3]	[m^3]
15	60.00	0.0112			
30	36.00	0.0067			
60	20.00	0.0037			
120	10.59	0.0020			
130	9.82	0.0018			
140	9.15	0.0017			
150	8.57	0.0016			
160	8.06	0.0015			
170	7.61	0.0014			
180	7.20	0.0013			

25 Year
Catchment Area – 6,739 m^2
Post-development Runoff Coefficient – 0.10
Required Storage – 0 m^3
Provided Storage – 0 m^3
A = 1973.1
B = 9.0
C = 0.868

Duration	IDF Intensity	Post Development Peak Q	Inflow Volume	Outflow Volume	Required Storage
min]	[mm/hr]	[m^3/s]	[m^3]	[m^3]	[m^3]
15	94.71	0.0178			
30	58.29	0.0109			
60	32.94	0.0062			
120	17.62	0.0033			
130	16.35	0.0031			
140	15.26	0.0029			
150	14.30	0.0027			
160	13.45	0.0025			
170	12.70	0.0024			
180	12.03	0.0023			

100 Year
Catchment Area – 6,739 m^2
Post-development Runoff Coefficient – 0.10
Required Storage – 0 m^3
Provided Storage – 0 m^3
A = 2193.1
B = 9.04
C = 0.871

Duration	IDF Intensity	Post Development Peak Q	Inflow Volume	Outflow Volume	Required Storage
[min]	[mm/hr]	[m^3/s]	[m^3]	[m^3]	[m^3]
15	104.74	0.0196			
30	64.50	0.0121			
60	36.47	0.0068			
120	19.51	0.0037			
130	18.11	0.0034			
140	16.89	0.0032			
150	15.83	0.0030			
160	14.90	0.0028			
170	14.06	0.0026			
180	13.32	0.0025			

Post Development – Catchment 201

2 Year
Catchment Area – 4,258 m^2
Post-development Runoff Coefficient – 0.16
Required Storage – 0 m^3
Provided Storage – 0 m^3
A = 807.44
B = 6.75
C = 0.828

Duration	IDF Intensity	Post Development Peak Q	Inflow Volume	Outflow Volume	Required Storage
[min]	[mm/hr]	[m^3/s]	[m^3]	[m^3]	[m^3]
15	44.84	0.0083	7.5133	0.2448	7.27
30	26.54	0.0049	8.8933	0.4896	8.40
60	14.61	0.0027	9.7926	0.9792	8.81
120	7.69	0.0014	10.3141	1.9584	8.36
130	7.13	0.0013	10.3565	2.1216	8.23
140	6.65	0.0012	10.3932	2.2848	8.11
150	6.22	0.0012	10.4251	2.448	7.98
160	5.85	0.0011	10.4533	2.6112	7.84
170	5.52	0.0010	10.4782	2.7744	7.70
180	5.22	0.0010	10.5005	2.9376	7.56

5 Year
Catchment Area – 4,258 m^2
Post-development Runoff Coefficient – 0.16
Required Storage – 0 m^3
Provided Storage – 0 m^3
A = 1135.4
B = 7.5
C = 0.841

Duration	IDF Intensity	Post Development Peak Q	Inflow Volume	Outflow Volume	Required Storage
[min]	[mm/hr]	[m^3/s]	[m^3]	[m^3]	[m^3]
15	60.00	0.0112	10.0549	0.3366	9.72
30	36.00	0.0067	12.0659	0.6732	11.39
60	20.00	0.0037	13.4066	1.3464	12.06
120	10.59	0.0020	14.1952	2.6928	11.50
130	9.82	0.0018	14.2597	2.9172	11.34
140	9.15	0.0017	14.3155	3.1416	11.17
150	8.57	0.0016	14.3642	3.366	11.00
160	8.06	0.0015	14.4071	3.5904	10.82
170	7.61	0.0014	14.4451	3.8148	10.63
180	7.20	0.0013	14.4791	4.0392	10.44

25 Year
Catchment Area – 4,258 m^2
Post-development Runoff Coefficient – 0.16
Required Storage – 0 m^3
Provided Storage – 0 m^3
A = 1973.1
B = 9.0
C = 0.868

Duration	IDF Intensity	Post Development Peak Q	Inflow Volume	Outflow Volume	Required Storage
min]	[mm/hr]	[m^3/s]	[m^3]	[m^3]	[m^3]
15	94.71	0.0176	15.8718	0.5202	15.35
30	58.29	0.0109	19.5346	1.0404	18.49
60	32.94	0.0061	22.0826	2.0808	20.00
120	17.62	0.0033	23.6232	4.1616	19.46
130	16.35	0.0030	23.7507	4.5084	19.24
140	15.26	0.0028	23.8610	4.8552	19.01
150	14.30	0.0027	23.9575	5.202	18.76
160	13.45	0.0025	24.0426	5.5488	18.49
170	12.70	0.0024	24.1181	5.8956	18.22
180	12.03	0.0022	24.1857	6.2424	17.94

100 Year
Catchment Area – 4,258 m^2
Post-development Runoff Coefficient – 0.16
Required Storage – 0 m^3
Provided Storage – 0 m^3
A = 2193.1
B = 9.04
C = 0.871

Duration	IDF Intensity	Post Development Peak Q	Inflow Volume	Outflow Volume	Required Storage
[min]	[mm/hr]	[m^3/s]	[m^3]	[m^3]	[m^3]
15	104.74	0.0195	17.5515	0.5814	16.97
30	64.50	0.0120	21.6157	1.1628	20.45
60	36.47	0.0068	24.4461	2.3256	22.12
120	19.51	0.0036	26.1586	4.6512	21.51
130	18.11	0.0034	26.3004	5.0388	21.26
140	16.89	0.0031	26.4231	5.4264	21.00
150	15.83	0.0029	26.5304	5.8140	20.72
160	14.90	0.0028	26.6249	6.2016	20.42
170	14.06	0.0026	26.7090	6.5892	20.12
180	13.32	0.0025	26.7841	6.9768	19.81

Post Development – Catchment 202

2 Year
Catchment Area – 1,067 m^2
Post-development Runoff Coefficient – 0.44
Required Storage – 6.5 m^3
Provided Storage – 16.8 m^3
A = 807.44
B = 6.75
C = 0.828

Duration	IDF Intensity	Post Development Peak Q	Inflow Volume	Outflow Volume	Required Storage
[min]	[mm/hr]	[m^3/s]	[m^3]	[m^3]	[m^3]
15	44.84	0.0058	5.2054	0.0828	5.12
30	26.54	0.0034	6.1615	0.1656	6.00
60	14.61	0.0019	6.7845	0.3312	6.45
120	7.69	0.0010	7.1459	0.6624	6.48
130	7.13	0.0009	7.1752	0.7176	6.46
140	6.65	0.0009	7.2006	0.7728	6.43
150	6.22	0.0008	7.2228	0.828	6.39
160	5.85	0.0008	7.2423	0.8832	6.36
170	5.52	0.0007	7.2596	0.9384	6.32
180	5.22	0.0007	7.2750	0.9936	6.28

5 Year
Catchment Area – 1,067 m^2
Post-development Runoff Coefficient – 0.44
Required Storage – 9.0 m^3
Provided Storage – 16.8 m^3
A = 1135.4
B = 7.5
C = 0.841

Duration	IDF Intensity	Post Development Peak Q	Inflow Volume	Outflow Volume	Required Storage
[min]	[mm/hr]	[m^3/s]	[m^3]	[m^3]	[m^3]
15	60.00	0.0077	6.9663	0.1098	6.86
30	36.00	0.0046	8.3596	0.2196	8.14
60	20.00	0.0026	9.2884	0.4392	8.85
120	10.59	0.0014	9.8348	0.8784	8.96
130	9.82	0.0013	9.8795	0.9516	8.93
140	9.15	0.0012	9.9181	1.0248	8.89
150	8.57	0.0011	9.9519	1.098	8.85
160	8.06	0.0010	9.9816	1.1712	8.81
170	7.61	0.0010	10.0079	1.2444	8.76
180	7.20	0.0009	10.0315	1.3176	8.71

25 Year
Catchment Area – 1,067 m^2
Post-development Runoff Coefficient – 0.44
Required Storage – 14.9 m^3
Provided Storage – 16.8 m^3
A = 1973.1
B = 9.0
C = 0.868

Duration	IDF Intensity	Post Development Peak Q	Inflow Volume	Outflow Volume	Required Storage
min]	[mm/hr]	[m^3/s]	[m^3]	[m^3]	[m^3]
15	94.71	0.0122	10.9964	0.1854	10.81
30	58.29	0.0075	13.5340	0.3708	13.16
60	32.94	0.0042	15.2993	0.7416	14.56
120	17.62	0.0023	16.3667	1.4832	14.88
130	16.35	0.0021	16.4550	1.6068	14.85
140	15.26	0.0020	16.5315	1.7304	14.80
150	14.30	0.0018	16.5983	1.854	14.74
160	13.45	0.0017	16.6573	1.9776	14.68
170	12.70	0.0016	16.7096	2.1012	14.61
180	12.03	0.0016	16.7564	2.2248	14.53

100 Year
Catchment Area – 1,067 m^2
Post-development Runoff Coefficient – 0.44
Required Storage – 16.7 m^3
Provided Storage – 16.8 m^3
A = 2193.1
B = 9.04
C = 0.871

Duration	IDF Intensity	Post Development Peak Q	Inflow Volume	Outflow Volume	Required Storage
[min]	[mm/hr]	[m^3/s]	[m^3]	[m^3]	[m^3]
15	104.74	0.0135	12.1601	0.18	11.98
30	64.50	0.0083	14.9759	0.3600	14.62
60	36.47	0.0047	16.9368	0.7200	16.22
120	19.51	0.0025	18.1233	1.4400	16.68
130	18.11	0.0023	18.2215	1.5600	16.66
140	16.89	0.0022	18.3065	1.6800	16.63
150	15.83	0.0020	18.3809	1.8000	16.58
160	14.90	0.0019	18.4464	1.9200	16.53
170	14.06	0.0018	18.5046	2.0400	16.46
180	13.32	0.0017	18.5567	2.1600	16.40

Infiltration Trench – Catchment 202

T-time = 30 min/cm (k = 5.56 x 10^{-6} m/s)*

Trench Dimensions

Length = 28.0 m
Width = 1.0 m
Depth = 1.5 m
Void Ratio = 40%

Infiltration equation is given by Q = k x I x A
where k = permeability (m/s)
I = water depth (m)
A = trench bottom area (m^2)

Depth	Total Volume	Storage Volume	Infiltration Discharge	Notes
0.00	0.00	0.00	0.000000	Bottom of Trench
0.05	1.40	0.56	0.000008	
0.10	2.80	1.12	0.000016	
0.15	4.20	1.68	0.000023	
0.20	5.60	2.24	0.000031	
0.25	7.00	2.80	0.000039	
0.30	8.40	3.36	0.000047	
0.35	9.80	3.92	0.000054	
0.40	11.20	4.48	0.000062	
0.45	12.60	5.04	0.000070	
0.50	14.00	5.60	0.000078	
0.55	15.40	6.16	0.000086	
0.58	16.24	6.50	0.000090	2 Year
0.60	16.80	6.72	0.000093	
0.65	18.20	7.28	0.000101	
0.70	19.60	7.84	0.000109	
0.75	21.00	8.40	0.000117	
0.79	22.12	8.85	0.000123	
0.80	22.40	8.96	0.000124	5 Year
0.85	23.80	9.52	0.000132	
0.90	25.20	10.08	0.000140	
0.95	26.60	10.64	0.000148	
1.00	28.00	11.20	0.000156	
1.05	29.40	11.76	0.000163	
1.10	30.80	12.32	0.000171	
1.15	32.20	12.88	0.000179	
1.20	33.60	13.44	0.000187	
1.25	35.00	14.00	0.000194	
1.30	36.40	14.56	0.000202	
1.35	37.80	15.12	0.000210	25 Year
1.40	39.20	15.68	0.000218	
1.45	40.60	16.24	0.000226	
1.50	42.00	16.80	0.000233	100 Year, Top of Trench

Post Development – Catchment 203

2 Year
Catchment Area – 507 m^2
Post-development Runoff Coefficient – 0.90
Required Storage – 6.5 m^3
Provided Storage – 16.8 m^3
A = 807.44
B = 6.75
C = 0.828

Duration	IDF Intensity	Post Development Peak Q	Inflow Volume	Outflow Volume	Required Storage
[min]	[mm/hr]	[m^3/s]	[m^3]	[m^3]	[m^3]
15	44.84	0.0057	5.1146	0.0693	5.05
30	26.54	0.0034	6.0540	0.1386	5.92
60	14.61	0.0019	6.6662	0.2772	6.39
120	7.69	0.0010	7.0212	0.5544	6.47
130	7.13	0.0009	7.0501	0.6006	6.45
140	6.65	0.0008	7.0750	0.6468	6.43
150	6.22	0.0008	7.0968	0.693	6.40
160	5.85	0.0007	7.1160	0.7392	6.38
170	5.52	0.0007	7.1329	0.7854	6.35
180	5.22	0.0007	7.1481	0.8316	6.32

5 Year
Catchment Area – 507 m^2
Post-development Runoff Coefficient – 0.90
Required Storage – 8.9 m^3
Provided Storage – 16.8 m^3
A = 1135.4
B = 7.5
C = 0.841

Duration	IDF Intensity	Post Development Peak Q	Inflow Volume	Outflow Volume	Required Storage
[min]	[mm/hr]	[m^3/s]	[m^3]	[m^3]	[m^3]
15	60.00	0.0076	6.8448	0.0945	6.75
30	36.00	0.0046	8.2138	0.189	8.02
60	20.00	0.0025	9.1264	0.378	8.75
120	10.59	0.0013	9.6632	0.756	8.91
130	9.82	0.0012	9.7072	0.819	8.89
140	9.15	0.0012	9.7451	0.882	8.86
150	8.57	0.0011	9.7783	0.945	8.83
160	8.06	0.0010	9.8075	1.008	8.80
170	7.61	0.0010	9.8334	1.071	8.76
180	7.20	0.0009	9.8565	1.134	8.72

25 Year
Catchment Area – 507 m^2
Post-development Runoff Coefficient – 0.90
Required Storage – 14.8 m^3
Provided Storage – 16.8 m^3
A = 1973.1
B = 9.0
C = 0.868

Duration	IDF Intensity	Post Development Peak Q	Inflow Volume	Outflow Volume	Required Storage
min]	[mm/hr]	[m^3/s]	[m^3]	[m^3]	[m^3]
15	94.71	0.0120	10.8046	0.1557	10.65
30	58.29	0.0074	13.2980	0.3114	12.99
60	32.94	0.0042	15.0325	0.6228	14.41
120	17.62	0.0022	16.0813	1.2456	14.84
130	16.35	0.0021	16.1680	1.3494	14.82
140	15.26	0.0019	16.2432	1.4532	14.79
150	14.30	0.0018	16.3088	1.557	14.75
160	13.45	0.0017	16.3667	1.6608	14.71
170	12.70	0.0016	16.4182	1.7646	14.65
180	12.03	0.0015	16.4641	1.8684	14.60

100 Year
Catchment Area – 507 m^2
Post-development Runoff Coefficient – 0.90
Required Storage – 16.37 m^3
Provided Storage – 16.8 m^3
A = 2193.1
B = 9.04
C = 0.871

Duration	IDF Intensity	Post Development Peak Q	Inflow Volume	Outflow Volume	Required Storage
[min]	[mm/hr]	[m^3/s]	[m^3]	[m^3]	[m^3]
15	104.74	0.0133	11.9480	0.18	11.77
30	64.50	0.0082	14.7147	0.3600	14.35
60	36.47	0.0046	16.6414	0.7200	15.92
120	19.51	0.0025	17.8072	1.4400	16.37
130	18.11	0.0023	17.9037	1.5600	16.34
140	16.89	0.0021	17.9872	1.6800	16.31
150	15.83	0.0020	18.0603	1.8000	16.26
160	14.90	0.0019	18.1247	1.9200	16.20
170	14.06	0.0018	18.1819	2.0400	16.14
180	13.32	0.0017	18.2330	2.1600	16.07

Infiltration Trench – Catchment 203

T-time = 30 min/cm (k = 5.56 x 10^{-6} m/s)*

Trench Dimensions

Length = 24.0 m
Width = 1.0 m
Depth = 1.5 m
Void Ratio = 40%

Infiltration equation is given by Q = k x I x A
where k = permeability (m/s)
I = water depth (m)
A = trench bottom area (m^2)

Depth	Total Volume	Storage Volume	Infiltration Discharge	Notes
0.00	0.00	0.00	0.000000	Bottom of Trench
0.05	1.40	0.56	0.000008	
0.10	2.80	1.12	0.000016	
0.15	4.20	1.68	0.000023	
0.20	5.60	2.24	0.000031	
0.25	7.00	2.80	0.000039	
0.30	8.40	3.36	0.000047	
0.35	9.80	3.92	0.000054	
0.40	11.20	4.48	0.000062	
0.45	12.60	5.04	0.000070	
0.50	14.00	5.60	0.000078	
0.55	15.40	6.16	0.000086	
0.58	16.24	6.50	0.000090	2 Year
0.60	16.80	6.72	0.000093	
0.65	18.20	7.28	0.000101	
0.70	19.60	7.84	0.000109	
0.75	21.00	8.40	0.000117	
0.79	22.12	8.85	0.000123	5 Year
0.80	22.40	8.96	0.000124	
0.85	23.80	9.52	0.000132	
0.90	25.20	10.08	0.000140	
0.95	26.60	10.64	0.000148	
1.00	28.00	11.20	0.000156	
1.05	29.40	11.76	0.000163	
1.10	30.80	12.32	0.000171	
1.15	32.20	12.88	0.000179	
1.20	33.60	13.44	0.000187	
1.25	35.00	14.00	0.000194	
1.30	36.40	14.56	0.000202	25 Year
1.35	37.80	15.12	0.000210	
1.40	39.20	15.68	0.000218	
1.45	40.60	16.24	0.000226	
1.50	42.00	16.80	0.000233	100 Year, Top of Trench

Post Development – Catchment 204

2 Year
Catchment Area – 907 m^2
Post-development Runoff Coefficient – 0.60
Required Storage – 7.7 m^3
Provided Storage – 19.8 m^3
A = 807.44
B = 6.75
C = 0.828

Duration	IDF Intensity	Post Development Peak Q	Inflow Volume	Outflow Volume	Required Storage
[min]	[mm/hr]	[m^3/s]	[m^3]	[m^3]	[m^3]
15	44.84	0.0068	6.1055	0.0909	6.01
30	26.54	0.0040	7.2269	0.1818	7.05
60	14.61	0.0022	7.9577	0.3636	7.59
120	7.69	0.0012	8.3815	0.7272	7.65
130	7.13	0.0011	8.4159	0.7878	7.63
140	6.65	0.0010	8.4457	0.8484	7.60
150	6.22	0.0009	8.4717	0.909	7.56
160	5.85	0.0009	8.4945	0.9696	7.52
170	5.52	0.0008	8.5148	1.0302	7.48
180	5.22	0.0008	8.5329	1.0908	7.44

5 Year
Catchment Area – 907 m^2
Post-development Runoff Coefficient – 0.60
Required Storage – 10.5 m^3
Provided Storage – 19.8 m^3
A = 1135.4
B = 7.5
C = 0.841

Duration	IDF Intensity	Post Development Peak Q	Inflow Volume	Outflow Volume	Required Storage
[min]	[mm/hr]	[m^3/s]	[m^3]	[m^3]	[m^3]
15	60.00	0.0091	8.1709	0.1323	8.04
30	36.00	0.0054	9.8050	0.2646	9.54
60	20.00	0.0030	10.8945	0.5292	10.37
120	10.59	0.0016	11.5353	1.0584	10.48
130	9.82	0.0015	11.5878	1.1466	10.44
140	9.15	0.0014	11.6331	1.2348	10.40
150	8.57	0.0013	11.6727	1.323	10.35
160	8.06	0.0012	11.7075	1.4112	10.30
170	7.61	0.0012	11.7384	1.4994	10.24
180	7.20	0.0011	11.7660	1.5876	10.18

25 Year
Catchment Area – 907 m^2
Post-development Runoff Coefficient – 0.60
Required Storage – 17.6 m^3
Provided Storage – 19.8 m^3
A = 1973.1
B = 9.0
C = 0.868

Duration	IDF Intensity	Post Development Peak Q	Inflow Volume	Outflow Volume	Required Storage
min]	[mm/hr]	[m^3/s]	[m^3]	[m^3]	[m^3]
15	94.71	0.0143	12.8978	0.2061	12.69
30	58.29	0.0088	15.8742	0.4122	15.46
60	32.94	0.0050	17.9448	0.8244	17.12
120	17.62	0.0027	19.1967	1.6488	17.55
130	16.35	0.0025	19.3003	1.7862	17.51
140	15.26	0.0023	19.3900	1.9236	17.47
150	14.30	0.0022	19.4684	2.061	17.41
160	13.45	0.0020	19.5375	2.1984	17.34
170	12.70	0.0019	19.5989	2.3358	17.26
180	12.03	0.0018	19.6538	2.4732	17.18

100 Year
Catchment Area – 907 m^2
Post-development Runoff Coefficient – 0.60
Required Storage – 19.4 m^3
Provided Storage – 19.8 m^3
A = 2193.1
B = 9.04
C = 0.871

Duration	IDF Intensity	Post Development Peak Q	Inflow Volume	Outflow Volume	Required Storage
[min]	[mm/hr]	[m^3/s]	[m^3]	[m^3]	[m^3]
15	104.74	0.0158	14.2627	0.2313	14.03
30	64.50	0.0098	17.5654	0.4626	17.10
60	36.47	0.0055	19.8654	0.9252	18.94
120	19.51	0.0030	21.2571	1.8504	19.41
130	18.11	0.0027	21.3722	2.0046	19.37
140	16.89	0.0026	21.4720	2.1588	19.31
150	15.83	0.0024	21.5591	2.3130	19.25
160	14.90	0.0023	21.6360	2.4672	19.17
170	14.06	0.0021	21.7043	2.6214	19.08
180	13.32	0.0020	21.7653	2.7756	18.99

Infiltration Trench – Catchment 204

T-time = 30 min/cm (k = 5.56 x 10^{-6} m/s)*

Trench Dimensions

Length = 22.0 m
Width = 1.5 m
Depth = 1.5 m
Void Ratio = 40%

Infiltration equation is given by Q = k x I x A
where k = permeability (m/s)
I = water depth (m)
A = trench bottom area (m^2)

Depth	Total Volume	Storage Volume	Infiltration Discharge	Notes
0.00	0.00	0.00	0.000000	Bottom of Trench
0.05	1.65	0.66	0.000009	
0.10	3.30	1.32	0.000018	
0.15	4.95	1.98	0.000028	
0.20	6.60	2.64	0.000037	
0.25	8.25	3.30	0.000046	
0.30	9.90	3.96	0.000055	
0.35	11.55	4.62	0.000064	
0.40	13.20	5.28	0.000073	
0.45	14.85	5.94	0.000083	
0.50	16.50	6.60	0.000092	
0.55	18.15	7.26	0.000101	2 Year
0.58	19.14	7.66	0.000106	
0.60	19.80	7.92	0.000110	
0.65	21.45	8.58	0.000119	
0.70	23.10	9.24	0.000128	
0.75	24.75	9.90	0.000138	
0.79	26.07	10.43	0.000145	5 Year
0.80	26.40	10.56	0.000147	
0.85	28.05	11.22	0.000156	
0.90	29.70	11.88	0.000165	
0.95	31.35	12.54	0.000174	
1.00	33.00	13.20	0.000183	
1.05	34.65	13.86	0.000193	
1.10	36.30	14.52	0.000202	
1.15	37.95	15.18	0.000211	
1.20	39.60	15.84	0.000220	
1.25	41.25	16.50	0.000229	25 Year
1.30	42.90	17.16	0.000238	
1.35	44.55	17.82	0.000248	
1.40	46.20	18.48	0.000257	100 Year
1.45	47.85	19.14	0.000266	
1.50	49.50	19.80	0.000275	Top of Trench