



**INFILTRATION TESTING PROGRAM
65 GRACE STREET
TORONTO, ONTARIO
M6J 2S4**

**REPORT NO.: 5625-22-HB
REPORT DATE: SEPTEMBER 20, 2022**

**CONSEIL SCOLAIRE VIAMONDE
UNIT 101, 1 VANIER DRIVE
WELLAND, ONTARIO**

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1 Introduction

1.1 Project Background

Toronto Inspection Ltd. (TIL) was retained by Conseil Scolaire Viamonde (the Client) to carry out an infiltration testing program to assess the preliminary design of the proposed Low Impact Development (LID) feature proposed at 65 Grace Street in Toronto, Ontario (the “Site”).

1.2 Site Description

The Site, approximately 2.5 hectares in area, is located on the east side of Grace Street, about 130m north of Dundas Street West in Toronto, Ontario.

At the time of the investigation, the Site was occupied by Pierre Elliott Trudeau Elementary School, a two-storey, part one storey building with a slab on grade. There was a paved parking area on the southeast side accessible from Belwoods Avenue from the east. A paved driveway and a small parking area on the northwest side provides access Grace Street. The remainder of the property consisted of a paved play area and a landscaped area on the eastern portion, and a sodded playing field on the northern portion of the Site.

The developments surrounding the Site consisted mostly of residential dwellings. The site gradient was slightly sloping from north to south.

1.3 Objectives of the Infiltration Testing Program

The objective for the field infiltration testing program was to determine the saturated hydraulic conductivity and a representative unfactored infiltration rate within the soil overburden at the depths where the proposed LID features are anticipated to infiltrate.

Based on communications with the civil engineer, an LID is proposed on the site, with its bottom elevation at 102.29 and 102.79 masl at location of TP-1 and TP-2, respectively.

We also understand that the design and location of the LID may be subject to change depending on the local groundwater conditions present at the Site. Therefore, the results of this infiltration testing program should be used to confirm the selection and design of the infiltration feature that is proposed at the Site thus far and make modifications as required to the Scope of Work.

1.4 Groundwater Levels

During Toronto Inspection Limited's geotechnical investigation conducted at the same Site, five (5) boreholes were drilled across the northwestern portion of the Site. The borehole depths varied between 3.47 m and 9.60 m. All boreholes were dry and open upon the completion of drilling. No monitoring wells were installed on the Site.

On the day of the infiltration test, both test pits were dry up to 3.7 m below ground surface (mbgs).

2 Testing Location and In-Situ Soil

In total two (2) test pit were dug by an excavator. One infiltration test was conducted at the bottom of each test pit. The locations of the test pit are identified in **Figure 1**.

Based on observations made in the field, a 0.3 m thick layer of topsoil was encountered at both test pit locations. A layer of fill whose thickness varies from 2.1 m to 2.4 m was found overlying the native sandy silt layer which extends to the terminal investigation depth of 3.9 mbgs.

No water seepage was observed from all test pit locations.

The visual observations from the test pits are summarized in **Table 2-1**.

Table 2-1 Test Pit Observations

Test Pit ID	Depth of Investigation (mbgs)	Soil Conditions	Water Seepage Observations
TP-1	3.9	0 – 0.3 m – top soil, brown, some rootlets, moist; 0.3 – 2.4 m – fill, brown, sandy silt, trace of construction debris (bricks and concrete slabs), trace of rootlets, moist; 2.4 – end of investigation – sandy silt, dark brown, trace of gravel, moist	No seepage observed
TP-2	3.5	0 – 0.3 m – top soil, brown, some rootlets, moist; 0.3 – 2.1 m – fill, brown, sandy silt, trace of construction debris (bricks and concrete slabs), trace of rootlets, moist; 2.1 – end of investigation – sandy silt, dark brown, trace of gravel, moist	No seepage observed

3 Laboratory Grain Size Analysis

Grain size analyses for select soil samples were completed in the laboratory using sieve and hydrometer methods. The purpose of completing the grain size analyses was to determine the particle size distribution of the soil samples collected. A finer particle size distribution is typically indicative of a lower permeability material hence poorer drainage. A poorly sorted matrix, one with a range of grain sizes, is typically indicative of lower availability of void spaces for fluids to flow through hence lower permeability and poorer drainage.

The Hazen Permeability is directly proportional to the infiltration rate, indicating lower values are likely to exhibit lower infiltration rates relative to higher values.

Grain size analysis were conducted at the bottom of both test pit locations to assess the particle size distribution at the location of the in-situ infiltration testing. The grain size distribution curves are attached as **Appendix A**. A summary of the results from the analyses are provided in **Table 3-1**.

Table 3-1 Hazen Permeability Summary

Test ID	Test Depth	Soil Description	Hazen Permeability (cm/s)	Laboratory Infiltration Rate (mm/hr)
	(mbgs)			
TP-1	3.9	Sandy Silt	1.10×10^{-4}	47
TP-2	3.5	Sandy Silt	1.19×10^{-4}	49

4 In-situ Infiltration Test

In-situ infiltration testing was carried out using a Guelph Permeameter in accordance with the equipment's operating instructions (Soilmoisture Equipment Corp., 2012)¹. A 6 cm diameter holes were hand-augured at the bottom of each test pit location.

The infiltration test details are summarized in **Table 4-1**. The approximate infiltration test locations are shown on **Figure 1** and the field Guelph Permeameter data tables documenting stabilization of drawdown rates are provided in **Appendix B**.

Table 4-1 Infiltration Test Summary

Test ID	Test Depth	Well Hole Soil Description	Water Column Height	Reservoir Used	Method
	(mbgs)		(cm)		
TP-1	3.9	Sandy Silt	5 & 10	Combined	Average of Single Heads
TP-2	3.5	Sandy Silt	5 & 10	Combines	Average of Single Heads

5 Test Results

5.1 Soil Condition

Based on the field logging of soil samples, the soil deposit within the proposed operating depth of the two storm chambers is the same layer of sandy silt. Some sandy clayey silt and gravels are present in certain areas.

5.2 Estimated Field Hydraulic Conductivity and Infiltration Rate

The field saturated hydraulic conductivity (Kfs) was calculated using the "Guelph Permeameter Calculator" prepared by Soilmoisture Equipment Corp (2012)².

Based on the output from the Guelph Permeameter Calculator using the inputs presented in **Appendix C**, the estimate of Kfs for the sandy silt at the base of the LID varies between 8.52×10^{-6} cm/s and 5.32×10^{-5} mm/hr with an average value of 2.94×10^{-5} mm/hr.

To determine the corresponding soil infiltration rate, the Kfs must be converted to a rate of infiltration (T). The approximate relationship between Kfs and T is provided in the Toronto and Region Conservation Authority (TRCA) *Stormwater Management Criteria* (TRCA, 2012)³ to complete this conversion.

Based on the measured saturated hydraulic conductivity, the corresponding unfactored infiltration rate estimated for the clayey silt varies between 24 mm/hr and 39 mm/hr with an average value of 32 mm/hr.

¹ Soilmoisture Equipment Corp. 2012. 2800 Guelph Permeameter Operating Instructions dated December 2012

² Soilmoisture Equipment Corp. 2012. 2800 Guelph Permeameter Operating Instructions dated December 2012

³ Toronto and Region Conservation Authority (TRCA). 2012. Stormwater Management Criteria August 2012 Version 1.0.

It should be noted that the estimated field infiltration rates are specific to the areas tested at the Site and at the point in time when the tests were conducted. Test results may therefore not be applicable to other areas of the Site where subsurface conditions are not consistent with those of the test locations.

A summary of the Kfs from the current investigation is presented in **Table 5-1**. The calculation sheets from the Guelph Permeameter Calculator and field data are included in **Appendix B**.

Table 5-1 Unfactored Infiltration Rate from In-situ Infiltration Testing

Test Pit Location	Depth	Soil Unit	Saturated Hydraulic Conductivity Kfs (cm/s)	Unfactored Infiltration Rate (mm/hour) *
	mbgs			
TP-1	3.9	Sandy Silt	8.52×10^{-6}	24
TP-2	3.5	Sandy Silt	5.32×10^{-5}	39

Notes:

1. *Unfactored Infiltration Rate at tested depth.

6 Summary and Recommendations

The soil deposit at the base of the proposed LID is identified to be sandy silt. Based on the grain size analysis and in-situ infiltration testing completed, an unfactored infiltration rate of 24 mm/hr is estimated for both areas, and it will be at the discretion of the civil engineer to select a factor of safety to apply to this unfactored infiltration rates calculated.

It should also be noted that the field infiltration rates are specific to the areas tested at the Site, at the point in time when the tests were conducted. Test results may therefore not be applicable to other areas of the Site where subsurface conditions are not consistent with those at the test locations.

We trust that the findings from this investigation will meet your needs. Should you have any questions or comments, please do not hesitate to contact the undersigned.

Yours truly,

Toronto Inspection Ltd.



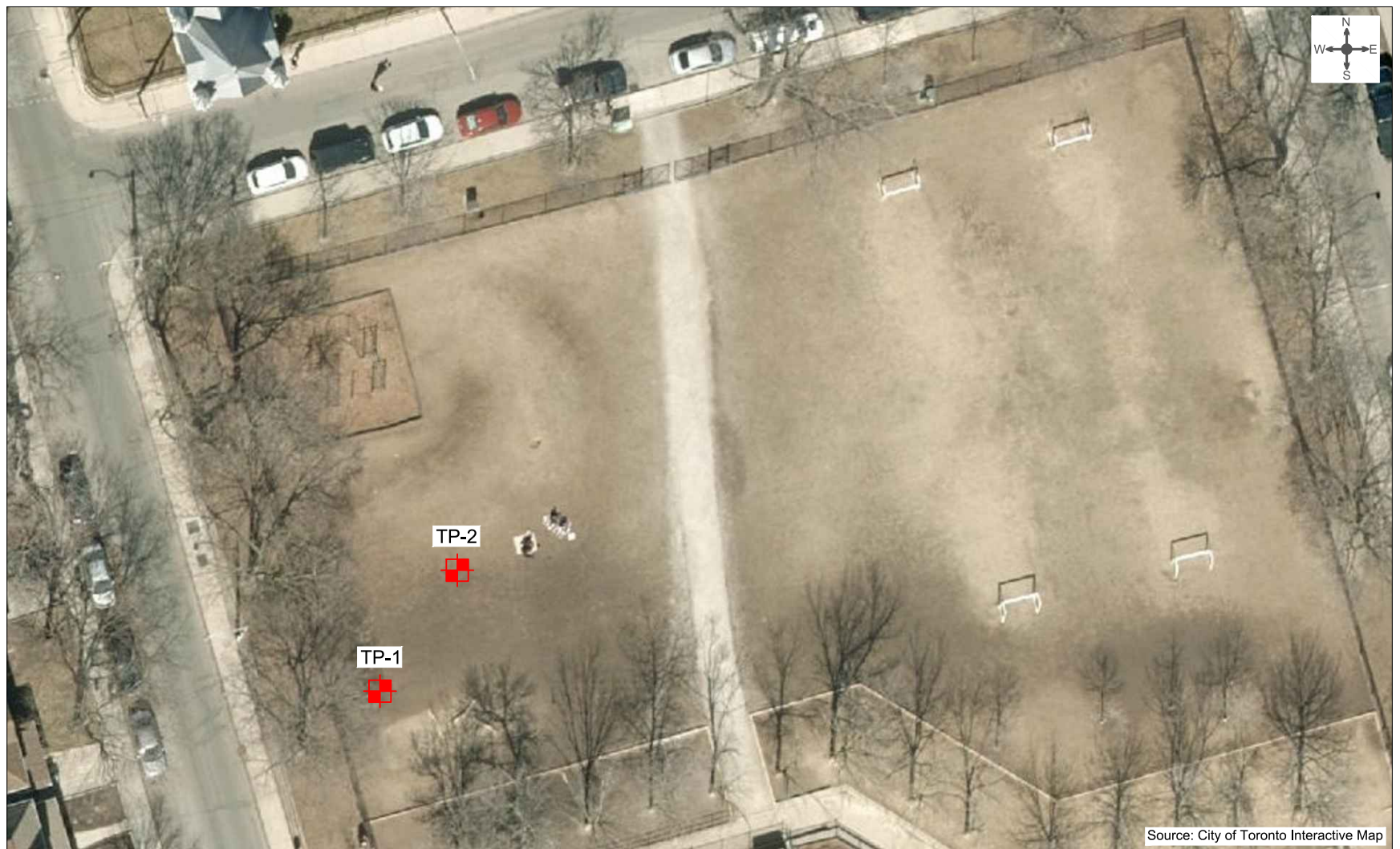
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Project Manager, Hydrogeology and Environmental Services



Toronto Inspection Ltd.

FIGURES



LEGEND:



Test Pit Location

NOT TO SCALE

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TITLE: Test Pit Location Plan

LOCATION: 65 Grace Street, Toronto, Ontario

PROJECT NO. 5625-22-HB

DATE : September 2022

FIGURE NO. 1

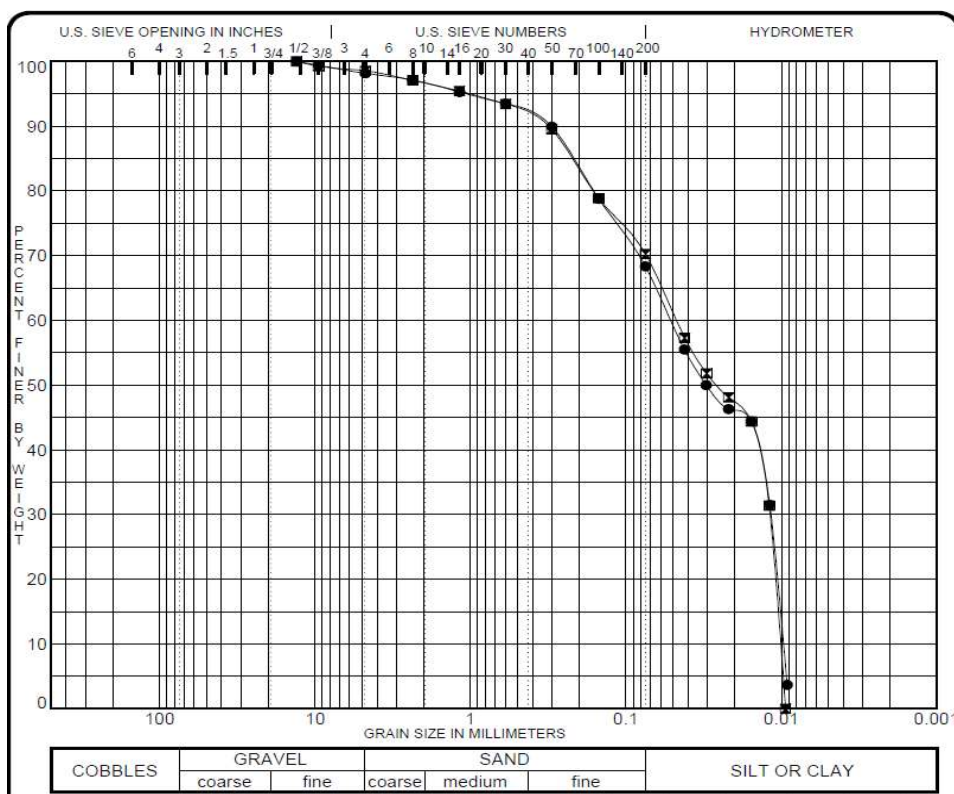


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APPENDIX A

Grain Size Analysis Gradation Curve

Company:	TIL
Client:	CSV
Project:	5625
Location:	65 Grace St, Toronto
Test Well:	TP-1
Test Date:	23-Aug-22
Test Conducted By:	YL

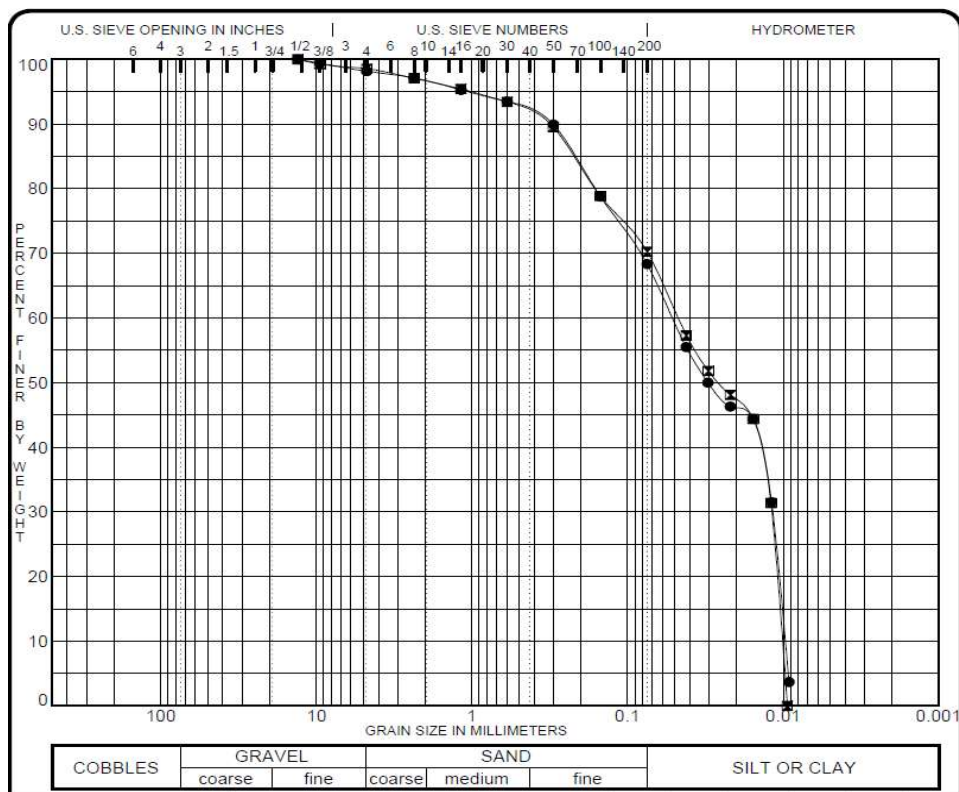


Legend: ● TP-1

Sampled Unit:	Sandy Silt	Sampled Depth (mbgs):	3.9
% Gravel	1.8	D100:	13.2000
% Sand	29.8	D60	0.0500
% Silt	68.3	D30:	0.0120
% Clay	0	D10:	0.0098
K (m/s)	1.10E-06	Temperature (°C):	10

Grainsize Analyses: TP-2

Company: TIL
 Client: CSV
 Project: 5625
 Location: 65 Grace St, Toronto
 Test Well: TP-2
 Test Date: 23-Aug-22
 Test Conducted By: YL





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APPENDIX B

Infiltration Test Calculations and Guelph Permeameter Field Data



Guelph Permeameter Calculations

Input
Result

Single Head Method (1)

Reservoir Cross-sectional area in cm^2
(enter "35.22" for Combined and "2.16" for Inner reservoir): **35.22**

Enter water Head Height ("H" in cm): **5**

Enter the Borehole Radius ("a" in cm): **3**

Enter the soil texture-structure category (enter one of the below numbers): **3**

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropores, etc.

Steady State Rate of Water Level Change ("R" in cm/min): **0.0100**

Res Type: 35.22
H: 5
a: 3
H/a: 1.667
a*: 0.12
C0.01: 0.809
C0.04: 0.842
C0.12: 0.803
C0.36: 0.803
C: 0.803
R: 0.010
Q: 0.006
pi: 3.142

$\alpha^* = 0.12 \text{ cm}^{-1}$

$C = 0.803154$

$Q = 0.00587$

$K_{fs} = 1.07E-05 \text{ cm/sec}$
 $6.41E-04 \text{ cm/min}$
 $1.07E-07 \text{ m/sec}$

$2.52E-04 \text{ inch/min}$
 $4.20E-06 \text{ inch/sec}$

$\Phi_m = 8.90E-05 \text{ cm}^2/\text{min}$

Single Head Method (2)

Reservoir Cross-sectional area in cm^2
(enter "35.22" for Combined and "2.16" for Inner reservoir): **35.22**

Enter water Head Height ("H" in cm): **10**

Enter the Borehole Radius ("a" in cm): **3**

Enter the soil texture-structure category (enter one of the below numbers): **3**

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropores, etc.

Steady State Rate of Water Level Change ("R" in cm/min): **0.0100**

Res Type: 35.22
H: 10
a: 3
H/a: 3.33333
a*: 0.12
C0.01: 1.21841
C0.04: 1.29023
C0.12: 1.28754
C0.36: 1.28754
C: 1.28754
R: 0.010
Q: 0.00587
pi: 3.1415

$\alpha^* = 0.12 \text{ cm}^{-1}$

$C = 1.287543$

$Q = 0.00587$

$K_{fs} = 6.36E-06 \text{ cm/sec}$
 $3.82E-04 \text{ cm/min}$
 $6.36E-08 \text{ m/sec}$

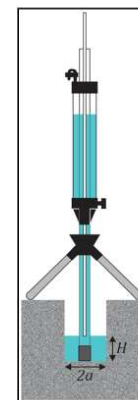
$1.50E-04 \text{ inch/min}$
 $2.50E-06 \text{ inch/sec}$

$\Phi_m = 5.30E-05 \text{ cm}^2/\text{min}$

Average

$K_{fs} = 8.52E-06 \text{ cm/sec}$
 $5.11E-04 \text{ cm/min}$
 $8.52E-08 \text{ m/s}$
 $2.01E-04 \text{ inch/min}$
 $3.35E-06 \text{ inch/sec}$

$\Phi_m = 7.10E-05 \text{ cm}^2/\text{min}$



Infiltration Test Calculation at TP-1 at 3.9 mbgs

Table 1: Guelph Permeameter Data at TP-1 at 3.9 mbgs

5 cm Head			10 cm		
Combined Reservoir			Combined Reservoir		
Time (min)	Reading (cm)	Rate (cm/min)	Time (min)	Reading (cm)	Rate (cm/min)
0	3.4		0	7.2	
10	3.5	0.01	10	7.3	0.01
20	3.6	0.01	20	7.4	0.01
30	3.7	0.01	30	7.5	0.01



Guelph Permeameter Calculations

Input
Result

Single Head Method (1)

Reservoir Cross-sectional area in cm^2
(enter "35.22" for Combined and "2.16" for Inner reservoir): **35.22**
Enter water Head Height ("H" in cm): **5**
Enter the Borehole Radius ("a" in cm): **3**

Enter the soil texture-structure category (enter one of the below numbers): **3**

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravelly sands; may also include some highly structured soils with large and/or numerous cracks, macropores, etc

Steady State Rate of Water Level Change ("R" in cm/min): **0.0400**

Res Type: 35.22
H: 5
a: 3
H/a: 1.667
a*: 0.12
C0.01: 0.809
C0.04: 0.842
C0.12: 0.803
C0.36: 0.803
C: 0.803
R: 0.040
Q: 0.023
pi: 3.142

$\alpha^* = 0.12 \text{ cm}^{-1}$
 $C = 0.803154$
 $Q = 0.02348$
 $K_{fs} = 4.27E-05 \text{ cm/sec}$
 $2.56E-03 \text{ cm/min}$
 $4.27E-07 \text{ m/sec}$
 $1.01E-03 \text{ inch/min}$
 $1.68E-05 \text{ inch/sec}$
 $\Phi_m = 3.56E-04 \text{ cm}^2/\text{min}$

Single Head Method (2)

Reservoir Cross-sectional area in cm^2
(enter "35.22" for Combined and "2.16" for Inner reservoir): **35.22**
Enter water Head Height ("H" in cm): **10**
Enter the Borehole Radius ("a" in cm): **3**

Enter the soil texture-structure category (enter one of the below numbers): **3**

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravelly sands; may also include some highly structured soils with large and/or numerous cracks, macropores, etc

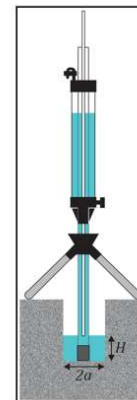
Steady State Rate of Water Level Change ("R" in cm/min): **0.1000**

Res Type: 35.22
H: 10
a: 3
H/a: 3.33333
a*: 0.12
C0.01: 1.21841
C0.04: 1.29023
C0.12: 1.28754
C0.36: 1.28754
C: 1.28754
R: 0.100
Q: 0.0587
pi: 3.1415

$\alpha^* = 0.12 \text{ cm}^{-1}$
 $C = 1.287543$
 $Q = 0.0587$
 $K_{fs} = 6.36E-05 \text{ cm/sec}$
 $3.82E-03 \text{ cm/min}$
 $6.36E-07 \text{ m/sec}$
 $1.50E-03 \text{ inch/min}$
 $2.50E-05 \text{ inch/sec}$
 $\Phi_m = 5.30E-04 \text{ cm}^2/\text{min}$

Average

$K_{fs} = 5.32E-05 \text{ cm/sec}$
 $3.19E-03 \text{ cm/min}$
 $5.32E-07 \text{ m/s}$
 $1.26E-03 \text{ inch/min}$
 $2.09E-05 \text{ inch/sec}$
 $\Phi_m = 4.43E-04 \text{ cm}^2/\text{min}$



Infiltration Test Calculation at TP-2 at 3.5 mbgs

Table 2: Guelph Permeameter Data at TP-2 at 3.5 mbgs

5 cm Head			10 cm		
Combined Reservoir			Combined Reservoir		
Time (min)	Reading (cm)	Rate (cm/min)	Time (min)	Reading (cm)	Rate (cm/min)
0	55.1		0	56.6	
5	55.1	0	5	57.0	0.4
10	55.2	0.1	10	57.5	0.5
15	55.3	0.1	15	58.0	0.5
20	55.5	0.2	20	58.5	0.5
25	55.7	0.2			
30	55.9	0.2			