FUNCTIONAL SERVICING & STORMWATER MANAGEMENT REPORT

PROPOSED RESIDENTIAL COMMON ELEMENT DEVELOPMENT
900 MISSISSAUGA HEIGHTS DRIVE
CITY FILE No. OZ/OPA 22-1
904 MISSISSAUGA HEIGHTS DRIVE
CITY FILE No. OZ 21-13 W7

CITY OF MISSISSAUGA
REGIONAL MUNICIPALITY OF PEEL

FILE No. 219-M20

APRIL 19, 2023

SKIRA & ASSOCIATES LTD.
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1.0 INTRODUCTION

The purpose of this report is to determine that the proposed residential common element development can be completed in accordance with the City of Mississauga, Region of Peel and Credit Valley Conservation guidelines from overall servicing and functionality for stormwater management perspective.

Our report is to support rezoning application for Diamond Developments for 900 Mississauga Heights Drive Plan (City File No. OZ/OPA 22-1) and Mario Polla for 904 Mississauga Heights Drive Plan (City File No. OZ 21-13 W7).

During the preparation of this report, Skira & Associates obtained existing records of Mississauga Heights Drive infrastructure from City of Mississauga and Region of Peel. We also consulted and arranged site visit with CVC regarding the proposed storm outlet location.

2.0 SITE AREA INFORMATION

The subject site is Part of Lot 2, Registered Plan 342, City of Mississauga, Regional Municipality of Peel.

The subject site is located on the east side of Mississauga Heights Drive in the City of Mississauga. The site consists of approximately 1.9696ha (Diamond Developments) and 1.2623ha (Mario Polla). The proposed development is a joint project between the two (2) above listed owners to construct a common element condominium road along the common property line.

The proposed condominium road will support the creation of eighteen (18) single detached lots. The ownership of the individual lots located within each of the respective parcels will remain. Only condominium road and associated infrastructure will be subject to common element practices and shared costs.

Easement or dedications will be required from both of the properties in order to construct the required infrastructure and common element areas.

An area of approximately 0.9399ha will be dedicated to the City of Mississauga for natural heritage buffer block along Credit River tributary. It will be excluded from the stormwater management analysis in this report.

The subject site is currently occupied by two single-family dwellings, which are to remain. They are delineated as Lots 9 and H, with a total area of approximately 0.7998ha. They are included in the proposed development but not in the stormwater management analysis in this report. The project area under consideration is the remaining area, approximately **1.4922ha**.

3.0 SITE ACCESS

Currently, the two single family dwellings are each accessed by a single residential driveway off Mississauga Heights Drive. Individual driveways will be removed and Mississauga Heights Drive boulevard will be reconstructed.

As previously described, a common element condominium road will be constructed to support the proposed residential dwellings as per City of Mississauga standard C.M. STD. 2211.155 (without sidewalk).

The creation of condominium road will be established through easement and dedication of all required land for construction and grading from both parties.

The common element condominium road will be sloped toward south with a gradual slope of 2-3% which is acceptable for garbage trucks, fire trucks and other emergency vehicles.

Refer to Dwg. C102 Overall Site Grading Plan

4.0 STORM DRAINAGE SYSTEM

4.1 Existing Drainage Conditions

The site generally drains to the southeast via sheet flow and ultimately discharges to the Credit River. The table land is generally flat with gentle slopes ranging between 2% and 4%.

As previously described, natural heritage dedication areas are drastically sloping toward Credit River, Mississauga Golf Club Valley and Sheridan Creek.

4.2 Allowable Discharge

On-site stormwater management will be provided for the proposed development to restrict post-development flows, including 100-year storm intensity to 10-year storm at pre-development level.

Based on the proposed grade, Lots 1-8 and Lot I will have split drainage and the backyard runoff will sheet flow towards the tree preservation area and steep slope. It is considered as uncontrolled runoff and the total area of uncontrolled runoff is 0.4356ha.

The total area of controlled runoff is 1.4922- 0.4356 = **1.0566ha**.

10-year storm flow at pre-development level is as follows:

$$\text{Allowable 10-yr. } Q_{SITE} = 0.0028 \times 0.55 \times 99.17 \times 1.0566$$
$$= \mathbf{0.1614\ m^3/s}$$

4.3 Proposed Drainage Conditions

Based on the site characteristics, the weighted runoff coefficient is calculated below:

Area Description	Area (m^2)	Runoff Coefficient
Building/Roof	2831	0.9
Paved	2853	0.9
Landscaped	4882	0.25
Total	10566	0.60

Based on City of Mississauga storm criteria, the calculated weighted runoff coefficient for a 100-year storm will be adjusted by a saturation factor of 1.25. The runoff coefficient used to determine storage volume is 0.60 x 1.25 = **0.75**.

4.4 Quantity Control

Using Rational Method for the 100-year storm event calculation and previously established allowable discharge, the total runoff and required detention volume are as follows:

YEAR STORM
100 year
CITY
Mississauga

C = 0.750
A (ha) = 1.05660
Allow. Discharge Q_a (m^3/s) = 0.161400
Safety Factor S_f = 0%

Max. Required Detention (m^3) = *138.56*

RAINFALL DURATION T_c *(min)*	**RAINFALL INTENSITY** *I (mm/hr)*	**TOTAL RUNOFF** *$Q=CIA/360$ (m^3/sec)*	**INFLOW VOLUME** V_i (m^3)	**OUTFLOW VOLUME** V_o (m^3)	**REQUIRED DETENTION VOLUME (m^3)** *$D=(V_i-V_o)*S_f$*
5	242.53	0.5339	160.16	53.92	106.25
10	176.31	0.3881	232.86	96.84	136.02
15	140.69	0.3097	278.72	140.16	**138.56**
20	118.12	0.2600	312.02	183.76	128.26
25	102.41	0.2254	338.15	227.57	110.58

The maximum detention volume required is **138.56m³** which will be provided by an underground storm sewer system.

4.5 Underground Storm Sewer system

The storage volume provided by the underground storm sewer system is as follows:

Sewer Leg	Size (mm)	Slope (%)	Flow Area (m^2)	Sewer Length (m)	Storage Volume (m^3)
STMMH 3-4	975	0.25	0.7466	70.5	52.64
STMMH 4-5	975	0.25	0.7466	38.5	28.74
STMMH 5-7	975	0.25	0.7466	45.0	33.60
STMMH 3 (1500mm) – 1.767m² x 6.06m					10.71
STMMH 4 (1800mm) – 2.545m² x 4.12m					10.49
STMMH 5 (1500mm) – 1.767m² x 2.54m					4.49
Total					**140.67**

It provides a storage volume of **140.67m³** and satisfies the detention volume requirement.

4.6 Orifice Control

The allowable discharge from the proposed residential development will be controlled by means of an orifice tube installed downstream of STMMH 3. The size of the orifice tube is **155mm** diameter, with a discharge rate of **0.1645 m³/s**. Refer to ***Appendix A*** for the orifice control tube calculations done through Flow Master Program developed by Haestad Methods Inc. (USA).

In addition to the orifice tube, a reduced outlet pipe is proposed downstream of orifice restrictor. A 200mm diameter pipe will be installed. See ***219-M20 C101*** for overall site servicing plan.

4.7 100-Year Flow Capture

The controlled runoff area (1.0566ha) will be further divided into two areas, drainage area A1 (0.2427ha) and drainage area A2 (0.8139ha). Refer to ***Figure 4*** for the storm drainage plan. Based on the site characteristics, the weighted runoff coefficient is calculated below:

Drainage Area	Area Description	Area (m^2)	Runoff Coefficient
A1	Building/Roof	727	0.9
	Paved	27	0.9
	Landscaped	1673	0.25
	Total	2427	0.45

Based on City of Mississauga storm criteria, the calculated weighted runoff coefficient for a 100-year storm will be adjusted by a saturation factor of 1.25. The runoff coefficient used to determine storage volume is 0.45 x 1.25 = **0.56**.

Drainage Area	Area Description	Area (m^2)	Runoff Coefficient
A2	Building/Roof	1990	0.9
	Paved	2869	0.9
	Landscaped	3280	0.25
	Total	8139	0.64

Based on City of Mississauga storm criteria, the calculated weighted runoff coefficient for a 100-year storm will be adjusted by a saturation factor of 1.25. The runoff coefficient used to determine storage volume is 0.64 x 1.25 = **0.8**.

The 100-year flows for the two drainage areas are established as follows:

Q_{A1} = 0.0028 x 0.56 x 140.69 x 0.2427
= 0.0535 m^3/s

Q_{A2} = 0.0028 x 0.8 x 140.69 x 0.8139
= 0.2565 m^3/s

Runoff from the drainage area A1 will be captured at the proposed ditch inlet along the south boundary of the site. Runoff from the drainage area A2 will be captured at the proposed double catchbasins along the north boundary of the site. Runoff captured will be conveyed through the proposed storm leads. The capacities of the proposed storm leads are as follows:

Q_{DI} = 1.5m – 250Ø @ 1.20%
= 0.0680 m^3/s

Q_{DCB} = 2 x 3.0m – 375Ø @ 1.00%
= 0.3658 m^3/s

Therefore, the proposed storm leads have sufficient capacity for the 100-year flows.

LEGEND

- EXISTING STORM SEWER
- PROPOSED STORM SEWER
- EXISING STORM MANHOLE
- PROPOSED STORM MANHOLE
- DRAINAGE AREA BOUNDARY
- AREA (HECTARES)
- RUN-OFF COEFFICIENT
- LIMIT OF PROPERTY

DIAMOND DEVELOPMENTS
CITY FILE: OZ/OPA 22-1

MARIO POLLA
CITY FILE: OZ 21-13 W7

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STORM DRAINAGE SYSTEM

PROJECT No. 219-M20
DATE - APRIL 2023
SCALE - 1 : 500
DRAWN BY - D.W.
FIGURE 4

4.8 Quality Control

According to the Ministry of the Environment & Climate Change's Stormwater Management Planning & Design Manual, the site is required to provide a long-term average removal of 80% of Total Suspended Solids (TSS) for the enhanced protection of waterways.

The overall strategy to achieve TSS removal includes:

- Discharge from roofs will be directed to grass swales along lot lines
- Driveways will be constructed of permeable pavers
- A portion of the condominium road will be constructed of permeable paving
- Runoff from the asphalt condominium road will be directed to permeable condominium road and then treated by an Oil/Grit Separator (O.G.S.)

The proposed O.G.S. is HydroStorm HS 5 manufactured by Hydroworks. This unit will provide Level 1 protection (81% TSS removal). Refer to ***Appendix B*** for the output file created by Hydroworks.

With these measures, the TSS removal rate is as follows:

Area Description	**Area (m^2)**	**TSS Removal Rate (%)**
Building (Discharge to Grass Swales)	2831	80
Landscaped	4882	80
Driveway (Permeable Paver)	705	80
Condominium Road (Permeable)	419	80
Condominium Road (Directed to Permeable Condominium Road and Treated by O.G.S.)	1729	80 + (1-0.8) x 50
Total	10566	81.6

Therefore, the total TSS removal rate for the development prior to reaching the proposed storm sewer is 81.6%.

4.9 Proposed Outfall

After treated at the proposed O.G.S., stormwater runoff will be conveyed through the proposed storm sewer and directed to the proposed head wall. The existing retaining wall will be removed and armour stone wing walls will be constructed to accommodate the proposed plunge pool. Stormwater runoff will be retained in the proposed plunge pool and temporary check dam before releasing to Shardawn Creek.

Refer to ***219-M20 C101*** for the location of the proposed outfall.

4.10 Water Balance Consideration

The latest City of Mississauga Water Balance Management Plan contains a water balance target/criterion that requires the site to retain 5mm of every rainfall and allow it to infiltrate back into the ground or use for irrigation purposes.

The required retention volume for the proposed site is as follows:

V_{5mm} = 10,566m² x 0.005m
= **52.83m³** per rainfall

Based on the development site statistics, the following table summarizes the initial abstraction:

Area Description	**Area (m^2)**	**Initial Abstraction (mm)**	**5mm Volume (m^3)**
Building/Roof	2831	0	0
Paved	2853	0	0
Landscaped	4882	5	24.41
Total	10566	**-**	**24.41**

Therefore, the remaining volume to be retained on-site is:

V_{5mm} = 52.83m^3 – 24.41m^3
= **28.42m^3**

The retention volume can be provided by permeable paver on the proposed driveways and condominium road. The storage volume provided is as follows:

V_{paver} = 1124m² (permeable paver area) x 0.1m (thickness) x 0.40 (porosity)
= 44.96m^3

It provides a storage volume of **44.96m^3** and satisfies the retention volume requirement.

Alternatively, the retention volume can be provided by increasing topsoil thickness on the landscaped area. Refer to ***Appendix C*** for the subsurface investigation report. The storage volume provided is as follows:

$V_{topsoil}$ = 4882m² (landscaped area) x 0.02m (thickness) x 0.40 (porosity)
= 39.06m^3

It provides a storage volume of **39.06m^3** and satisfies the retention volume requirement. Detailed calculation will be provided at the final stage of site plan approval.

5.0 WATERMAIN SERVICING

The proposed residential common element development will be serviced to the existing 150mm watermain on Mississauga Heights Drive. The existing watermain will provide sufficient water supply to service the development.

A 150mm watermain connection will be constructed on Mississauga Heights Drive. Each unit will be supplied with service internally. Two existing water services on Mississauga Heights Drive will be removed and capped at main.

Water Demand Calculations

Proposed Development	= 50 persons/hectare x 1.5215ha = 76.075p = **76p**
Average Flow Rate	= 280 x 76 = 21,280 L/day = **0.2463 L/s**
Max. Day Flow Rate	= 280 x 76 x 2.0 = 42,560 L/day = **0.4926 L/s**
Peak Hour Flow Rate	= 280 x 76 x 3.0 = 63,840 L/day = **0.7389 L/s**

Fire Flow Calculations

Fire Flow required based on *Fire Underwriters Survey 1999* using formula:

F = 220 x C x √A

Where, C = coefficient related to type of construction, 1.0 for ordinary construction
A = total gross floor area of the largest residential dwelling without basement
= 516m^2

F = 220 x 1.0 x √516
= 4,997 L/min ≈ **5,000 L/min**

A decrease can be applied for occupancy having a low contents fire hazard:

F = 5,000 L/min – 15% = **4,250 L/min**

The exposure separation for the north, east, west and south exterior walls cumulates to a charge of 70%:

F = 4,250 L/min x 70% = **2,975 L/min**

Therefore, the fire flow demand is:

F = 4,250 + 2,975
= 7,225 L/min = **120.4 L/s**

Maximum Peak Flow = 0.7389 L/s + 120.4 L/s = **121.14 L/s**

Maximum Daily Flow = **0.4926 L/s**

A fire flow test will be completed on the 150mm local watermain to ensure sufficient fire protection and domestic flows.

6.0 SANITARY SEWER SYSTEM

The proposed residential common element development will be serviced to the existing 250mm sanitary sewer on Mississauga Heights Drive. A 200mm sanitary sewer will be constructed along common element road.

Lots 1-8 and A-F will be provided with individual 125mm sanitary connections.

Lots 1-6 and A-D will be provided with laterals for gravity flow.

Lots 7-8 and E-F will have gravity flow for aboveground areas whereas sanitary ejector pumps will be installed for basement floor.

Lots 9, G, H and I will be provided with sanitary grinder pumps and forcemain connections to provide sanitary sewer.

Sanitary Sewage Flow Calculations

Proposed Development = 76p

Peak Factor $= 1 + \frac{14}{4 + 0.076^{0.5}}$
$= 1 + 3.27$
$= 4.27$ (**max. 4.0**)

Expected Peak Flow = 0.013 m^3/s x 4.0 (peak factor)
= **52 L/s**

7.0 SUMMARY

The findings and recommendations were prepared in accordance with accepted professional engineering principles and practices. Based on the above, the proposed uses of the site can be adequately serviced by the proposed and existing infrastructure. The findings of this report are global and are related to the servicing functionality of this application. These findings by means are final and are not to replace the detail review of this application which shall take place upon submission of future application for building permit.

The conclusion is as follows:

- The proposed development will be serviced via internal storm sewer. Quantity control will be achieved by underground storm sewer system. Quality control will be provided through the use of permeable paving and oil/grit separator.
- The proposed development will be serviced via connection to the existing 150mm watermain on Mississauga Heights Drive.
- The proposed development will be serviced via internal 200mm sanitary sewer.

We respectively submit this report with intention of obtaining approval in principal the recommendations herein, which will be implemented in detail design during engineering submission, site plan process and building permits.

Yours truly,

SKIRA & ASSOCIATES LTD.

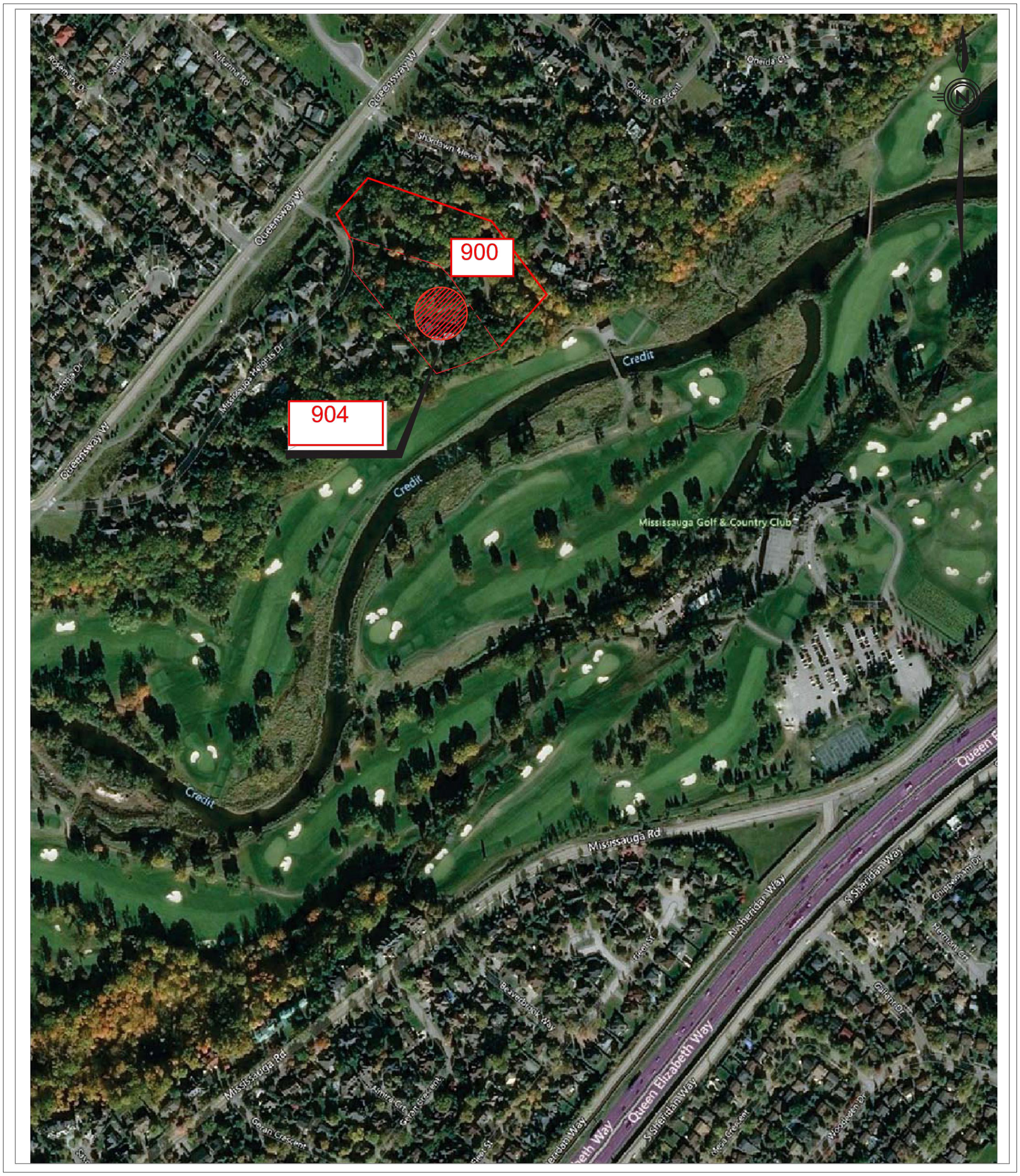
Michael Jozwik, P. Eng.
MJ:dw

LICENSED PROFESSIONAL ENGINEER
M. JOZWIK
Apr. 18, 2023
PROVINCE OF ONTARIO

NOTE: ***Limitation of Report***

*This report was prepared by **Skira & Associates Ltd.** for **Diamond Developments & Mario Polla** for review and approval by government agencies only.*

*In light of the information available at the time of preparation of this report, any use by a **Third Party** of this report are solely the responsibility of such **Third Party** and **Skira & Associates Ltd.** accepts no responsibility for any damages, if any, suffered by the **Third Party**.*



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KEY PLAN

PROJECT No. 219-M20
DATE - NOV. 2021
SCALE - N.T.S.
DRAWN BY - M.J.

FIGURE No. 1

APPENDIX A

ORIFICE CONTROL CALCULATIONS
FLOW MASTER OUTPUT

WORKSHEET
for Circular Orifice

Project Description	
Worksheet	Orifice - 1
Type	Circular Orifice
Solve For	Diameter

Input Data		
Discharge	0.1645	m^3/s
Headwater Elevation	107.63	m
Centroid Elevation	101.87	m
Tailwater Elevation	101.67	m
Discharge Coefficient	0.82	

Results		
Diameter	155	mm
Headwater Height Above	5.76	m
Tailwater Height Above	0.20	m
Flow Area	1.89E-02	m^2
Velocity	10.63	m/s

APPENDIX B

OIL/GRIT SEPARATOR CALCULATIONS
HYDROWORKS OUTPUT

Hydroworks Sizing Summary

900-904 Mississauga Heights Drive
Mississauga, Ontario

03-23-2023

Recommended Size: HydroStorm HS 5

A HydroStorm HS 5 is recommended to provide 80 % annual TSS removal based on a drainage area of 1.05 (ha) with an imperviousness of 57.1 % and Toronto Central, Ontario rainfall for the 20 um to 2000 um particle size distribution.

The recommended HydroStorm HS 5 treats 98 % of the annual runoff and provides 81 % annual TSS removal for the Toronto Central rainfall records and 20 um to 2000 um particle size distribution.

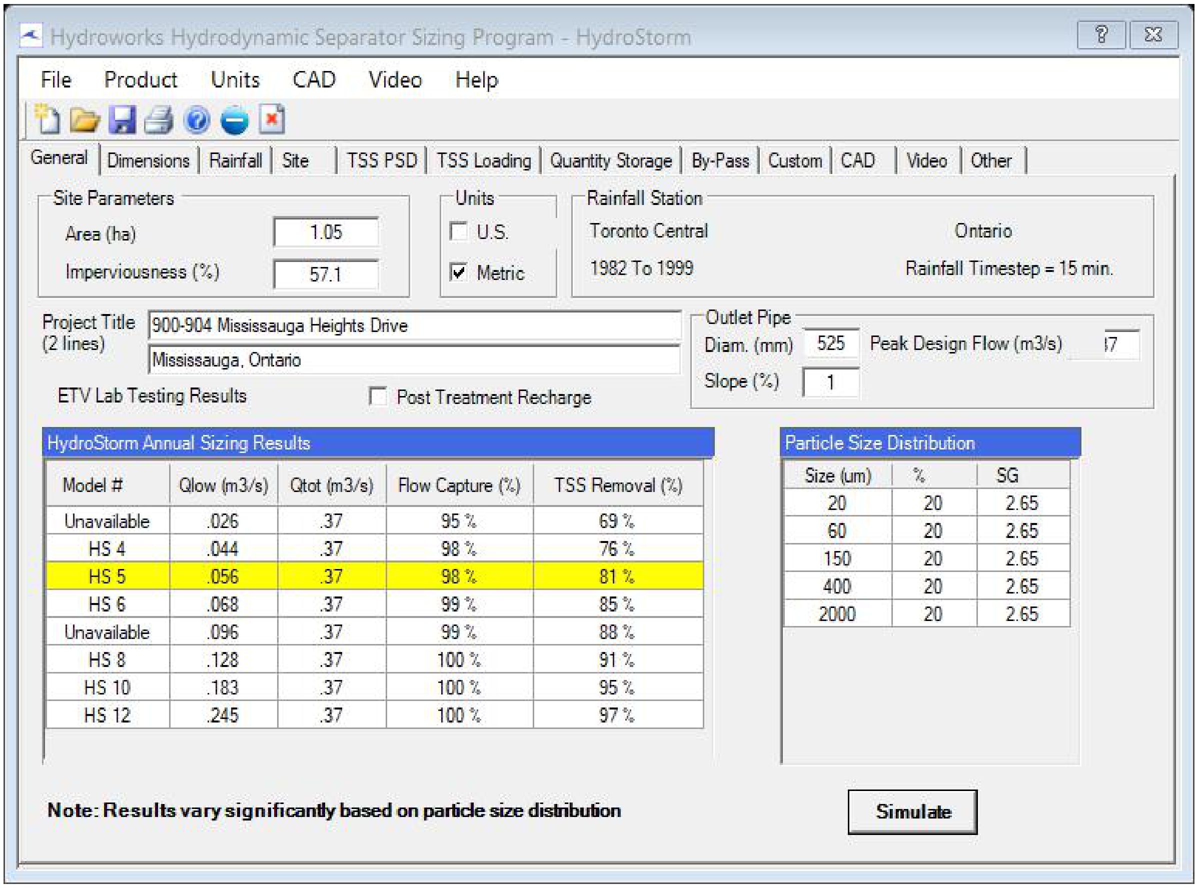
The HydroStorm has a headloss coefficient (K) of 1.04. The given peak flow of .37 (m3/s) Is less than the full pipe flow of .43 (m3/s) indicating free flow in the pipe during the peak flow assuming no tailwater condition. Partial pipe flow was assumed For the headloss calculations. The critical depth Is greater than the normal depth For the peak flow And 525 (mm) pipe diameter And 1 % slope given. Critical depth was assumed For the headloss calculations. The headloss was calculated to be 224 (mm) based on a flow depth of 407 (mm) .

This summary report provides the main parameters that were used for sizing. These parameters are shown on the summary tables and graphs provided in this report.

If you have any questions regarding this sizing summary please do not hesitate to contact Hydroworks at 888-290-7900 or email us at support@hydroworks.com.

The sizing program is for sizing purposes only and does not address any site specific parameters such as hydraulic gradeline, tailwater submergence, groundwater, soils bearing capacity, etc. Headloss calculations are not a hydraulic gradeline calculation since this requires a starting water level and an analysis of the entire system downstream of the HydroStorm .

TSS Removal Sizing Summary



Site Parameters

Area (ha) 1.05

Imperviousness (%) 57.1

Units

☐ U.S.

☑ Metric

Rainfall Station

Toronto Central Ontario

1982 To 1999 Rainfall Timestep = 15 min.

Project Title (2 lines)

900-904 Mississauga Heights Drive

Mississauga, Ontario

ETV Lab Testing Results

☐ Post Treatment Recharge

Outlet Pipe

Diam. (mm) 525

Peak Design Flow (m3/s) 7

Slope (%) 1

HydroStorm Annual Sizing Results

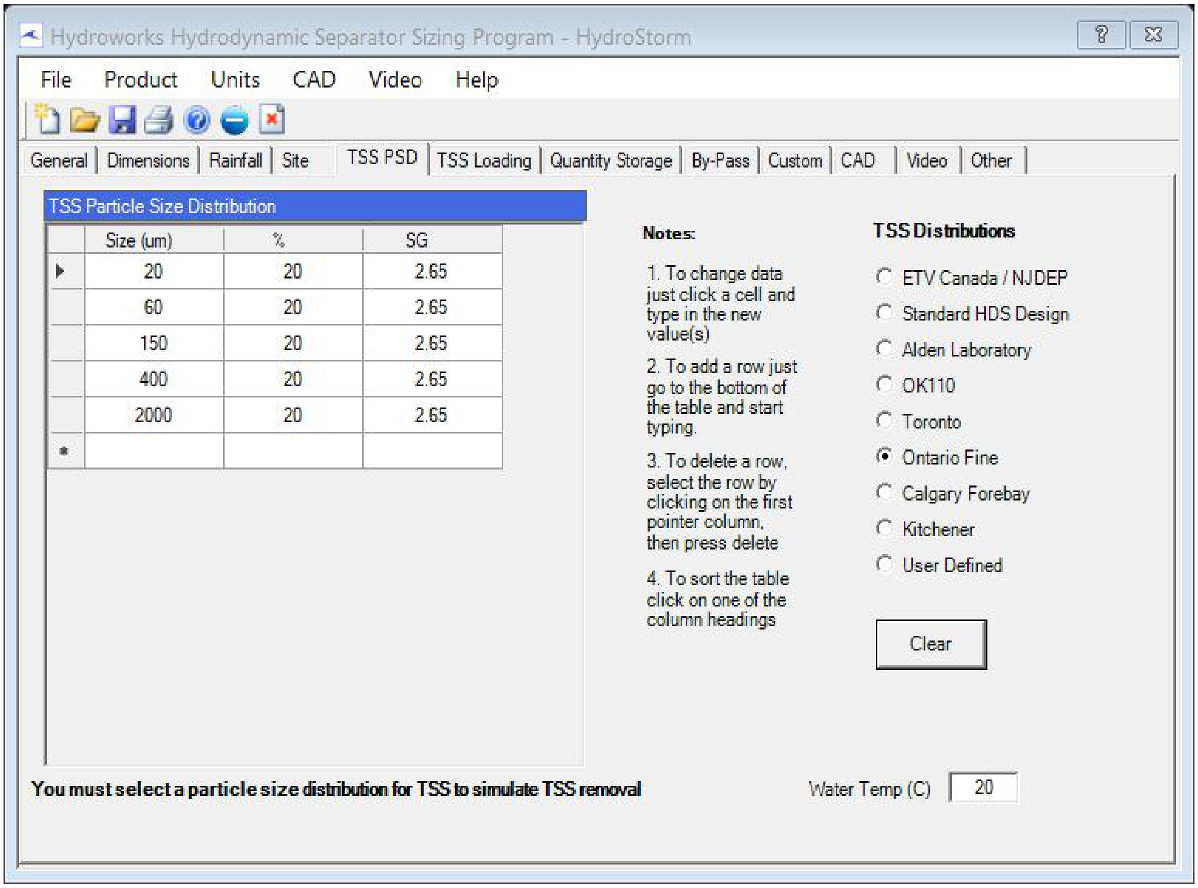
Model #	Qlow (m3/s)	Qtot (m3/s)	Flow Capture (%)	TSS Removal (%)
Unavailable	.026	.37	95 %	69 %
HS 4	.044	.37	98 %	76 %
HS 5	.056	.37	98 %	81 %
HS 6	.068	.37	99 %	85 %
Unavailable	.096	.37	99 %	88 %
HS 8	.128	.37	100 %	91 %
HS 10	.183	.37	100 %	95 %
HS 12	.245	.37	100 %	97 %

Particle Size Distribution

Size (um)	%	SG
20	20	2.65
60	20	2.65
150	20	2.65
400	20	2.65
2000	20	2.65

Note: Results vary significantly based on particle size distribution

TSS Particle Size Distribution



TSS Particle Size Distribution

Size (um)	%	SG
20	20	2.65
60	20	2.65
150	20	2.65
400	20	2.65
2000	20	2.65

Notes:

1. To change data just click a cell and type in the new value(s)
2. To add a row just go to the bottom of the table and start typing.
3. To delete a row, select the row by clicking on the first pointer column, then press delete
4. To sort the table click on one of the column headings

TSS Distributions

○ ETV Canada / NJDEP

○ Standard HDS Design

○ Alden Laboratory

○ OK110

○ Toronto

● Ontario Fine

○ Calgary Forebay

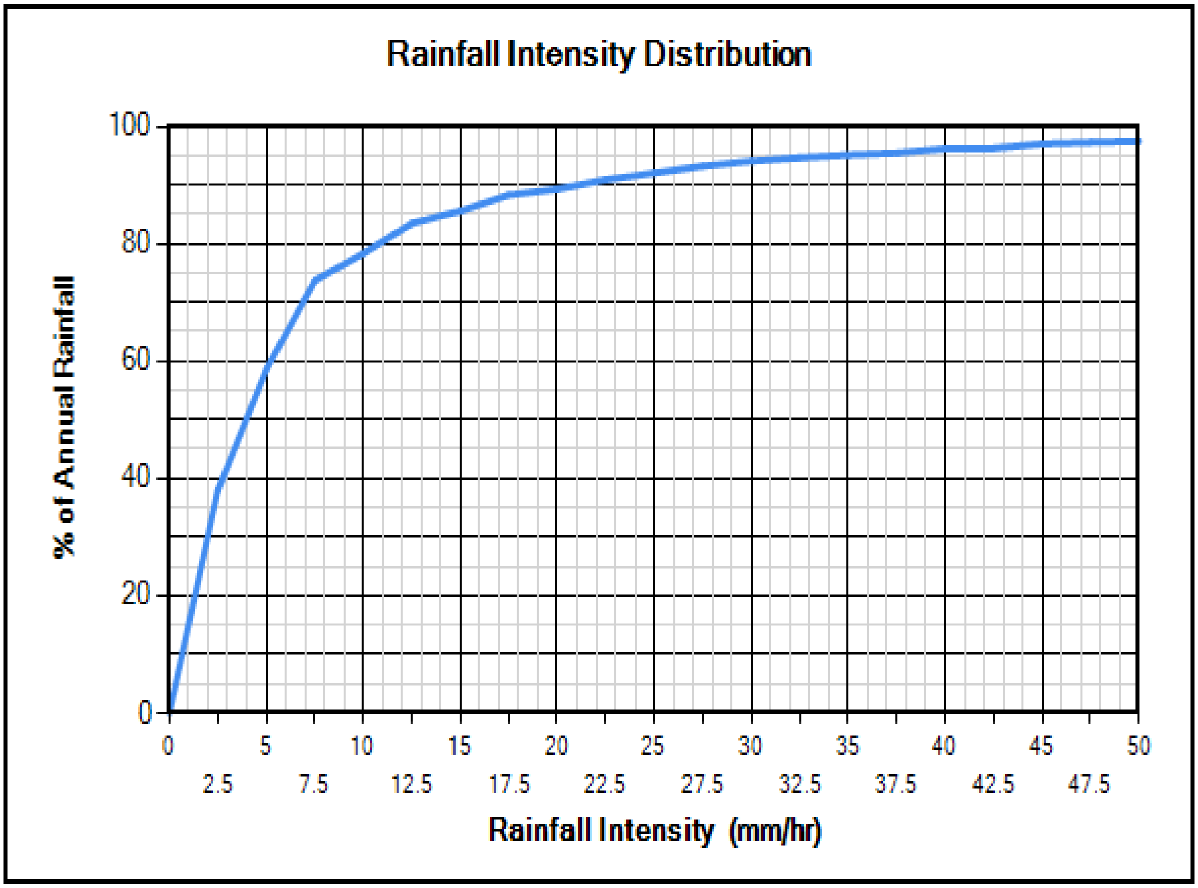
○ Kitchener

○ User Defined

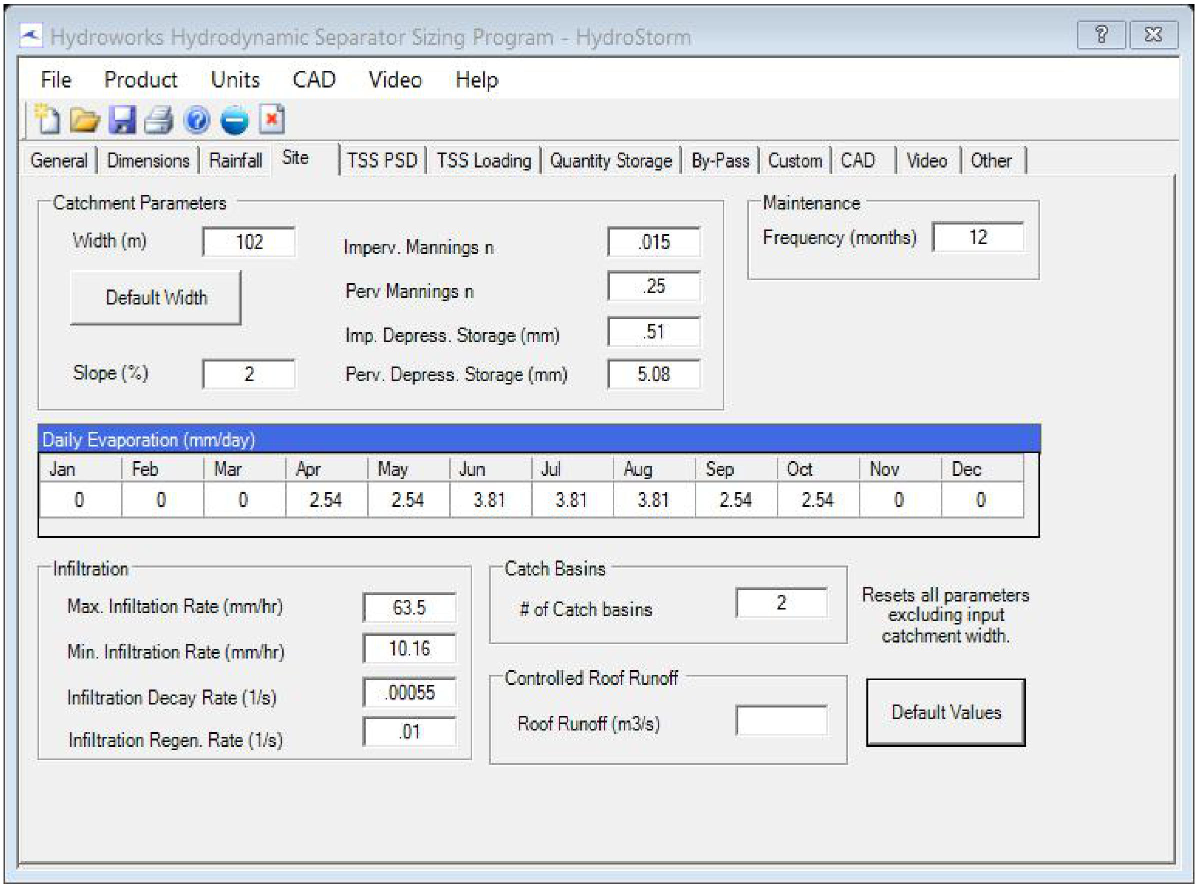
You must select a particle size distribution for TSS to simulate TSS removal

Water Temp (C) 20

Rainfall Station - Toronto Central, Ontario(1982 To 1999)



Site Physical Characteristics



Catchment Parameters

Width (m) 102

Slope (%) 2

Imperv. Mannings n .015

Perv Mannings n .25

Imp. Depress. Storage (mm) .51

Perv. Depress. Storage (mm) 5.08

Maintenance

Frequency (months) 12

Daily Evaporation (mm/day)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	2.54	2.54	3.81	3.81	3.81	2.54	2.54	0	0

Infiltration

Max. Infiltation Rate (mm/hr) 63.5

Min. Infiltration Rate (mm/hr) 10.16

Infiltration Decay Rate (1/s) .00055

Infiltration Regen. Rate (1/s) .01

Catch Basins

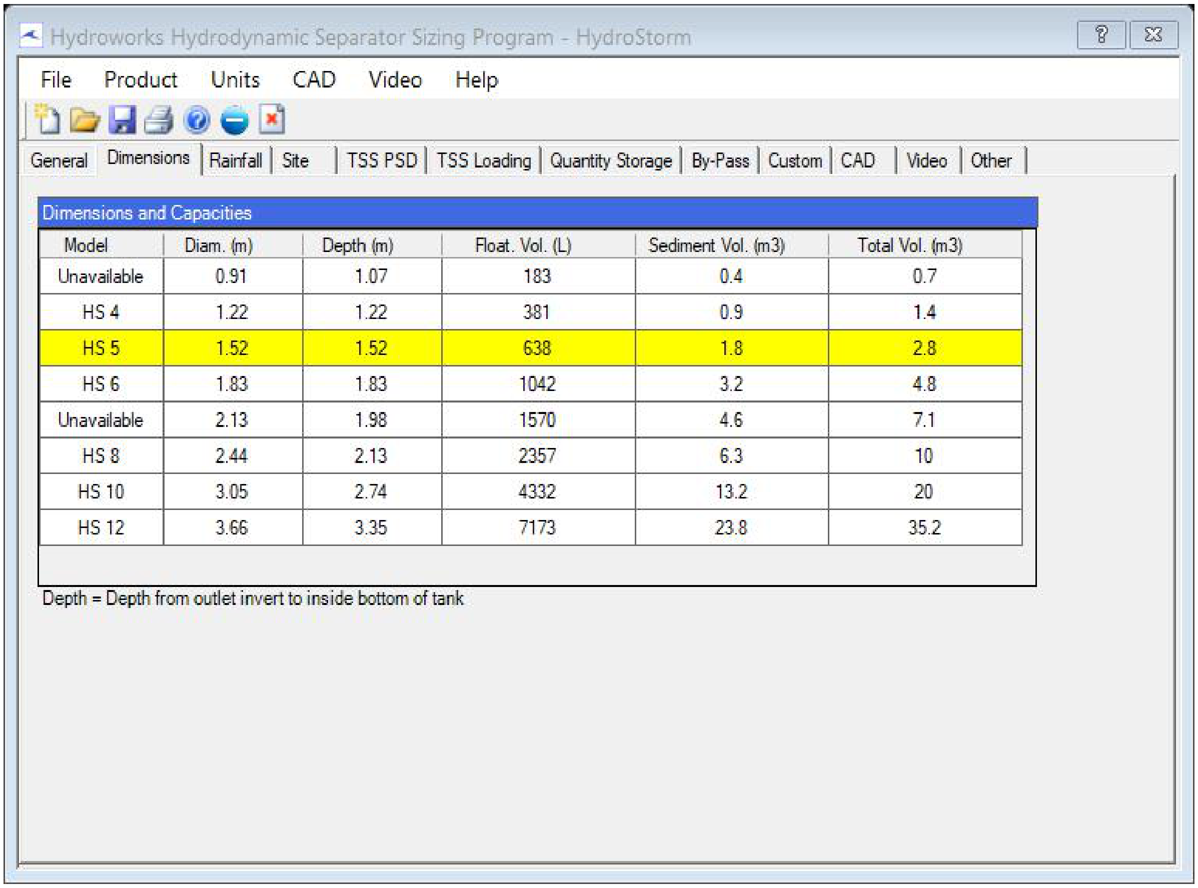
# of Catch basins 2

Controlled Roof Runoff

Roof Runoff (m3/s)

Resets all parameters excluding input catchment width.

Dimensions And Capacities

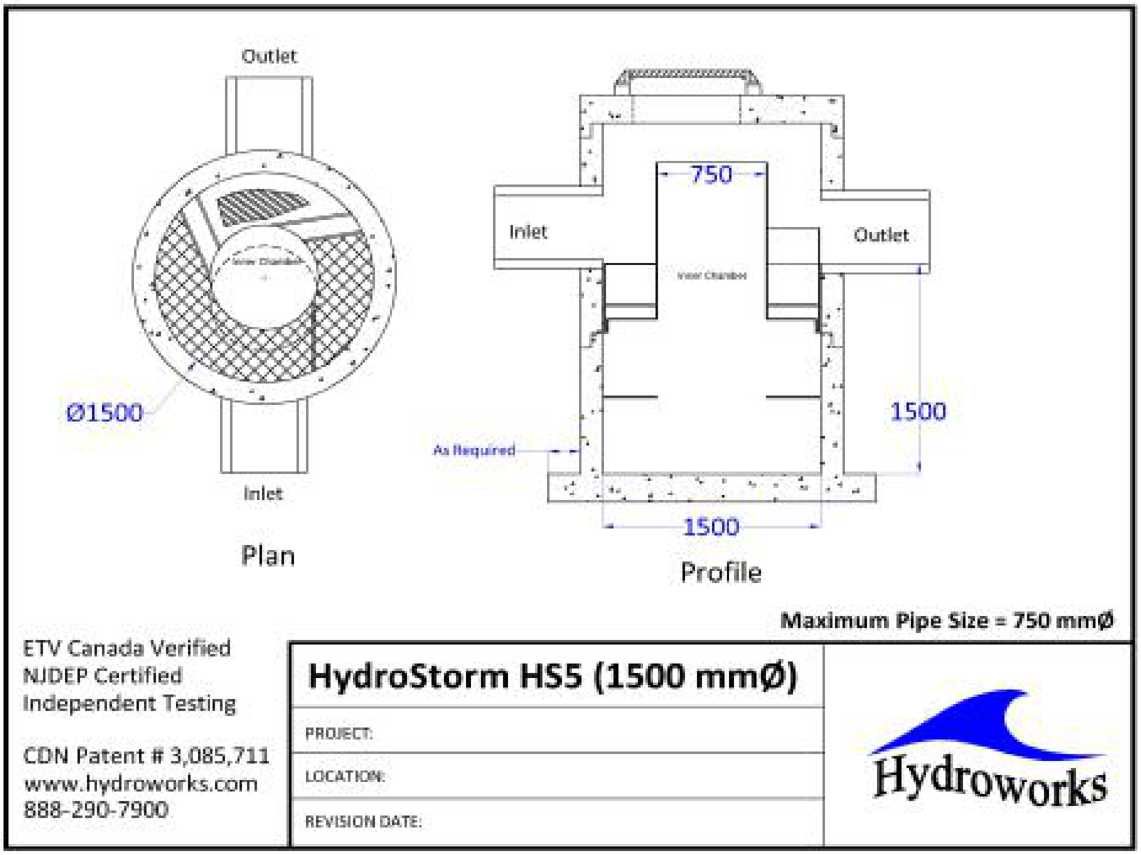


Dimensions and Capacities

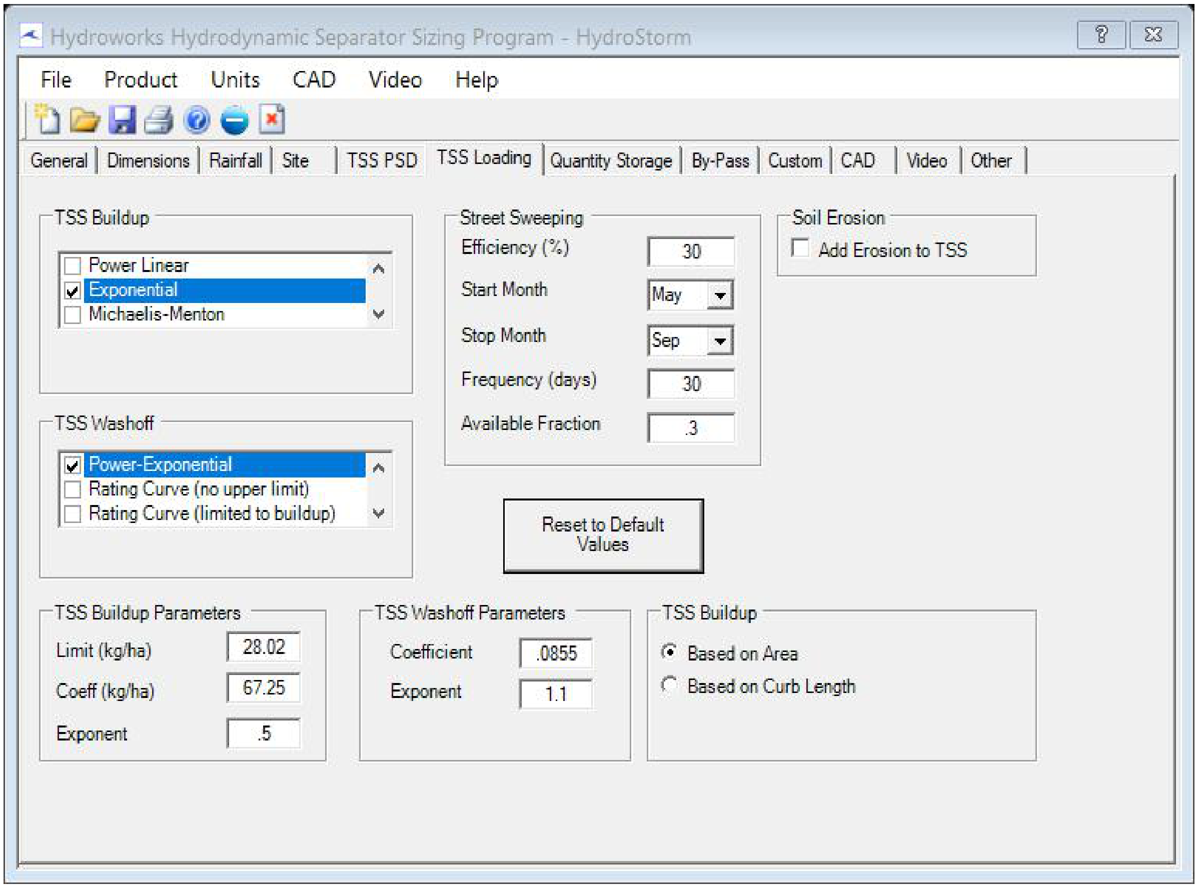
Model	Diam. (m)	Depth (m)	Float. Vol. (L)	Sediment Vol. (m3)	Total Vol. (m3)
Unavailable	0.91	1.07	183	0.4	0.7
HS 4	1.22	1.22	381	0.9	1.4
HS 5	1.52	1.52	638	1.8	2.8
HS 6	1.83	1.83	1042	3.2	4.8
Unavailable	2.13	1.98	1570	4.6	7.1
HS 8	2.44	2.13	2357	6.3	10
HS 10	3.05	2.74	4332	13.2	20
HS 12	3.66	3.35	7173	23.8	35.2

Depth = Depth from outlet invert to inside bottom of tank

Generic HS 5 CAD Drawing



TSS Buildup And Washoff



TSS Buildup

☐ Power Linear
☑ Exponential
☐ Michaelis-Menton

TSS Washoff

☑ Power-Exponential
☐ Rating Curve (no upper limit)
☐ Rating Curve (limited to buildup)

Street Sweeping

Efficiency (%): 30
Start Month: May
Stop Month: Sep
Frequency (days): 30
Available Fraction: .3

Soil Erosion

☐ Add Erosion to TSS

TSS Buildup Parameters

Limit (kg/ha): 28.02
Coeff (kg/ha): 67.25
Exponent: .5

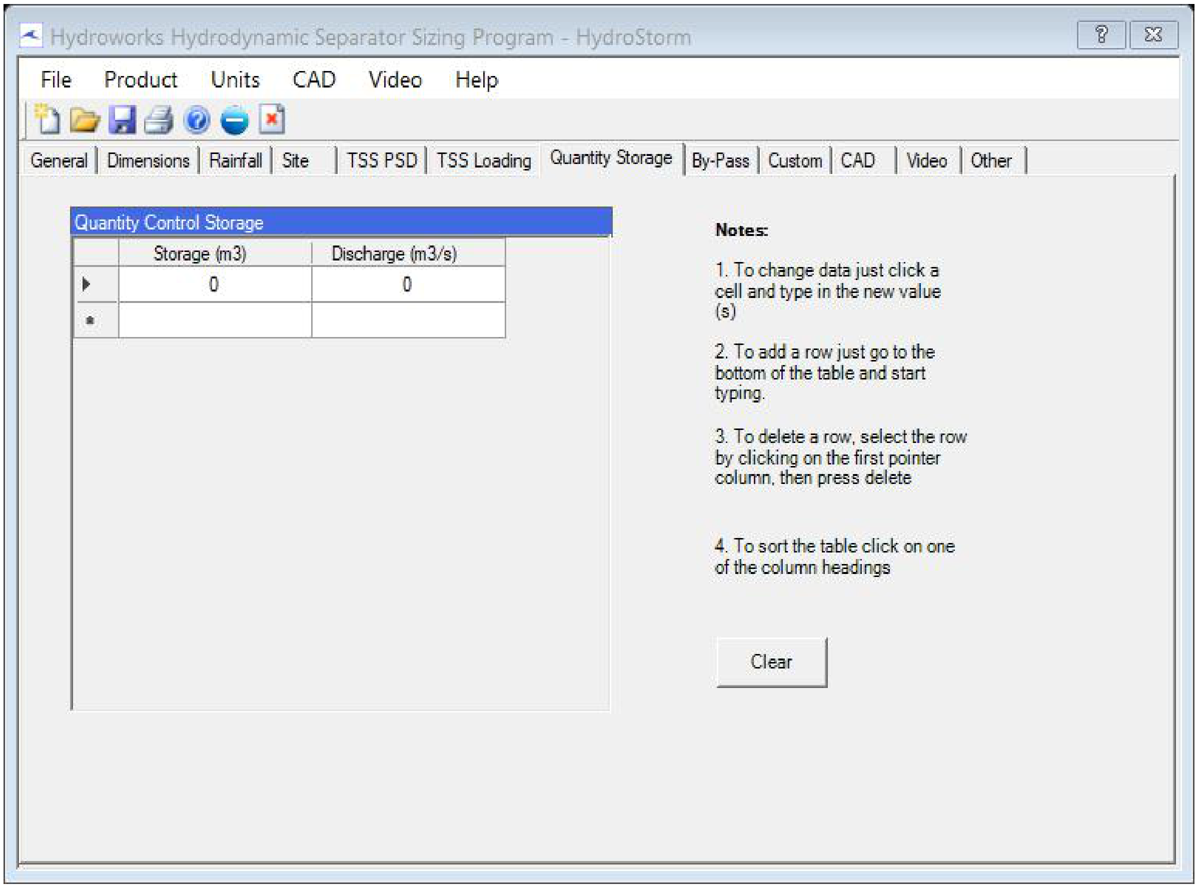
TSS Washoff Parameters

Coefficient: .0855
Exponent: 1.1

TSS Buildup

● Based on Area
○ Based on Curb Length

Upstream Quantity Storage



Quantity Control Storage

	Storage (m3)	Discharge (m3/s)
▶	0	0
*		

Notes:

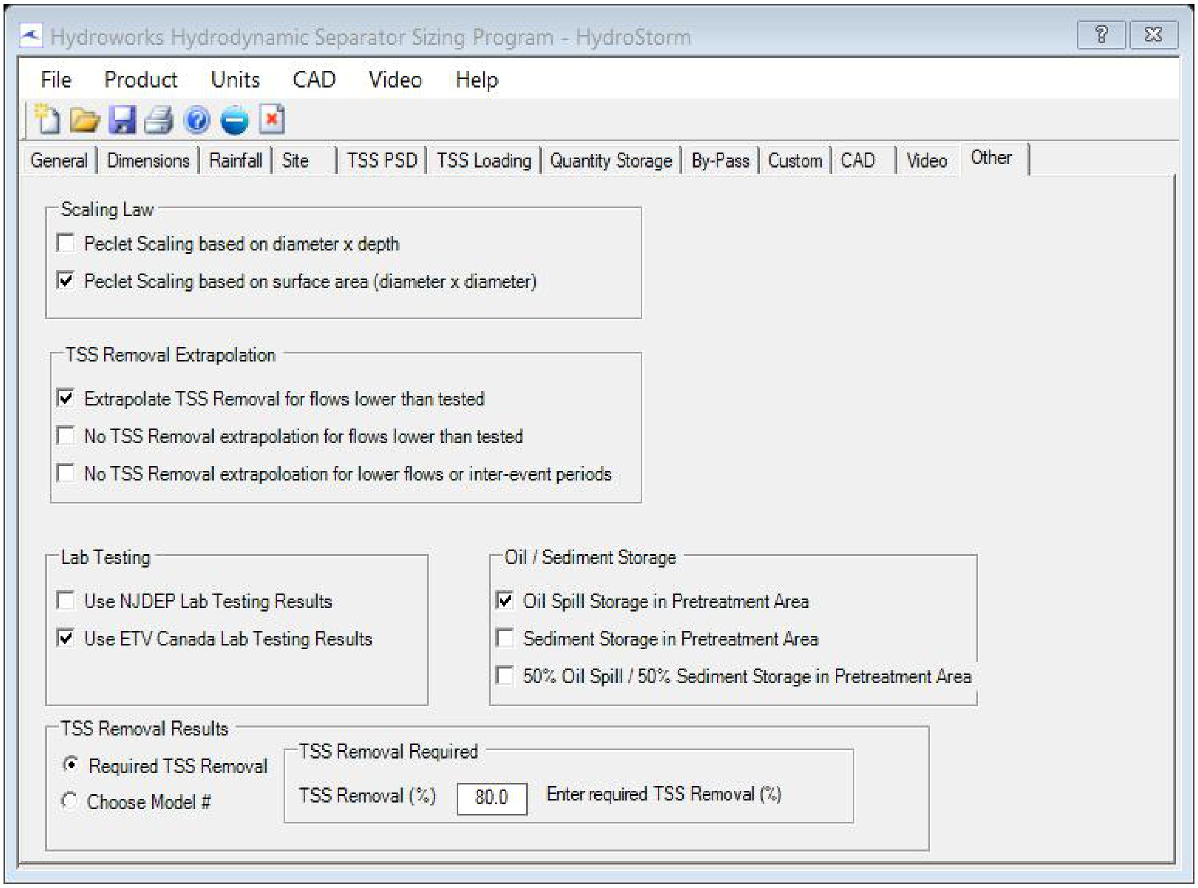
1. To change data just click a cell and type in the new value (s)

2. To add a row just go to the bottom of the table and start typing.

3. To delete a row, select the row by clicking on the first pointer column, then press delete

4. To sort the table click on one of the column headings

Other Parameters



Scaling Law
☐ Peclet Scaling based on diameter x depth
☑ Peclet Scaling based on surface area (diameter x diameter)

TSS Removal Extrapolation
☑ Extrapolate TSS Removal for flows lower than tested
☐ No TSS Removal extrapolation for flows lower than tested
☐ No TSS Removal extrapoloation for lower flows or inter-event periods

Lab Testing
☐ Use NJDEP Lab Testing Results
☑ Use ETV Canada Lab Testing Results

Oil / Sediment Storage
☑ Oil Spill Storage in Pretreatment Area
☐ Sediment Storage in Pretreatment Area
☐ 50% Oil Spill / 50% Sediment Storage in Pretreatment Area

TSS Removal Results
● Required TSS Removal
○ Choose Model #

TSS Removal Required
TSS Removal (%) 80.0 Enter required TSS Removal (%)

Flagged Issues

None

Hydroworks Sizing Program - Version 5.7

1-800-290-7900
www.hydroworks.com

APPENDIX C
SUBSURFACE INVESTIGATION REPORT
INSPEC.SOL DATED APRIL 11, 2007

INSPEC-SOL INC. 111 Brunel Rd., Suite 200, Mississauga, Ontario L4Z 1X3 • Tel.: (905) 712-4771 • Fax: (905) 712-0515

DANIEL JOHNSON ARCHITECT INC.

Subsurface Investigation and Slope Stability Analyses
Proposed Residential Dwelling and Guesthouse
904 Mississauga Heights Road
Mississauga, Ontario

Date :	**April 11, 2007**	Reference No :	**T040022-A1**

INSPEC-SOL

INSPEC-SOL INC. 111 Brunel Rd., Suite 200, Mississauga, Ontario L4Z 1X3 • Tel.: (905) 712-4771 • Fax: (905) 712-0515

Reference No. T040022-A1

April 11, 2007

Mr. Daniel Johnson
Daniel Johnson Architect Inc.
90 Richmond Street East, Suite 100
Toronto, Ontario
M5C 1P1

Re: Subsurface Investigation and Slope Stability Analyses
Proposed Residential Dwelling and Guesthouse
904 Mississauga Heights Road
Mississauga, Ontario

Dear Mr. Johnson:

In accordance with your request, Inspec-Sol Inc. has conducted a subsurface investigation and slope stability analyses at the above-mentioned site and is pleased to present this report.

We trust that this information meets with your approval. Please do not hesitate to contact us, should any questions arise.

Yours very truly,

INSPEC-SOL INC.

Karl Roechner, P. Eng.,
Associate

Detroit • Windsor • Waterloo • Toronto • Kingston • Ottawa • Montréal • Mont-Tremblant • St-Bruno • Thetford Mines • Québec • Lévis • Rimouski • Matane
www.inspecsol.com

TABLE OF CONTENTS

FIGURES

1.0 INTRODUCTION

Inspec-Sol Inc. was retained by Daniel Johnson Architect Inc. to carry out a subsurface investigation and slope stability analyses at 904 Mississauga Heights Road, in Mississauga, Ontario (Site). The Site is irregular in shape, overlooking the Credit River, and is approximately 1.09 hectares (2.7 acres). A Site Location Plan is provided as Figure No. 1.

It is our understanding that the anticipated development activities include the demolition of the existing dwelling, construction of a 418 square metres (4,500 square feet) primary residence, and a 232 square metres (2,500 ft^2) guest house. The primary residence will generally be located at the rear of the property on the footprint of the existing dwelling but will be slightly larger with no portion of the structure closer to the slope crest than the existing building. The guest house residential structure will be located in the central portion of the property. The rear portion of the property slopes down towards a branch of the Credit River. The slope is approximately 22 m high and the inclination varies between 1.3:1 to 3:1 (horizontal to vertical).

The purpose of the investigation was to assess the subsurface conditions adjacent to the existing slope situated along the rear boundary of the proposed development (south limit) in order to establish the stable slope allowance and the toe erosion allowance for the development. Engineering recommendations are also provided with regards to design and construction of the proposed residential dwelling and guest house, including measures to be undertaken to maintain long term stability of the existing slope. The scope of work included advancing three boreholes, installation of two piezometer for groundwater level measurements, a detailed visual slope inspection and mapping, and a stability analysis of one critical slope section.

2.0 FIELD PROCEDURES

The borehole exploration was carried out on March 9, 2007 under the supervision of an Inspec-Sol field representative. The work consisted of drilling and sampling one borehole (Borehole 1) in the area of the proposed guest house in the central portion of the site and two boreholes (Boreholes 2 and 3) at the rear of the existing dwelling adjacent to the crest of the slope. One of the boreholes (Borehole 2) was extended to a depth of 12.8 m to explore the subsurface conditions in the slope profile. The location of the boreholes advanced at the Site are shown on the Borehole Location Plan provided as Figure No. 2. The detailed results of the individual boreholes are recorded on the accompanying Borehole Logs in Appendix A (Enclosures 1 to 5).

The stratigraphy at each borehole location has been referenced to the current grade level. The ground surface elevations at the borehole locations have been surveyed to a temporary benchmark (geodetic elevation of 107.38 m), which is the top of manhole at the intersection of the property driveway with Mississauga Heights Road.

The boreholes were advanced with a track-mounted continuous flight power auger for conventional augering and sampling. Representative disturbed samples of the strata penetrated were collected using a split-barrel sampler advanced by a 63.5-kg hammer dropping approximately 760 mm. The results of these Penetration Tests are reported as "N" values on the borehole logs at the corresponding depths. The supervising technician logged the borings and examined the samples as they were obtained. The samples were sealed in clean, airtight containers and transferred to our laboratory, where they were reviewed by a senior geotechnical engineer.

Ground water observations were made in the boreholes as drilling proceeded. Standpipe type peizometers were installed in Boreholes 2 and 3 to permit monitoring of the groundwater levels. The standpipes comprised of 19 mm I.D. PVC tubing, were saw-slotted near the base, and fitted with a cloth filter and bentonite seal.

Laboratory testing consisted of moisture content tests on all recovered samples and gradation analysis on two select samples obtained from the boreholes. The moisture content results are presented on the borehole logs and the grain size results are attached in Appendix B.

3.0 SUBSURFACE CONDITIONS

3.1 Stratigraphy

Details of the subsurface conditions encountered at the Site are summarized in this section. It should be noted that the subsurface conditions are confirmed only at the borehole locations and may vary elsewhere. The boundaries between the various strata, as shown on the Borehole Logs, are based on non-continuous sampling. These boundaries represent an inferred transition between the various strata, rather than a precise plane of geological change.

A detailed description of the soils and the depths that they were encountered is presented on the accompanying Borehole Logs attached as Enclosures 1 through 5 (Appendix A).

3.1.1 Topsoil

All boreholes encountered a surficial topsoil layer at the ground surface. The topsoil generally ranged in thickness from 150 mm to 300 mm.

3.1.2 Earth Fill

Earth fill, consisting primarily of clayey silt, silty sand, and sand, was encountered immediately below the surficial topsoil in all boreholes and extended to depths ranging from 0.8 m to 1.5 m below existing grade.

The relative density of the fill materials was assessed by carrying out Standard Penetration Test (SPT). The SPT results obtained using standard sampling procedures yielded 'N' values ranging from 7 blows per 300 mm of penetration to 32 blows per 300 mm of penetration, indicating a loose to dense or stiff condition.

3.1.3 Clayey Silt Till

A stratum of glacial till with a matrix predominantly consisting of clayey silt size particles was encountered beneath the surficial fill in Borehole 1 at a depth of 1.5 m, and extended to 4.6 m below grade.

The penetration resistance measured in the clayey silt till by standard sampling procedures yielded 'N' values ranging from 44 blows per 300 mm of penetration to 50 blows per 25 mm of penetration. The shear strength of the stratum was measured using a pocket penetrometer and found to be greater than 225 kPa, indicating a hard consistency. The consistency of the undisturbed till generally increases with depth.

The moisture content of samples extracted from the native deposit generally varied between 11 and 21 percent by weight, indicating a moist to very moist condition.

3.1.4 Silty Sand and Gravel

A deposit of silty sand and sand and gravel till was encountered beneath the fill layer in Boreholes 2 and 3 and extended to a depth of 6.1 and 7.6 m below grade respectively. The layer is initially silty sand from a depth of 1.5 m to 4.6 m below grade and becomes silty sand and gravel at a depth of 4.6 m.

The penetration resistance measured in the native sandy deposit by standard sampling procedures yielded results ranging from 11 blows per 300 mm of penetration to 34 blows per 300 mm of penetration, indicating a relative density varying between compact and dense. The relative density of the deposit generally increases with depth.

Grain size distribution analyses were carried out on two (2) representative samples of the native soils, at depths ranging from 1.5 and 5.0 m below grade (Appendix B). A summary of the composition is presented below.

Borehole No.	Sample Depth	% Gravel	% Sand	% Silt	% Clay
BH 2	1.5 to 2.0 m	-	73	24	3
BH 2	4.6 to 5.0 m	27	54	15	4

The moisture content of samples extracted from the sandy soils generally varied between 3 and 16 percent by weight, indicating a moist to wet condition.

3.1.5 Weathered Shale (Bedrock)

Weathered shale bedrock was encountered beneath the clayey silt till in Borehole 1 and beneath the silty sand and gravel deposit in Boreholes 2 and 3. The weathered shale was encountered at depths ranging from 3.0 to 7.6 m and extended to the depths of the investigations (i.e. 4.6 m to 12.8 m below existing grade). The bedrock predominantly consisted of grey shale, which is thinly laminated and friable, with interbeds of limestone and sandstone. Borehole 2 was terminated due to auger refusal on competent shale or limestone layers.

The weathered shale was generally in a hard state, with 'N' values varying between 50 blows per 100 mm of penetration to 50 blows per 25 mm penetration. The moisture content of samples extracted from the borings varied between 5 to 12 percent by weight.

4.0 GROUNDWATER

A standpipe type peizometer was sealed into Boreholes 2 and 3 in order to permit observation of the groundwater levels. The standpipes were comprised of 19-mm I.D. PVC tubing. The following table presents a summary of the depths at which groundwater was encountered in the open boreholes, upon completion of drilling, and in the two standpipe piezometers several days following drilling. Water level measurements were taken in the piezometers on March 21, 2007.

Location	Depth of Borehole	Water Level at Completion of Drilling (March 9, 2007)	Water Level in Standpipe on March 21, 2007
Borehole 1	5.0 m BG	3.0 m BG	N/A
Borehole 2	12.8 m BG	3.0 m BG	8.8 m BG
Borehole 3	9.2 m BG	dry	6.4 m BG

BG: Below Grade N/A: No piezometer installed

It should be noted that groundwater levels are transient and tend to fluctuate with the seasons and periods of precipitation and temperature.

5.0 SLOPE INSPECTION

A detailed visual inspection of the slope condition was conducted by Inspec-Sol on March 19 and 27, 2007 and included an examination of the exposed soil and groundwater conditions, slope configuration, presence of seepage and erosional features, vegetation, and evidence of instability such as exposed scarps, slumps and sloughing. In addition, a topographical Site Plan obtained by the City of Mississauga and cross sections of the slope profile prepared by Inspec-Sol were reviewed. The topographic contours for the slope are provided on Figure 2 and a cross section of the slope profile prepared by Inspec-Sol is presented on Figure 3.

Based on the topographical plan and the cross section, the slope along the rear (south) property has a height of approximately 22 meters, and locally varied in gradient from about 1.3 to 1 (horizontal to vertical) to about 3 to 1. The upper slope section was measured to have an inclination of approximately 2 to 1 and the lower portion was measured to be 3 to 1. The central portion of the slope was found to be steeper with an inclination of 1.3 to 1.

Based on our field observations, the slope face comprises of tall mature trees and shrubs. No significant evidence of erosion, sloughing, or instability were observed on the slope face and there were no tension cracks observed parallel to the slope crest. Also, no wet areas or evidence of water seepage was observed emanating from the slope. The slope face was observed to be dry. Also, there was no evidence of surface erosion associated with the surface water or runoff flow.

Minor gully features were also observed on the slope and found to be covered with grass. The features were relatively shallow and there were no signs of surficial erosion or slumping observed.

The existing dwelling is located approximately 12 to 24 m from the crest of the slope. The rear yard is generally flat and comprises of a grass lawn.

Typical photographs of the slope along the rear of the property taken on March 19 and 27, 2007 are presented in Appendix C.

6.0 ENGINEERING DISCUSSION AND ASSESSMENT

6.1 General

The known development activities will involve the demolition of the existing dwelling, and construction of a new primary residence and a guesthouse. The primary residence will be constructed adjacent to the existing slope on the footprint of the existing dwelling but will be slightly larger with no portion of the structure closer to the slope crest than the existing building. The guest house will be located in the central portion of the property. The total floor area of the primary residence will be 418 square metres and the area of the guest house will be 232 square metres.

Based upon the above comments and on the borehole information, and assuming them to be representative of the subsoil conditions across the Site, the following comments and recommendations are offered:

6.2 Foundation Design Parameters For New Structures

All foundations must be designed to extend through the surficial earth fill materials and bear on the underlying undisturbed native strata. Footings exposed to freezing temperatures must be provided with at least 1.2 metres of earth cover for frost protection or equivalent insulation.

The undisturbed native clayey silt soil deposit encountered in Borehole 1 and the native silty sand deposit encountered in Borehole 2 and 3, at depth varying between 1.0 m and 1.8 m below existing grades, is considered suitable to support conventional spread footings. A maximum net allowable bearing pressure of 150 kPa is recommended for the design of spread footings established on the very stiff/compact native stratum. It is recommended that the minimum footing width for spread footings be 450 mm, and the minimum width for square or pad footings be 800 mm. The settlement of spread footings established on the native soils at this design bearing pressure is expected to be less than 25 mm.

The minimum founding depth at each of the borehole locations is summarized in the table below. Conventional spread footings or augered piers must be founded at least 0.3 metres into the undisturbed native soil for the allowable bearing capacity values provided.

Borehole Location	*Minimum Founding Depth Below Existing Grade * / Elevation*
1	1.0 m / 106.4 m
2	1.8 m / 103.0 m
3	2.3 m / 100.9 m

Note: * Footings exposed to freezing temperatures must be provided with at least 1.2 metres of earth cover for frost protection or equivalent insulation.

It is noted that seepage is anticipated in localized excavated areas during foundation construction from surface drainage and seepage from perched water within any preferentially permeable features in the earth fill or glacial till, such as thin sand / gravel seams. Since the till soils are, in general, of low permeability, the volume of water to be anticipated is such that temporary pumping from the excavations should suffice to control groundwater.

6.3 SLOPE STABILITY ASSESSMENTS AND STABILITY SETBACK

Analysis Method

Based on the topographic survey provided by the City of Mississauga representative slope profile (i.e. Sections A-A) was plotted as shown on Figure 3. An engineering analysis was carried out on the stability of the representative slope section utilizing borehole soil and groundwater information, and using long-term effective stress parameters.

The analyses was carried out using the SLOPE/W (Version 5.18) limit equilibrium software, adopting the Bishop method of slices, to evaluate the potential of movements of deep and shallow masses of soil over hypothetical failure surfaces. This assessment provides an estimate of the Factors of Safety against slope stability failure. A Factor of Safety of 1.0 or less is considered to represent a potential failure condition when the resisting forces to failure (soil shear strength) are equal to, or less than the driving gravitational forces tending to cause instability. For engineering design purposes a minimum Factor of Safety of 1.3 to 1.5 is generally considered acceptable depending on the type of slope soils and consequences of slope failure. A

Factor of safety of 1.5 is adequate for this Site given that a new residential dwellings will be constructed on the crest of the slope.

The analyses was conducted using the profile represented by section A-A. The inclination of the slope profile is approximately 2 to 1 (horizontal to vertical) in the upper slope, approximately 1.3 to 1 in the central slope, and then flattering near the base to approximately 3 to 1. Based on the borehole penetration data and the laboratory index properties, long-term effective stress soil strength parameters were estimated as presented in the following table.

Soil Type	Unit Weight (kN/m^3)	Cohesion (kPa)	Angle of Internal Friction (Deg)
Fine Sand Fill	18	0	28
Native Silty Sand	19	0	34
Silty Sand & Gravel Till	20	0	38
Shale Bedrock	22	5	42

Note : Soil strength properties estimated using relationship between SPT 'N' values and soil friction established by Peck.

Factors of Safety (FOS)

Based on the subsurface conditions encountered at the boreholes and considering them to be representative of the overall site conditions, the following table presents the slope stability results:

Section	Overall Slope Inclination	FOS against Shallow Slope Failure	FOS against Intermediate/Deep Seated Slope Failure
A-A	Upper: 2:1 Central 1.3:1 Lower: 3:1	1.22	1.54

Based on the results of our engineering analyses, the existing slope represented by Section A-A is considered to be safe against intermediate and deep seated failure (FOS > 1.5).

It is noted that the slope face comprises of tall mature trees and shrubs. No significant evidence of erosion, sloughing, or instability were observed on the slope face and there were no tension cracks observed parallel to the slope crest. Also, no wet areas or evidence of water seepage was observed emanating from the slope. The slope face was observed to be dry. Based on our observations, experience and analysis, the existing slope represented by Section A-A is considered safe against shallow slope failure.

6.4 EROSION CONTROL ASSESSMENT AND EROSION SETBACK

The erosion setback is based on the nature of the soils present at the toe of the slope and banks of the drainage course and on the flood plain distances between the toe of the slope and the bank of the watercourse.

Based on the field visual investigation of the watercourse banks and the results of the subsurface investigation, the surficial soils encountered along the toe of the slope and adjacent to the watercourse consisted mainly of clayey silt, sand and silt, and sand and gravel soils. Also, there was no evidence of active erosion of the slope face or toe of slope.

The flood plain width obtained from the topographic survey (Figure 2) and the cross section plan (Figure 3) indicates the distance between the existing toe of slope and the watercourse channel varies between 35 m and 40m. Based on the results of our engineering analyses, no additional erosion setback is required for the proposed residential dwelling.

6.5 CRITERIA FOR MAINTAINING SLOPE STABILITY

To ensure that the stability of the existing slopes is not adversely affected by the proposed developments, the following general constraints are recommended:

- Development should be conducted in a manner that does not result in surface erosion of the slopes. In particular, site grading and drainage should be designed to prevent direct concentrated or channelized surface run-off from flowing over the crest and face of the slope. Low velocity 'sheet flow' run-off over the slope crest should not result in erosion, provided the volume and flow velocities do not exceed existing conditions.

- Water drained from pools, downspouts, sumps, and the like, should not be allowed to flow from over the crest of the slope.
- A healthy vegetative cover should be maintained in all areas that may become disturbed as a result of construction.
- The configuration of the slope face and crest should not be altered without prior consultation with an experienced geotechnical engineer. In particular, the slopes should not be steepened, and fill materials should not be placed on the slope face, without engineering advice.
- Appropriate temporary silt fences should be erected and maintained until after construction is complete.
- An interceptor drainage swale should be constructed immediately upslope of any swimming pool areas to divert surface runoff around the pools.
- During construction, no equipment or earth stockpiles should be placed within 5 meters of the slope crest.

7.0 LIMITATIONS OF THE INVESTIGATION

This report is intended solely for the named consultant and their client. The material in this report reflects our best judgement in light of the information available to Inspec-Sol Inc. at the time of preparation. No portion of this report may be use as a separate entity, it is to be read in its entirety. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties.

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

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

We trust that this report meets with your present requirements. Please do not hesitate to contact us should any questions arise.

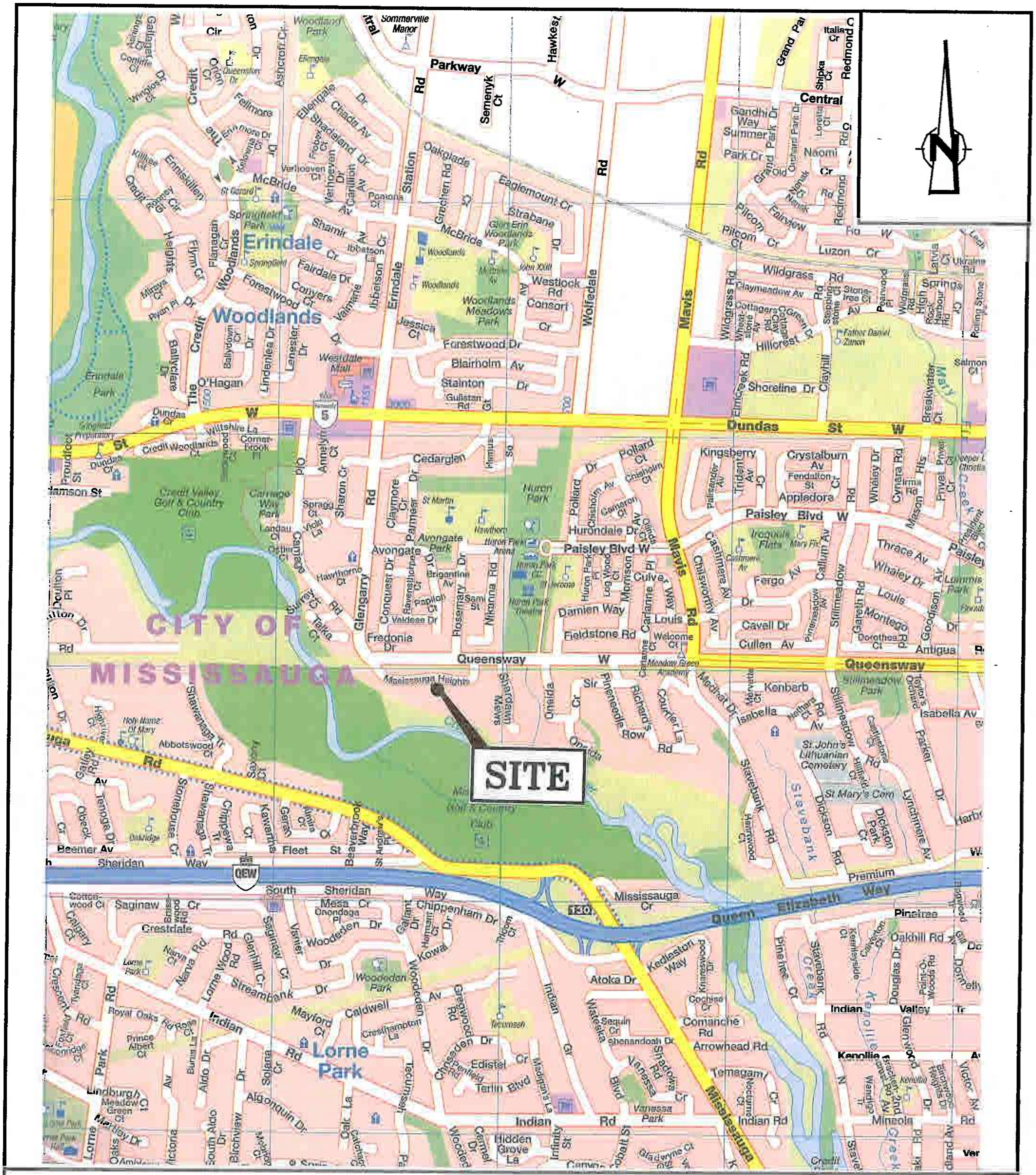
INSPEC-SOL INC.

Helal Ahmed, P.Eng.
Project Manager

LICENSED PROFESSIONAL ENGINEER
H.U. AHMED
April 13, 07
PROVINCE OF ONTARIO

Karl Roechner, P.Eng.
Associate

FIGURES



Source: MapArt Publishing

figure 1

SITE LOCATION PLAN
PROPOSED RESIDENTIAL DWELLING AND GUESTHOUSE
904 MISSISSAUGA HEIGHTS ROAD, MISSISSAUGA, ONTARIO
Daniel Johnson Architects Inc.

INSPEC•SOL

T040022-A1-(003) APR 11/07

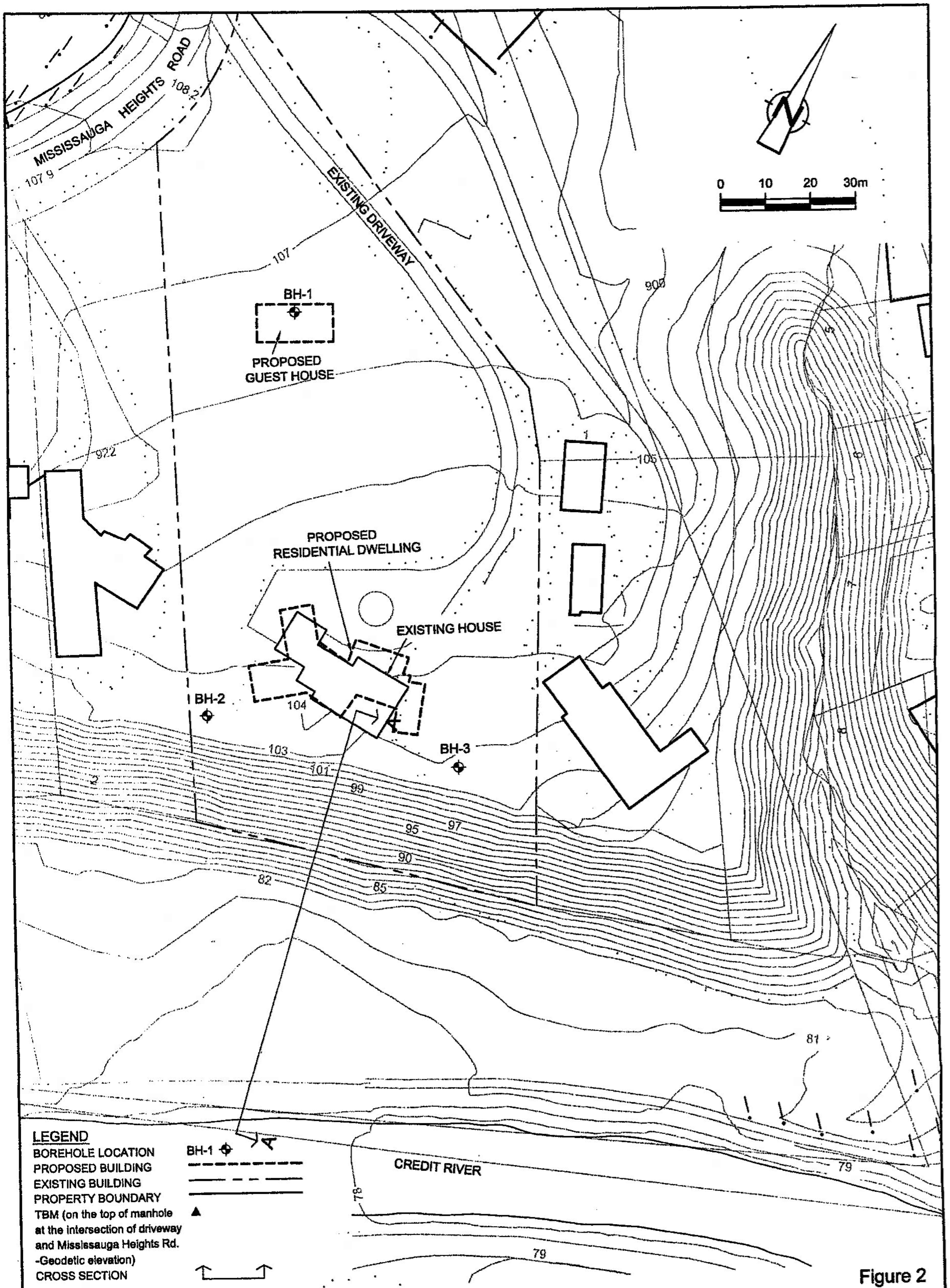


Figure 2

BOREHOLE AND CROSS SECTION LOCATION PLAN
PROPOSED RESIDENTIAL DWELLING AND GUESTHOUSE
904 MISSISSAUGA HEIGHTS ROAD, MISSISSAUGA
Daniel Johnson Architects Inc.

INSPEC•SOL

T040022-A1(003)GN-TO001

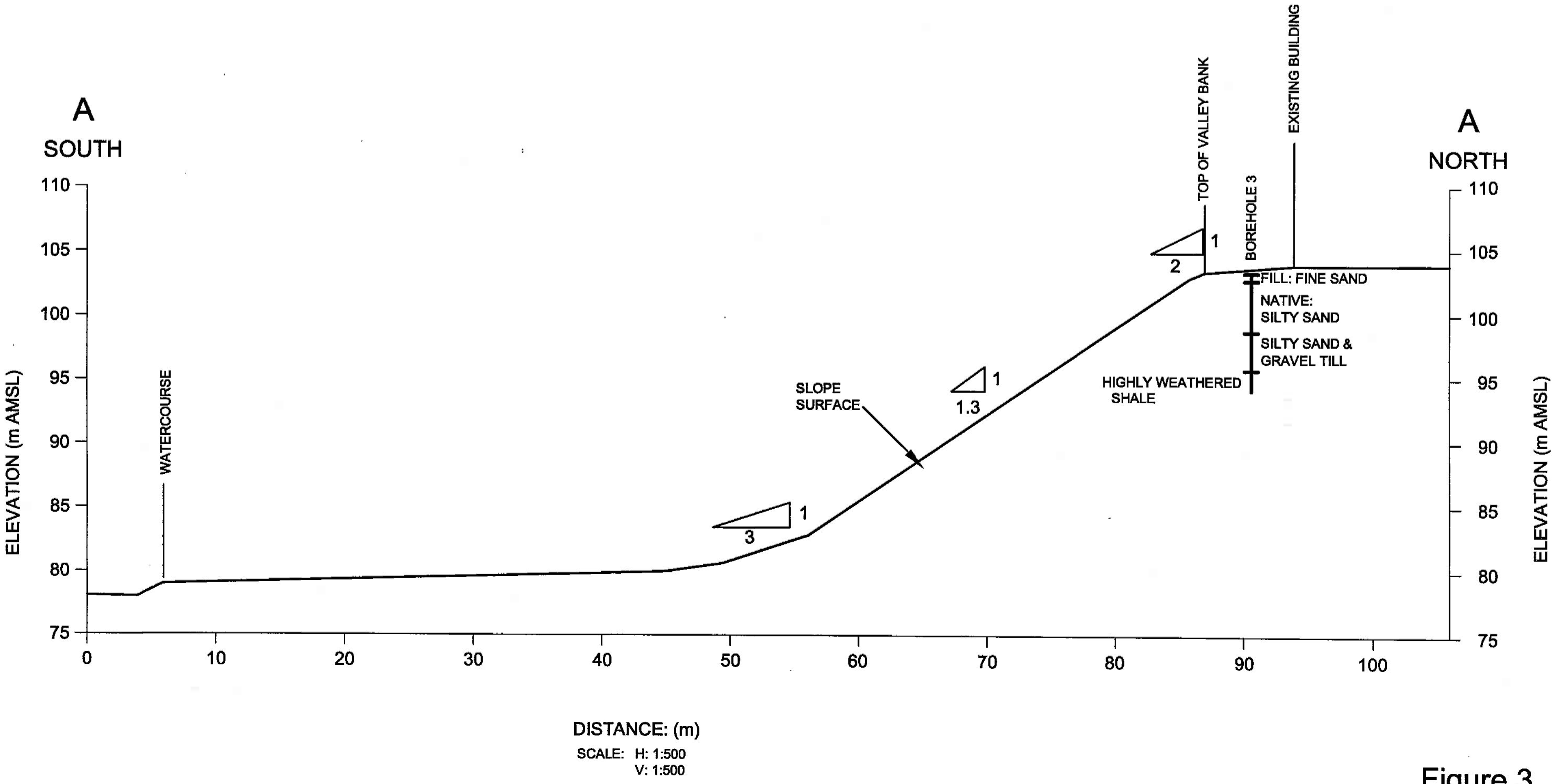


Figure 3

CROSS SECTION A-A
PROPOSED RESIDENTIAL DWELLING AND GUESTHOUSE
904 MISSISSAUGA HEIGHTS ROAD, ONTARIO

Daniel Johnson Architects Inc.

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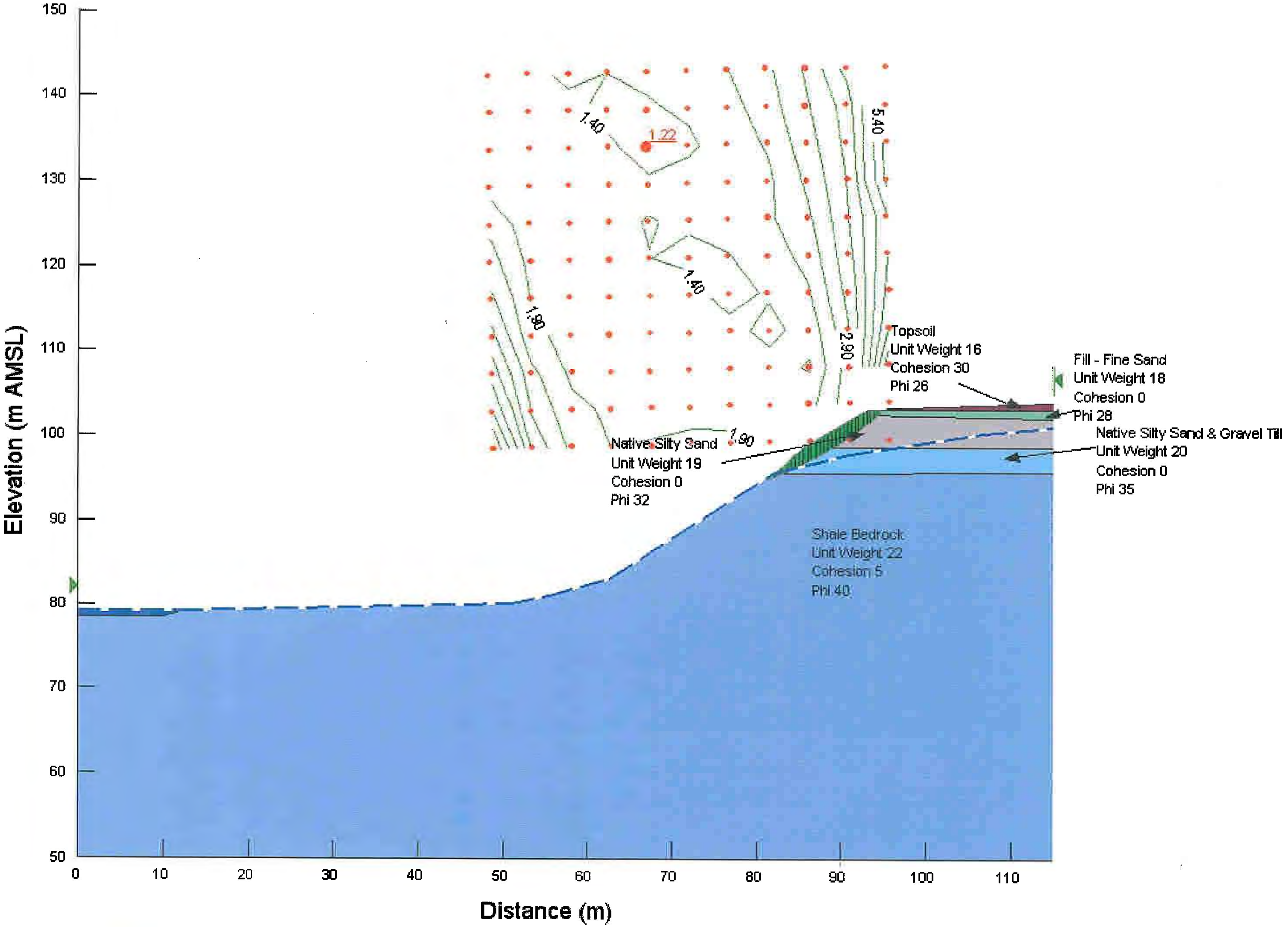

INSPEC·SOL

Figure 4
T040022-A1
Slope Stability Analyses Section A-A - Shallow Failure
Proposed Residential Dwelling and Guesthouse
904 Mississauga Heights Road, Ontario

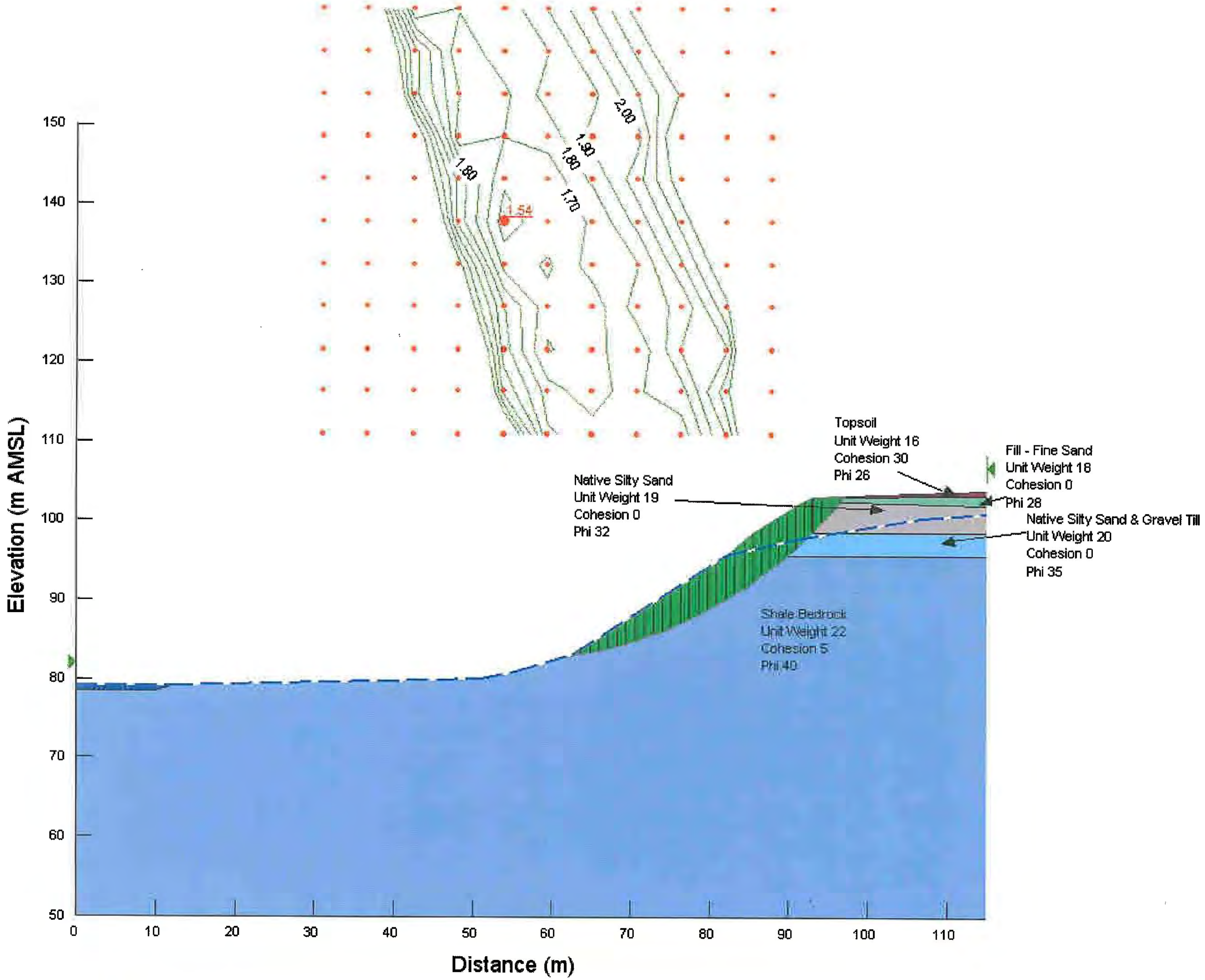

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Figure 5
T040022-A1
Slope Stability Analyses Section A-A - Deep Failure
Proposed Residential Dwelling and Guesthouse
904 Mississauga Heights Road, Ontario

APPENDIX A

BOREHOLES LOGS

ENCLOSURES 1 TO 5

REFERENCE No.: T040022A1 ENCLOSURE No.: 1

INSPEC·SOL

BOREHOLE No.: BH-1
ELEVATION: 107.4m

BOREHOLE REPORT

Page 1 of 1

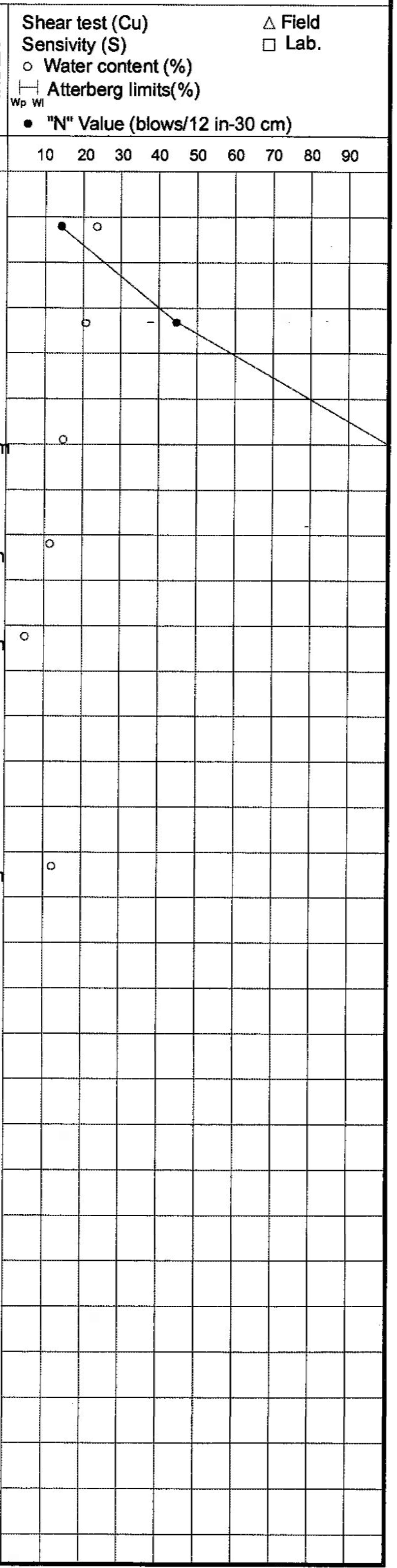
CLIENT: Daniel Johnson Architect Inc.
PROJECT: Proposed Residential Dwelling and Guest House
LOCATION: 904 Mississauga Heights Road, Mississauga
DESCRIBED BY: A. Mazzuca CHECKED BY: Karl Roechner
DATE (START): March 09, 2007 DATE (FINISH): March 09, 2007

LEGEND

☒ SS SPLIT SPOON
▨ ST SHELBY TUBE
◫ RC ROCK CORE
▼ WATER LEVEL

STRATIGRAPHY					SAMPLE				TEST RESULTS	
DEPTH		ELEVATION (m)	STRATIGRAPHY	DESCRIPTION OF SOILS AND BEDROCK	STATE	TYPE AND NUMBER	RECOVERY	SHEAR STRENGTH (C_u)	BLOWS 6 in/15 cm or RQD	PENETRATION INDEX
Feet	Metres	107.4		GROUND SURFACE			%	KPa		N
0	0			Topsoil: 300mm						
				Fill: Clayey Silt, occasional rootlets, brown, moist, stiff	☒	SS-1	75		6-7-7-9	14
	0.8	106.6		Native: Clayey Silt Till, brown, moist, hard						
	1.0				☒	SS-2	100	>225	9-16-28	44
5										
					☒	SS-3	56	>225	30-50/125mm	50/ 125mm
	2.0									
					☒	SS-4	44		30-50/25mm	50/ 25mm
10	3.0	104.4		Highly weathered, Georgian bay shale, saturated seam	☒	SS-5	11		50/50mm	50/ 50mm
	4.0	103.4		Auger grinding at 4.0m depth						
15	4.6				☒	SS-6	83		50/50mm	50/ 50mm
	5.0	102.4		END OF BOREHOLE						
	6.0									
20										
	7.0									
25										
	8.0									
	9.0									
30										

NOTE:
- Borehole terminated at 5.0m depth
- Water level remained at 3.0m depth upon completion of drilling



REFERENCE No.: T040022A1

ENCLOSURE No.: 2

INSPEC•SOL

BOREHOLE No.: BH-2

ELEVATION: 104.8m

BOREHOLE REPORT

Page 1 of 2

CLIENT: Daniel Johnson Architect Inc.

PROJECT: Proposed Residential Dwelling and Guest House

LOCATION: 904 Mississauga Heights Road, Mississauga

DESCRIBED BY: A. Mazzuca

CHECKED BY: Karl Roechner

DATE (START): March 09, 2007

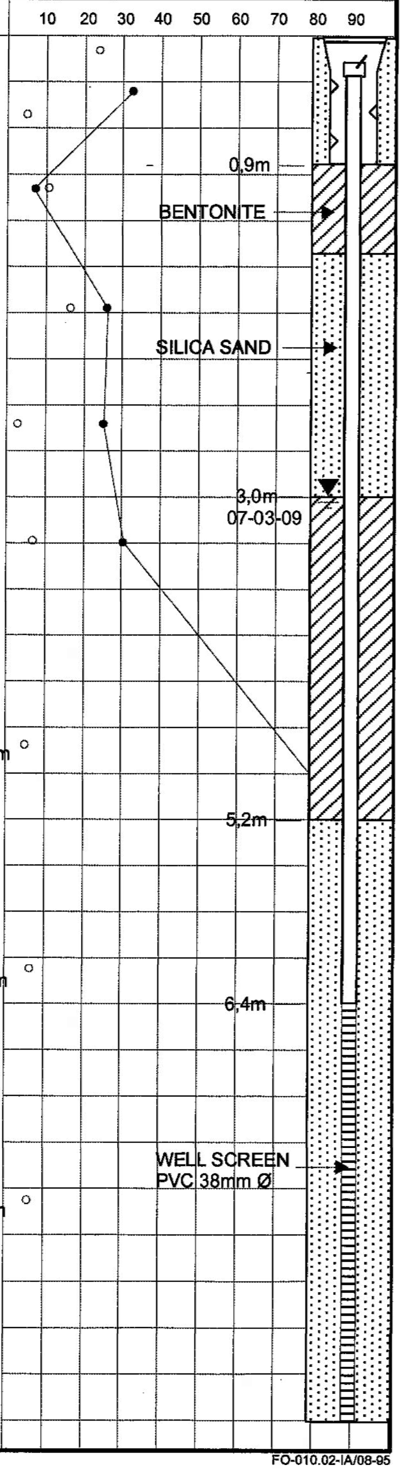
DATE (FINISH): March 09, 2007

LEGEND

☒ SS SPLIT SPOON
▨ ST SHELBY TUBE
◫ RC ROCK CORE
▼ WATER LEVEL

STRATIGRAPHY				SAMPLE				TEST RESULTS	
DEPTH Feet	DEPTH Metres	ELEVATION (m)	DESCRIPTION OF SOILS AND BEDROCK	TYPE AND NUMBER	RECOVERY %	SHEAR STRENGTH (Cu) KPa	BLOWS 6 in/15 cm or RQD	PENETRATION INDEX N	
		104.8	GROUND SURFACE						
0	0		Topsoil : 150mm						
	0.2	104.6	Fill: Silty Sand, dark brown, moist, dense	SS-1	75		18-20-12-12	32	
	0.8	104.0	becoming loose at 0.8m depth						
	1.0			SS-2	78		2-2-5	7	
5	1.5	103.3	Native: Silty Sand, trace clay, bedded, light brown, moist, compact	SS-3	78		5-12-14	26	
	2.0								
				SS-4	67		4-7-18	25	
10	3.0	101.8	becoming dense at 3.0m depth	SS-5	78		10-13-17	30	
	4.0								
15	4.6	100.2	Silty Sand and Gravel Till, trace clay, brown, moist, very dense	SS-6			40-50/100mm	50/ 100mm	
	5.0	99.8							
			Auger grinding at 5.5m depth						
	6.0								
20	6.1	98.7	Highly weathered shale, limestone fragments	SS-7	11		50/50mm	50/ 50mm	
	6.7	98.1	Auger grinding at 6.7m depth						
	7.0								
25	7.6	97.2	becoming hard at 7.6m depth	SS-8	11		50/50mm	50/ 50mm	
	8.0								
	9.0								
30									

Shear test (Cu) △ Field
Sensivity (S) □ Lab.
○ Water content (%)
├┤ Atterberg limits(%) Wp Wl
● "N" Value (blows/12 in-30 cm)



REFERENCE No.: T040022A1

ENCLOSURE No.: 3

INSPEC•SOL

BOREHOLE No.: BH-2

ELEVATION: 104.8m

BOREHOLE REPORT

Page 2 of 2

CLIENT: Daniel Johnson Architect Inc.

PROJECT: Proposed Residential Dwelling and Guest House

LOCATION: 904 Mississauga Heights Road, Mississauga

DESCRIBED BY: A. Mazzuca

CHECKED BY: Karl Roechner

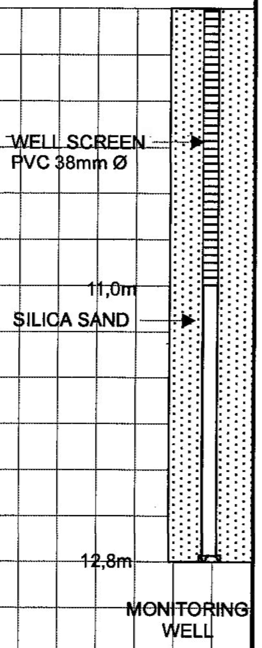
DATE (START): March 09, 2007

DATE (FINISH): March 09, 2007

LEGEND

☒	SS	SPLIT SPOON
▨	ST	SHELBY TUBE
◫	RC	ROCK CORE
▼		WATER LEVEL

STRATIGRAPHY					SAMPLE				TEST RESULTS		
DEPTH		ELEVATION (m)	STRATIGRAPHY	DESCRIPTION OF SOILS AND BEDROCK	STATE	TYPE AND NUMBER	RECOVERY	SHEAR STRENGTH (C_u)	BLOWS 6 in/15 cm or RQD	PENETRATION INDEX	Shear test (Cu) △ Field ☐ Lab. Sensitivity (S) ○ Water content (%) W_p ⊢⊣ W_l Atterberg limits(%) ● "N" Value (blows/12 in-30 cm)
Feet	Metres	95.6		GROUND SURFACE			%	KPa		N	10 20 30 40 50 60 70 80 90
30	9.2		▤	Highly weathered shale, limestone fragments	☒	SS-9	6		50/25mm	50/ 25mm	○
	10.0		▤								
35			▤		☒	SS-10			50/50mm	50/ 50mm	○
	11.0		▤								
	12.0		▤								
40			▤								
	12.8	92.0	▤								
	13.0			END OF BOREHOLE NOTE: • Borehole terminated at 12.8m depth due to auger refusal • Water level remained at 3.0m depth upon completion							
45											
	14.0										
	15.0										
50											
	16.0										
55											
	17.0										
	18.0										
60											



REFERENCE No.: T040022A1 ENCLOSURE No.: 4

INSPEC•SOL

BOREHOLE No.: BH-3
ELEVATION: 103.2m

BOREHOLE REPORT

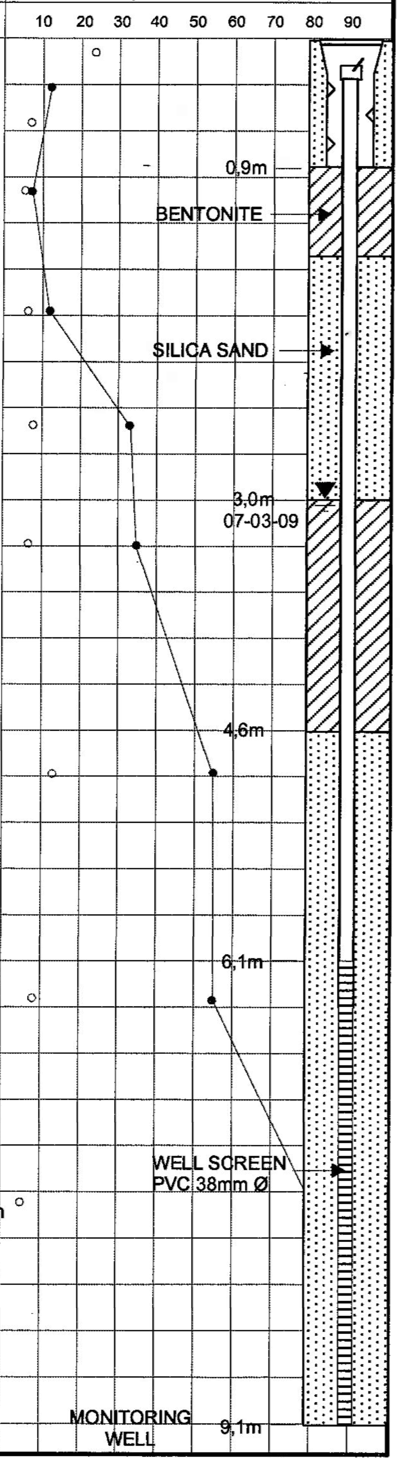
Page 1 of 2

CLIENT: Daniel Johnson Architect Inc.
PROJECT: Proposed Residential Dwelling and Guest House
LOCATION: 904 Mississauga Heights Road, Mississauga
DESCRIBED BY: A. Mazzuca CHECKED BY: Karl Roechner
DATE (START): March 09, 2007 DATE (FINISH): March 09, 2007

LEGEND
☒ SS SPLIT SPOON
▨ ST SHELBY TUBE
◫ RC ROCK CORE
▼ WATER LEVEL

STRATIGRAPHY					SAMPLE				TEST RESULTS	
DEPTH		ELEVATION (m)	STRATIGRAPHY	DESCRIPTION OF SOILS AND BEDROCK	STATE	TYPE AND NUMBER	RECOVERY	SHEAR STRENGTH (C_u)	BLOWS 6 in/15 cm or RQD	PENETRATION INDEX
Feet	Metres	103.2		GROUND SURFACE			%	KPa		N
0	0			Topsoil : 150mm						
	0.3	102.9		Fill: Fine Sand, orange, compact	☒	SS-1	58		12-8-3-5	11
	0.8	102.4		becoming loose at 0.8m depth						
	1.0				☒	SS-2	67		4-3-5	8
5	1.5	101.7		Native: Silty Sand, trace clay, bedded, light brown, moist, compact	☒	SS-3	78		4-5-6	11
	2.0									
	2.3	100.9		becoming dense at 2.3m depth	☒	SS-4	78		6-12-20	32
10	3.0									
					☒	SS-5	72		8-14-20	34
	4.0									
15	4.6	98.6		Silty Sand and Gravel Till, trace clay, occasional saturated zone	☒	SS-6			7-18-36	54
	5.0									
20	6.0									
					☒	SS-7	72		12-26-28	54
	7.0	96.2		Saturated seams at 7.0m depth						
25	7.6	95.6		Highly weathered shale, grey, hard	☒	SS-8	17		50/50mm	50/ 100mm
	8.0									
	8.5	94.7		Auger grinding at 8.5m depth						
	9.0									
30										

Shear test (Cu) △ Field
Sensitivity (S) □ Lab.
○ Water content (%)
$\vdash\!\dashv$ Atterberg limits(%) Wp Wl
● "N" Value (blows/12 in-30 cm)



REFERENCE No.: T040022A1 ENCLOSURE No.: 5

INSPEC•SOL

BOREHOLE No.: BH-3
ELEVATION: 103.2m

BOREHOLE REPORT

Page 2 of 2

CLIENT: Daniel Johnson Architect Inc.
PROJECT: Proposed Residential Dwelling and Guest House
LOCATION: 904 Mississauga Heights Road, Mississauga
DESCRIBED BY: A. Mazzuca CHECKED BY: Karl Roechner
DATE (START): March 09, 2007 DATE (FINISH): March 09, 2007

LEGEND
☒ SS SPLIT SPOON
▨ ST SHELBY TUBE
◫ RC ROCK CORE
▼ WATER LEVEL

STRATIGRAPHY					SAMPLE				TEST RESULTS		
DEPTH		ELEVATION (m)	STRATIGRAPHY	DESCRIPTION OF SOILS AND BEDROCK	STATE	TYPE AND NUMBER	RECOVERY	SHEAR STRENGTH (C_u)	BLOWS 6 in/15 cm or RQD	PENETRATION INDEX	Shear test (Cu) △ Field □ Lab. Sensivity (S) ○ Water content (%) ⊢⊣ Atterberg limits(%) Wp Wl ● "N" Value (blows/12 in-30 cm)
Feet	Metres			GROUND SURFACE			%	KPa		N	10 20 30 40 50 60 70 80 90
30	9.2	94.0		Highly weathered shale, limestone fragments	☒	SS-9	17		50/100mm	50/ 100mm	○
				END OF BOREHOLE							
	10.0			NOTE: • Borehole terminated at 9.2m depth • Borehole remained open and dry upon completion of drilling							
35	11.0										
	12.0										
40	13.0										
45	14.0										
	15.0										
50	16.0										
55	17.0										
	18.0										
60											

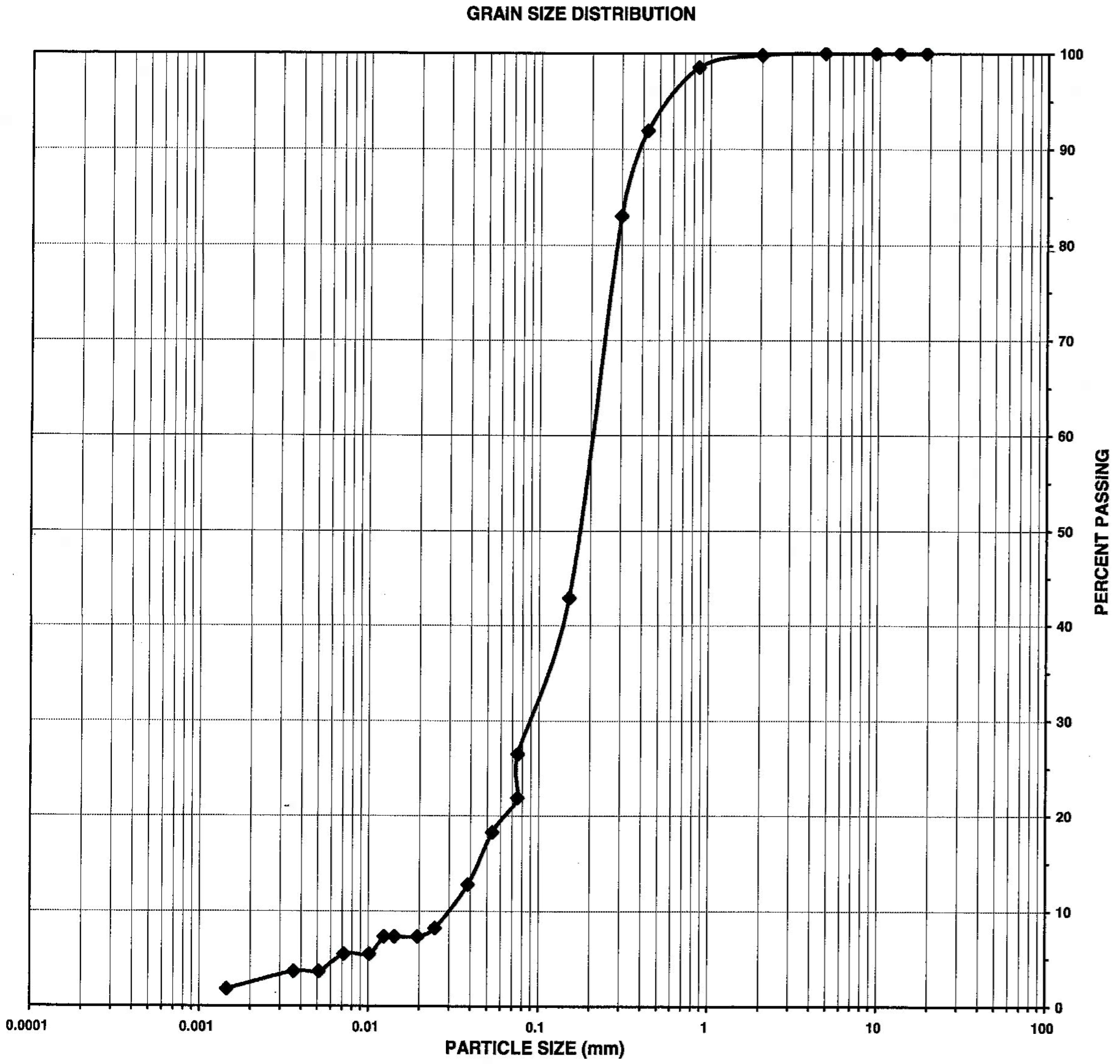
APPENDIX B

GRAIN SIZE ANALYSIS RESULTS

INSPEC•SOL

HYDROMETER ANALYSIS
ASTM D422

PROJECT:	**Proposed Residential Dwelling and Guest House**	FILE No.:	**T040022-A1**
		SAMPLE DATE:	**Mar. 9, 2007**
LOCATION:	**904 Mississauga Heights Drive,Mississauga,ON.**	BOREHOLE No.	**BH2 - SS3**
CLIENT:	**Daniel Johnson Architects Inc.**	SAMPLE DEPTH:	**1.5m - 2.0m**
SOIL DESCRIPTION:	**Silty Sand, trace clay**	SOIL COMPOSITION:	**Sand 73%, Silt 24%, Clay 3%**



UNIFIED SYSTEM	SILT OR CLAY FINES	FINE	MEDIUM	COARSE	FINE	COARSE
		SAND			GRAVEL	

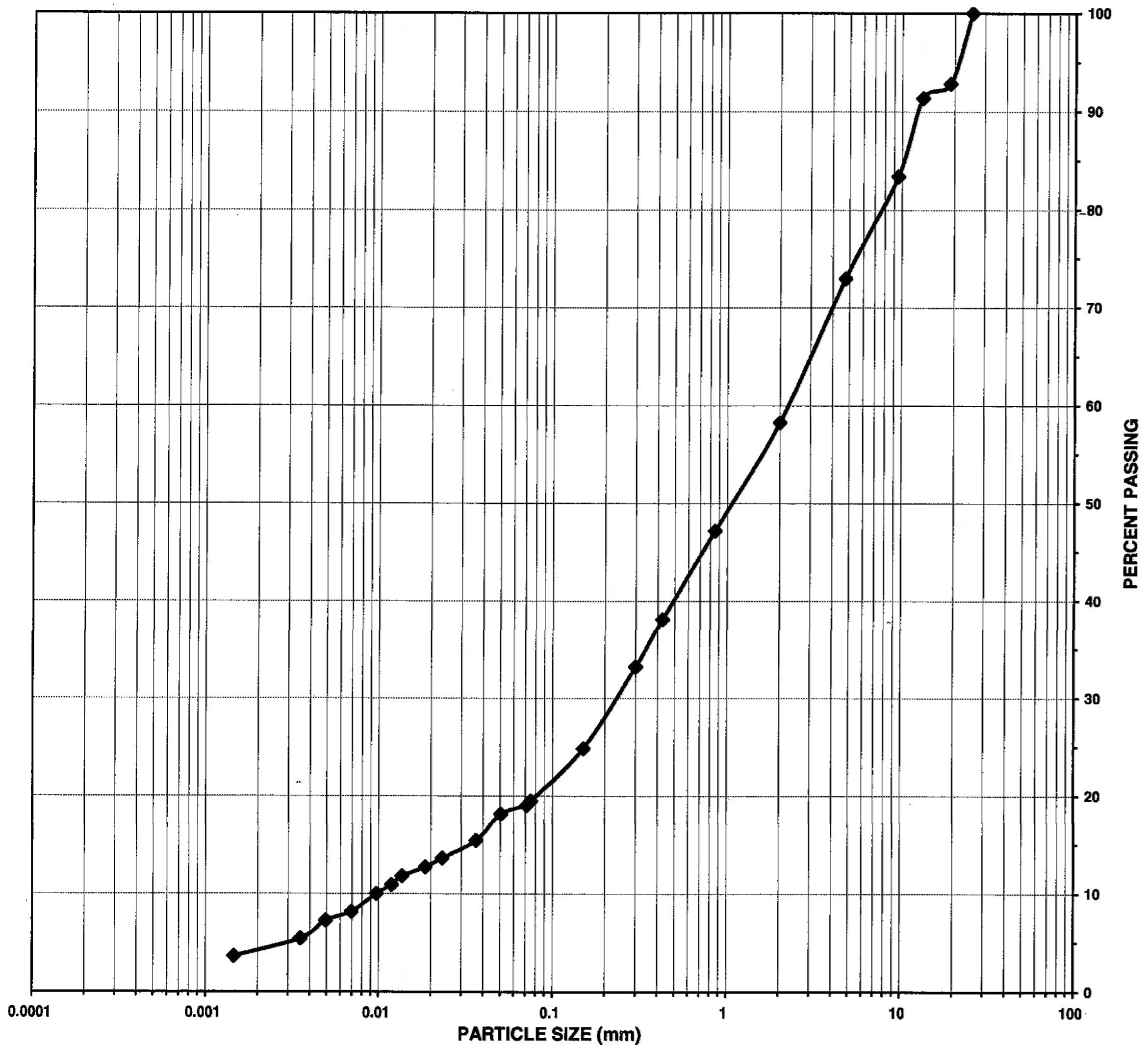
MIT SYSTEM	CLAY	SILT	FINE	MEDIUM	COARSE	GRAVEL
			SAND			

INSPEC•SOL

HYDROMETER ANALYSIS
ASTM D422

		FILE No.:	**T040022-A1**
PROJECT:	**Proposed Residential Dwelling and Guest House**	SAMPLE DATE:	**Mar. 9, 2007**
		BOREHOLE No.	**BH2 - SS6**
LOCATION:	**904 Mississauga Heights Drive,Mississauga,ON.**	SAMPLE DEPTH:	**4.6m - 5.0m**
CLIENT:	**Daniel Johnson Architects Inc.**	SOIL COMPOSITION:	**Sand 54%, Gravel 27%**
SOIL DESCRIPTION:	**Gravelly Sand, some silt, trace clay**		**Silt 15%, Clay 4%**

GRAIN SIZE DISTRIBUTION



UNIFIED SYSTEM	SILT OR CLAY FINES	FINE	MEDIUM	COARSE	FINE	COARSE
		SAND			GRAVEL	

MIT SYSTEM	CLAY	SILT	FINE	MEDIUM	COARSE	GRAVEL
			SAND			

APPENDIX C

PHOTOGRAPH LOG

REFERENCE No: T040022-A1

ENCLOSURE No: 1

PROPOSED RESIDENTIAL DWELLING AND GUEST HOUSE

904 Mississauga Heights Road
Mississauga, Ontario

Photo No 1 – Mid Section of the Slope Cross Section

Photo No 2 – Lower Section of the Slope Cross Section

INSPEC·SOL
ENGINEERING SOLUTIONS

REFERENCE No: T040022-A1

ENCLOSURE No: 2

PROPOSED RESIDENTIAL DWELLING AND GUEST HOUSE
904 Mississauga Heights Road
Mississauga, Ontario

Photo No 3 – Upper Section of the Slope Cross Section

Photo No 4 – Mid and Upper Section of the Slope Cross Section

INSPEC-SOL
ENGINEERING SOLUTIONS

PROPOSED RESIDENTIAL DWELLING AND GUEST HOUSE

904 Mississauga Heights Road
Mississauga, Ontario

Photo No 5 – The bottom of the slope with the creek setback from the slope toe by a significant distance

Photo No 6 – Mid Section of the Slope CrossSection

PROPOSED RESIDENTIAL DWELLING AND GUEST HOUSE

904 Mississauga Heights Road
Mississauga, Ontario

Photo No 7 – A view of the Upper Section & Flat Rear Yard from the crest of the slope

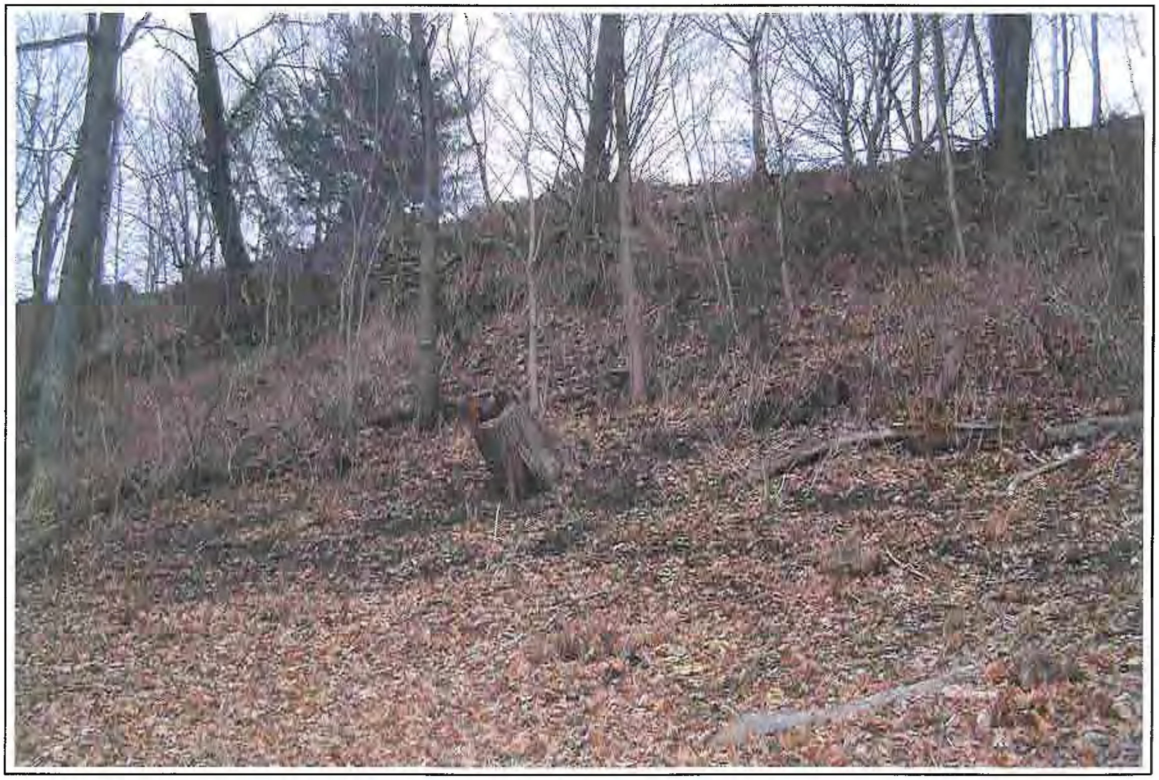


Photo No 8 – Lower Section of the Slope Cross Section