URBANTECH®

FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT BRIEF

BRONTE GREEN BLOCK C RESIDENTIAL DEVELOPMENT

TOWN OF OAKVILLE

HALTON REGION

PREPARED FOR
CAIVAN COMMUNITIES (BRONTE) LTD.

Urbantech File No.: 21-696

1ST SUBMISSION SPA – SEPTEMBER 2021
2nd SUBMISSION SPA – FEBRUARY 2022
3rd SUBMISSION SPA – MAY 2022
NOTE TO FILE SUBMISSION – MARCH 2023
NOTE TO FILE RESUBMISSION – JULY 2023

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1 INTRODUCTION

1.1. BACKGROUND

Urbantech has been retained as consulting engineers by Caivan Communities (Bronte) Ltd. and directed to complete a Functional Servicing and Stormwater Management Brief in support of a zoning application for the proposed three-hundred and thirty-five (335) unit six-storey residential building at the northwest intersection of Bronte Road and Saw Whet Blvd. in the Town of Oakville. The total developable area is 0.8 ha and the total property area is 0.8 ha, which includes future daylighting. The legal description of the site is Block 451, Plan 20M-1223.

The subject site is bounded by:

- Bronte Road to the south
- Saw Whet Blvd. to the east, and
- Yellow Rose Circle to the north and west.

This report provides an assessment of the impact of the current site plan concept on existing infrastructure. The concepts presented in this report are in general conformance with the latest standards and criteria prepared by the Town of Oakville (roads, grading and storm drainage) and Halton Region (water distribution and sanitary drainage).

1.2. PURPOSE

The purpose of this report is as follows:

- Discuss the optimal site grading strategy for the site;
- Identify site specific stormwater management requirements to ensure that the development project is in conformance with Town standards;
- For stormwater quantity control as per the pre-consultation meeting and inquiries with the Town of Oakville, an existing stormwater management (SWM) pond downstream of the proposed development is available for quantity and quality controls for a runoff coefficient no greater than 0.90. The allowable runoff coefficient was determined by the approved drainage plan from the Stormwater Management Design Brief prepared by DSEL;
- Determine an appropriate storm sewer system outlet which will work in accordance with the site's stormwater management strategy;
- Determine the site's sanitary sewage strategy and an appropriate outlet point, and;
- Determine an appropriate water service connection for the proposed development.

2 EXISTING CONDITIONS

2.1. LAND USE

The subject site is currently undeveloped. The land is zoned as residential Condominium. The subdivision storm services assumed this site would have a runoff coefficient of 0.90 under ultimate conditions.

2.2. GRADING AND DRAINAGE

The development has high points near the northeast and southeast parts of the site. Existing grades slope easterly towards Saw Whet Boulevard, and northerly towards Yellow Rose Circle.

2.3. SOIL CONDITIONS

A Geotechnical Investigation was prepared by Soil Engineers Ltd. for the subject lands.

The geotechnical report indicates the following subsurface conditions for the site:

- Topsoil – A surficial veneer of topsoil with a thickness ranging from approximately 80 to 200 mm
- Silty Clay/Silty Clay Till/Silt – Clayey soil was encountered below the topsoil to 6.1m below the ground surface
- Gravelly Sand – Gravelly sand soil was encountered 6.1m below the ground surface to the end of borehole

The static groundwater level is estimated to be 5 to 7 m below the existing ground surface.

The report is included in **Appendix C**.

2.4. CIVIL INFRASTRUCTURE

Based on the as-constructed drainage plans by DSEL, the existing municipal infrastructure surrounding the site are as follows:

- Yellow Rose Circle
  - 450 mm storm connection to subject lands
    - Connects to a 750 mm storm sewer, flows south-easterly
  - 200 mm sanitary connection
    - Connects to a 250 mm sanitary sewer, flows south-easterly
  - 200 mm watermain connection
    - Connects to a 300 mm watermain along the north side of the road

The existing storm and sanitary sewers and watermain along Yellow Rose Circle will service the proposed development.

3 PROPOSED CONDITIONS

3.1. LAND USE

The proposed development will consist of a 6-storey condominium with 333 units in total, internal private laneway (6.0 m in width), at-grade visitor parking spaces, and landscaped space. Vehicular access is provided by one (1) private driveway off Yellow Rose Circle.

3.2. GRADING AND DRAINAGE

The proposed grading design for the site is generally influenced by boundary conditions and will match existing grades along all property lines. The site grading design takes into consideration the following requirements and constraints

- Conform to the Town of Oakville's design criteria;
- Minimize cut and fill operations and work towards a balanced site;
- Match existing boundary conditions;
- Provide overland flow conveyance for major storm conditions;
- Reduce or eliminate (where possible) the need for retaining walls;
- Maximize the self-contained portion of the site conveying runoff to the storm sewer system(s); and
- Provide suitable cover on proposed servicing.

For the remainder of the site, most of the storm drainage flows are self-contained within the site boundaries into proposed catch basins. Minimal storm drainage is to discharge to existing ROWs. The proposed grading design matches into existing property line grades on all sides of the property.

Refer to the **Drawing GR-1** and **Drawing STM-1** for details.

4 STORM DRAINAGE AND STORMWATER MANAGEMENT

Storm servicing infrastructure for the site has been designed in accordance with the latest Town of Oakville standards and specifications. Due to high groundwater constraints that ultimately led to mechanical constraints within the building, a storm connection has been proposed at a different location from the existing storm connection that was provided during the construction of the subdivision. We are proposing to break into the existing 750mm concrete storm sewer along Yellow Rose Circle and install the proposed storm MH2. Inside of the property line, we are proposing to install a storm control MH1. The existing storm control manhole will be removed, and the existing 525 mm storm connection is to be plugged, grouted, and abandoned in place. Constant dewatering is not permitted to be directed to the Town storm sewer in any capacity.

Refer to the **Drawing SP-1 and STM-1** for details.

The runoff generated from the site up to 100-year events will be collected in an underground SWM storage tank and released at a controlled rate, such that the total site release rate is less than the allowable release rate of 202L/s. The maximum release rate from the SWM tank will be 166L/s, while the maximum uncontrolled release rate will be 30L/s. Based on the results from the Visual OTTHYMO model, the maximum combined release rate from the site is 185L/s (refer to model results summarized in **Table 2**, and in **Appendix A**).

The total area of the site is 0.8 ha. Table 1 shows the breakdown of drainage areas of the site and percentage imperious.

Table 1 : Drainage Areas and Percentage Impervious

Description	**Total Area**	**Pervious Area**	**Impervious Area**	**% Imperviousness**
	m^2	m^2	m^2	
Controlled Areas				
C1	1240	225	1015	82%
C2	922	232	690	75%
C3	715	225	490	69%
C4	187	30	157	84%
C5 (Roof)	4030	0	4030	100%
Total Controlled	7094	712	6382	90%
Uncontrolled Areas				
U1 (YRC)	386	259	127	33%
U2 (YRC)	146	99	47	32%
U3 (Bronte)	184	105	79	43%
U4 (SWB)	203	150	53	26%
Total Uncontrolled	919	613	306	33%
Total Site				
Controlled	7094	712	6382	90%
Uncontrolled	919	613	306	33%
TOTAL	**8013**	**1325**	**6688**	**83%**

The controlled flow from the SWM storage can be connected with a gravity connection as the invert elevation of the proposed out-letting storm sewer pipe is 125.81 and the proposed P1 level parking where the SWM storage tank and orifice will be located, elevation is 126.70m.

The underground storage tank and orifice size were first designed in an excel and then modelled in a Visual OTTHYMO program. With a few iterations, the right tank size and orifice plate diameter were designed and optimized. The following table summarizes the SWM storage tank and orifice size information.

Table 2: SWM Storage Tank, Orifice Size and Post Development Flows

Parameters	**Value**	**Units**
SWM Tank Size Provided (224 m^2 X 1 m)	224	m^3
Tank height	1000	mm
Orifice diameter	300	mm
Orifice coefficient	0.63	
Max. Allowable Flow (Controlled + Uncontrolled Areas)	202	L/s
100 - Year controlled Flow rate (Total Site)	185	L/s
5 - Year Controlled Flow Rate (Total Site)	117	L/s
100 – Year storage used	199	m^3
5 – Year storage used	109	m^3

The excel design table and Visual OTTHYMO input and output files has been included in Appendix A.

The uncontrolled area around the perimeter of the building will be mostly landscaped; with a 33% impervious, in a 100-year event it generates about 30 L/s flow. In a 5-year event this area generates about 13 L/s flow.

5 SANITARY SERVICING

Sanitary servicing infrastructure for the site has been designed in accordance with the latest Halton Region standards and specifications. The existing 200 mm sanitary connection off Merton Road will be used to service the site. Refer to the **Drawing SAN-1** for details.

Based upon the Region's DC background study that contains populations projections per unit type, the density for apartments was projected at 1.578 ppu, forecasted for the years 2017-2031. This amounts to a total population of 526 and peak sanitary flow of 7.00 L/s. Sanitary demand calculations are presented in **Table 3**. Refer to **Appendix A** for the as-constructed sanitary drainage plans by DSEL for the Bronte Green subdivision (Region File No. DO-1040) and **Appendix D** for the proposed **Sanitary Drainage Plan** for the proposed sanitary drainage plan.

Table 3: Sanitary Demand Calculations

Parameter	Proposed (Residential)
Site Area (ha)	0.8
Total Units	333
Population Density (ppu)	1.578
Unit Sewage Flow (L/person/s)	0.003183
Population	526
Harmon Peaking Factor, M	4.0
Infiltration Allowance (L/s/ha)	0.286
Sanitary Flow (L/s)	7.00

Initially, the subdivision design by DSEL accounted for a population of 400 persons for Block 451. As of the current design, a total of 333 units are proposed at a density of 1.578 ppu, which amounts to a total population of 526. The downstream sanitary system was assessed to determine any impact of the increase in population. It was determined sufficient capacity exists in the downstream system, and that the existing 250mm sanitary sewer leg spanning from MH 94A to MH 95A was the leg that required analysis as it had the least amount of available capacity based on the as-built information available. At the original population of 400 persons, the existing sanitary sewer had a capacity of 79.2% full at an existing slope of 0.36%. At the proposed population of 526, the existing sanitary sewer maintains a capacity of 81.9% full at an existing slope of 0.36%. A reduction of 2.7% in sewer capacity of the constrained sewer leg is the result of the increase in population which is negligible considering there is still an available 18% capacity in this section of the system. Refer to **Appendix A** for the as-constructed sanitary design sheets and drainage plans by DSEL.

6 WATER SERVICING

Water servicing infrastructure for the site has been designed in accordance with the latest Halton Region standards and specifications. To supply water demands to the site, a 200 mm connection has been provided off the existing 300 mm watermain along Merton Road. Refer to Drawing **SP-1** for details.

A hydrant flow test is being scheduled and a water analysis report will be completed in the future.

7 EROSION AND SEDIMENT CONTROL

Erosion and sediment controls will be implemented for all construction activities undertaken during site works including topsoil stripping, bulk earthworks, foundation excavation and stockpiling of materials, conforming to the ESC Best Practices. These measures will include:

- Installation of heavy-duty silt control fencing along the perimeter of the site at strategic locations.
- Provision of a temporary mud mat at the construction site entrance on Yellow Rose Circle.
- Preventing silt or sediment laden water from entering existing inlets on the adjacent ROWs (catchbasins/catchbasin maintenance holes) by wrapping their tops with filter fabric and using clearstone on the existing inlet within the property limit.
- Maintaining sediment and erosion control structures in good repair until such time as the Engineer or the Town approves their removal.

A conceptual erosion and sediment control plan is shown on **Drawing ESC-1**. If required, site-specific measures will be determined during the detailed design / site alteration application stage.

8 CONCLUSION

This report has demonstrated that:

- The proposed site can be graded to match into existing grades at all property lines while adhering to Town of Oakville grading standards and specifications.

- A suitable storm sewer system outlet for the proposed development is provided by the existing storm connection off Yellow Rose Circle Road.

- Water Quantity – the SWM tank of the proposed development will provide adequate quantity controls.

- Water Quality – since the runoff generated from the site is treated in a SWM pond downstream, it is not necessary to provide water quality on the site.

- A suitable sanitary sewer system outlet for the proposed development is provided by the existing sanitary connection off Yellow Rose Circle.

- A suitable water service connection for the proposed development is provided by the existing watermain connection off Yellow Rose Circle. A future water analysis will determine if the water distribution system can provide adequate flows and pressures to support the proposed development.

- Erosion Control – Measures and controls will be implemented for all construction activities undertaken during site works.

Report Prepared by:

LICENSED PROFESSIONAL ENGINEER
A.M.R. MCLENNAN
100509390
JULY 6, 2023
PROVINCE OF ONTARIO

Nava Poh

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Design Project Manager

Nava Pokharel, M.Sc., P.Eng.
Senior Water Resources Engineer

APPENDIX A

DESIGN CALCULATIONS AND MODELLING RESULTS

V.O. Model Results
Proposed Sanitary Design Sheet (Urbantech)
As-Constructed Sanitary Drainage Plans (DSEL)
As-Constructed Sanitary Design Sheets (DSEL)

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Tuesday, Mar 7 2023

<Name>

Circular

Diameter (m) = 0.4500

Invert Elev (m) = 100.0000
Slope (%) = 1.0000
N-Value = 0.013

Calculations

Compute by: Q vs Depth
No. Increments = 5

Highlighted

Depth (m) = 0.4500
Q (cms) = 0.2850
Area (sqm) = 0.1590
Velocity (m/s) = 1.7921
Wetted Perim (m) = 1.4137
Crit Depth, Yc (m) = 0.3749
Top Width (m) = 0.0000
EGL (m) = 0.6138

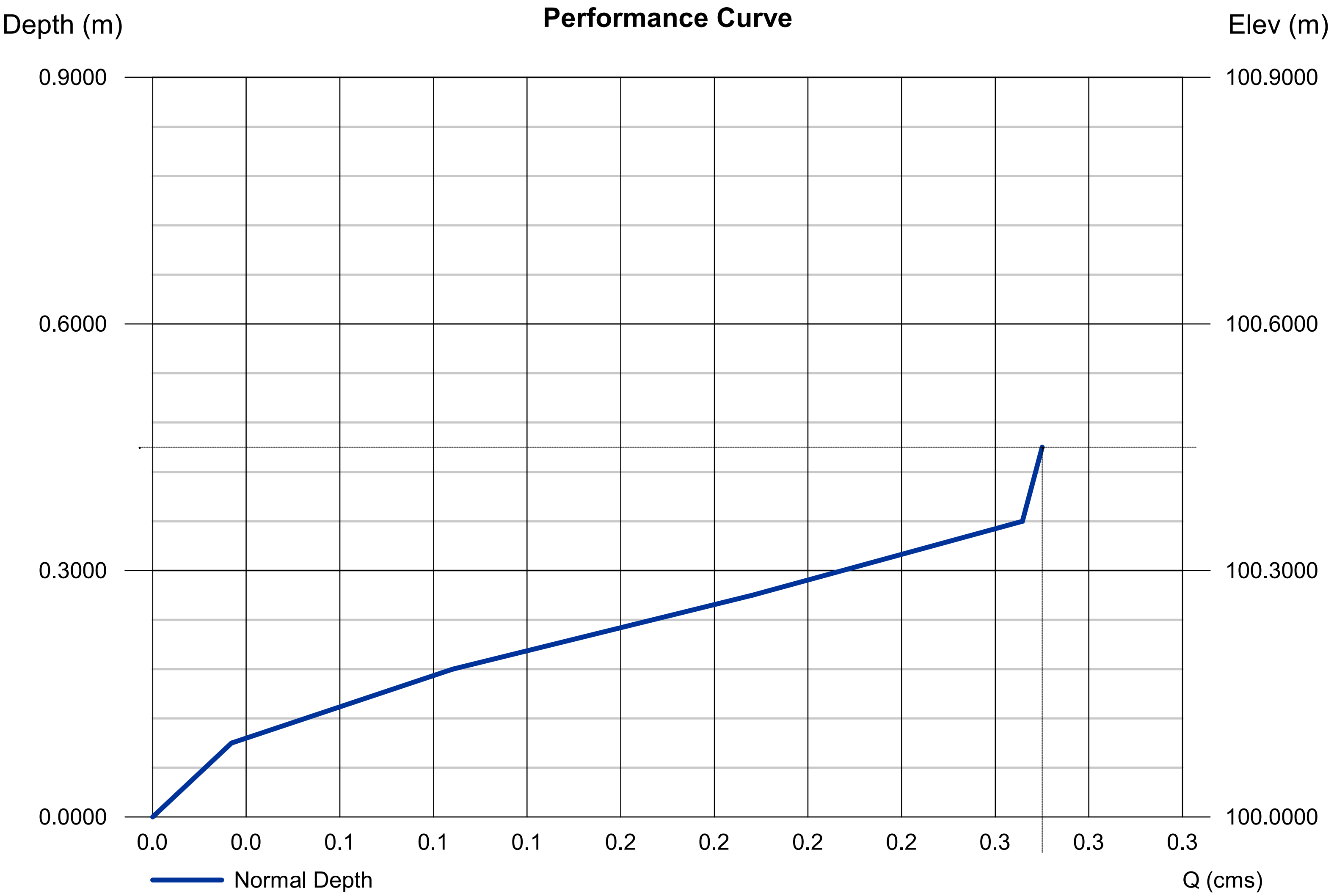


Table A1 - Underground SWM Storage Volume and Flow Release Rate Calculations

Designer Inputs: Underground Storage

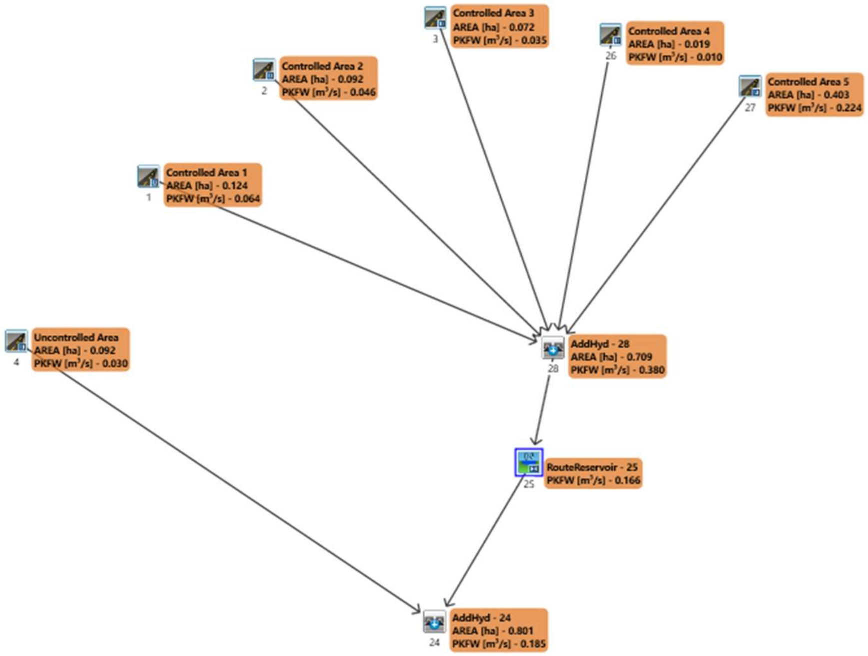
	Orifice		Height=	1000	mm	Length=	15.45	m		
Orifice Plate Diameter (m) =	0.300	m		1.000	m	Area	193125	m2		
			Width=	12500	mm	Storage Provided=	224.0	m3		
Area of Pipe (m2) =	0.071	m2		14.50	m					
Cd =	0.63									

Date: July 4, 2023
Designed by: N. Pokharel, P.Eng.

Controlled Drainage Area =	0.7094	ha
Uncontrolled Drainage Area =	0.0919	ha
Total Weighted % Impervious =	83%	
Allowable Flow =	202	(L/s)

	Stage (%)	**stage (mm)**	**Stage (m)**	**Elevation (m)**	**Storage Used - Events**	**Depth to Centre of Orifice (m)**	**Qout Orifice (m3/s)**	**He**	**Flow Control**	**Qout (m3/s)**	**Qout (L/s)**	**Incremental Volume (m3)**	**Total Storage (m3)**	**Total Storage (m-ha)**	**Inc. Time (s)**	**Cum. Time (s)**	**Cum. Time (hr)**
Top of Storage	100	1000	1.000	126.80		0.850	0.1819		Orifice Plate	0.1819	182	11.2	224	0.0224	1,232	19,797	5.5
	95	950	0.950	126.75	100 -Year	0.800	0.1764		Orifice Plate	0.1764	176	11.2	213	0.0213	1,206	18,565	5.2
	90	900	0.900	126.70		0.750	0.1708		Orifice Plate	0.1708	171	11.2	202	0.0202	1,180	17,359	4.8
	85	850	0.850	126.65		0.700	0.1650		Orifice Plate	0.1650	165	11.2	190	0.0190	1,154	16,178	4.5
	80	800	0.800	126.60		0.650	0.1590		Orifice Plate	0.1590	159	11.2	179	0.0179	1,127	15,025	4.2
	75	750	0.750	126.55		0.600	0.1528		Orifice Plate	0.1528	153	11.2	168	0.0168	1,100	13,898	3.9
	70	700	0.700	126.50		0.550	0.1463		Orifice Plate	0.1463	146	11.2	157	0.0157	1,072	12,798	3.6
	65	650	0.650	126.45		0.500	0.1395		Orifice Plate	0.1395	139	11.2	146	0.0146	1,044	11,726	3.3
	60	600	0.600	126.40		0.450	0.1323		Orifice Plate	0.1323	132	22.4	134	0.0134	1,016	10,682	3.0
	50	500	0.500	126.30		0.350	0.1167		Orifice Plate	0.1167	117	11.2	112	0.0112	960	9,666	2.7
	45	450	0.450	126.25		0.300	0.1080		Orifice Plate	0.1080	108	11.2	101	0.0101	933	8,706	2.4
	40	400	0.400	126.20		0.250	0.0986		Orifice Plate	0.0986	99	11.2	90	0.0090	909	7,773	2.2
	35	350	0.350	126.15		0.200	0.0882		Orifice Plate	0.0882	88	11.2	78	0.0078	889	6,865	1.9
	30	300	0.300	126.10		0.150	0.0764		Orifice Plate	0.0764	76	11.2	67	0.0067	880	5,976	1.7
	25	250	0.250	126.05		0.100	0.0624		Orifice Plate	0.0624	62	11.2	56	0.0056	898	5,096	1.4
	20	200	0.200	126.00		0.050	0.0441		Orifice Plate	0.0441	44	6.7	45	0.0045	1,016	4,198	1.2
	17	170	0.170	125.97		0.020	0.0279		Orifice Plate	0.0279	28	2.2	38	0.0038	1,365	3,182	0.9
	16	160	0.160	125.96		0.010	0.0197		Orifice Plate	0.0197	20	0.0	36	0.0036	1,817	1,817	0.5
	16	160	0.160	125.96		0.010	0.0197		Orifice Plate	0.0197	20	35.8	36	0.0036	-	-	0.0
Bottom of Storage	0	0	0.000	125.80	Orifice Invert	0.000	0.0000		Orifice Plate	0.0000	0	0.00	0	0.0000	-	-	0.0

Post Development VO Model Schematic



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*********************************
** SIMULATION:100-yr 24hr      **
*********************************
--------------------
| CHICAGO STORM    |    IDF curve parameters: A=2150.000
| Ptotal= 98.13 mm |                          B=   5.700
--------------------                          C=   0.861
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  = 24.00 hrs
                        Storm time step    = 10.00 min
                        Time to peak ratio =  0.33

                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.00    0.59 |  6.00    2.22 | 12.00    1.96 | 18.00    0.87
                 0.17    0.60 |  6.17    2.43 | 12.17    1.89 | 18.17    0.86
                 0.33    0.61 |  6.33    2.70 | 12.33    1.82 | 18.33    0.85
                 0.50    0.63 |  6.50    3.03 | 12.50    1.76 | 18.50    0.84
                 0.67    0.64 |  6.67    3.46 | 12.67    1.71 | 18.67    0.82
                 0.83    0.65 |  6.83    4.04 | 12.83    1.65 | 18.83    0.81
                 1.00    0.67 |  7.00    4.89 | 13.00    1.60 | 19.00    0.80
                 1.17    0.68 |  7.17    6.21 | 13.17    1.56 | 19.17    0.79
                 1.33    0.70 |  7.33    8.59 | 13.33    1.52 | 19.33    0.78
                 1.50    0.71 |  7.50   14.09 | 13.50    1.48 | 19.50    0.77
                 1.67    0.73 |  7.67   39.57 | 13.67    1.44 | 19.67    0.76
                 1.83    0.75 |  7.83  200.80 | 13.83    1.40 | 19.83    0.75
                 2.00    0.77 |  8.00   54.10 | 14.00    1.37 | 20.00    0.74
                 2.17    0.79 |  8.17   25.64 | 14.17    1.33 | 20.17    0.73
                 2.33    0.81 |  8.33   16.48 | 14.33    1.30 | 20.33    0.73
                 2.50    0.83 |  8.50   12.09 | 14.50    1.27 | 20.50    0.72
                 2.67    0.85 |  8.67    9.54 | 14.67    1.24 | 20.67    0.71
                 2.83    0.88 |  8.83    7.88 | 14.83    1.22 | 20.83    0.70
                 3.00    0.91 |  9.00    6.73 | 15.00    1.19 | 21.00    0.69
                 3.17    0.94 |  9.17    5.87 | 15.17    1.17 | 21.17    0.69
                 3.33    0.97 |  9.33    5.22 | 15.33    1.14 | 21.33    0.68
                 3.50    1.00 |  9.50    4.70 | 15.50    1.12 | 21.50    0.67
                 3.67    1.04 |  9.67    4.28 | 15.67    1.10 | 21.67    0.66
                 3.83    1.08 |  9.83    3.93 | 15.83    1.08 | 21.83    0.66
                 4.00    1.12 | 10.00    3.63 | 16.00    1.06 | 22.00    0.65
                 4.17    1.16 | 10.17    3.38 | 16.17    1.04 | 22.17    0.64
                 4.33    1.22 | 10.33    3.16 | 16.33    1.02 | 22.33    0.64
                 4.50    1.27 | 10.50    2.97 | 16.50    1.01 | 22.50    0.63
                 4.67    1.33 | 10.67    2.81 | 16.67    0.99 | 22.67    0.62
                 4.83    1.40 | 10.83    2.66 | 16.83    0.97 | 22.83    0.62
                 5.00    1.48 | 11.00    2.53 | 17.00    0.96 | 23.00    0.61
                 5.17    1.56 | 11.17    2.41 | 17.17    0.94 | 23.17    0.61
                 5.33    1.66 | 11.33    2.30 | 17.33    0.93 | 23.33    0.60
                 5.50    1.77 | 11.50    2.20 | 17.50    0.91 | 23.50    0.59
                 5.67    1.90 | 11.67    2.11 | 17.67    0.90 | 23.67    0.59
                 5.83    2.04 | 11.83    2.03 | 17.83    0.88 | 23.83    0.58


-------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0001)|   Area    (ha)=   0.12
|ID= 1 DT= 5.0 min |   Total Imp(%)=  82.00   Dir. Conn.(%)=  82.00
--------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.10          0.02
     Dep. Storage     (mm)=       1.00          1.50
     Average Slope     (%)=       1.00          2.00
     Length            (m)=      28.75         40.00
```

```
      Mannings n          =      0.013        0.250

          NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                                ---- TRANSFORMED HYETOGRAPH ----
                  TIME    RAIN |  TIME    RAIN |'  TIME    RAIN  |  TIME    RAIN
                   hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr  |   hrs   mm/hr
                 0.083    0.59 | 6.083    2.22 |12.083    1.96 | 18.08    0.87
                 0.167    0.59 | 6.167    2.22 |12.167    1.96 | 18.17    0.87
                 0.250    0.60 | 6.250    2.43 |12.250    1.89 | 18.25    0.86
                 0.333    0.60 | 6.333    2.43 |12.333    1.89 | 18.33    0.86
                 0.417    0.61 | 6.417    2.70 |12.417    1.82 | 18.42    0.85
                 0.500    0.61 | 6.500    2.70 |12.500    1.82 | 18.50    0.85
                 0.583    0.63 | 6.583    3.03 |12.583    1.76 | 18.58    0.84
                 0.667    0.63 | 6.667    3.03 |12.667    1.76 | 18.67    0.84
                 0.750    0.64 | 6.750    3.46 |12.750    1.71 | 18.75    0.82
                 0.833    0.64 | 6.833    3.46 |12.833    1.71 | 18.83    0.82
                 0.917    0.65 | 6.917    4.04 |12.917    1.65 | 18.92    0.81
                 1.000    0.65 | 7.000    4.04 |13.000    1.65 | 19.00    0.81
                 1.083    0.67 | 7.083    4.89 |13.083    1.60 | 19.08    0.80
                 1.167    0.67 | 7.167    4.89 |13.167    1.60 | 19.17    0.80
                 1.250    0.68 | 7.250    6.21 |13.250    1.56 | 19.25    0.79
                 1.333    0.68 | 7.333    6.21 |13.333    1.56 | 19.33    0.79
                 1.417    0.70 | 7.417    8.59 |13.417    1.52 | 19.42    0.78
                 1.500    0.70 | 7.500    8.59 |13.500    1.52 | 19.50    0.78
                 1.583    0.71 | 7.583   14.09 |13.583    1.48 | 19.58    0.77
                 1.667    0.71 | 7.667   14.09 |13.667    1.48 | 19.67    0.77
                 1.750    0.73 | 7.750   39.57 |13.750    1.44 | 19.75    0.76
                 1.833    0.73 | 7.833   39.58 |13.833    1.44 | 19.83    0.76
                 1.917    0.75 | 7.917  200.80 |13.917    1.40 | 19.92    0.75
                 2.000    0.75 | 8.000  200.79 |14.000    1.40 | 20.00    0.75
                 2.083    0.77 | 8.083   54.10 |14.083    1.37 | 20.08    0.74
                 2.167    0.77 | 8.167   54.10 |14.167    1.37 | 20.17    0.74
                 2.250    0.79 | 8.250   25.64 |14.250    1.33 | 20.25    0.73
                 2.333    0.79 | 8.333   25.64 |14.333    1.33 | 20.33    0.73
                 2.417    0.81 | 8.417   16.48 |14.417    1.30 | 20.42    0.73
                 2.500    0.81 | 8.500   16.48 |14.500    1.30 | 20.50    0.73
                 2.583    0.83 | 8.583   12.09 |14.583    1.27 | 20.58    0.72
                 2.667    0.83 | 8.667   12.09 |14.667    1.27 | 20.67    0.72
                 2.750    0.85 | 8.750    9.54 |14.750    1.24 | 20.75    0.71
                 2.833    0.85 | 8.833    9.54 |14.833    1.24 | 20.83    0.71
                 2.917    0.88 | 8.917    7.88 |14.917    1.22 | 20.92    0.70
                 3.000    0.88 | 9.000    7.88 |15.000    1.22 | 21.00    0.70
                 3.083    0.91 | 9.083    6.73 |15.083    1.19 | 21.08    0.69
                 3.167    0.91 | 9.167    6.73 |15.167    1.19 | 21.17    0.69
                 3.250    0.94 | 9.250    5.87 |15.250    1.17 | 21.25    0.69
                 3.333    0.94 | 9.333    5.87 |15.333    1.17 | 21.33    0.69
                 3.417    0.97 | 9.417    5.22 |15.417    1.14 | 21.42    0.68
                 3.500    0.97 | 9.500    5.22 |15.500    1.14 | 21.50    0.68
                 3.583    1.00 | 9.583    4.70 |15.583    1.12 | 21.58    0.67
                 3.667    1.00 | 9.667    4.70 |15.667    1.12 | 21.67    0.67
                 3.750    1.04 | 9.750    4.28 |15.750    1.10 | 21.75    0.66
                 3.833    1.04 | 9.833    4.28 |15.833    1.10 | 21.83    0.66
                 3.917    1.08 | 9.917    3.93 |15.917    1.08 | 21.92    0.66
                 4.000    1.08 |10.000    3.93 |16.000    1.08 | 22.00    0.66
                 4.083    1.12 |10.083    3.63 |16.083    1.06 | 22.08    0.65
                 4.167    1.12 |10.167    3.63 |16.167    1.06 | 22.17    0.65
                 4.250    1.16 |10.250    3.38 |16.250    1.04 | 22.25    0.64
                 4.333    1.16 |10.333    3.38 |16.333    1.04 | 22.33    0.64
                 4.417    1.22 |10.417    3.16 |16.417    1.02 | 22.42    0.64
                 4.500    1.22 |10.500    3.16 |16.500    1.02 | 22.50    0.64
                 4.583    1.27 |10.583    2.97 |16.583    1.01 | 22.58    0.63
                 4.667    1.27 |10.667    2.97 |16.667    1.01 | 22.67    0.63
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                4.750     1.33 |10.750    2.81 |16.750    0.99 | 22.75    0.62
                4.833     1.33 |10.833    2.81 |16.833    0.99 | 22.83    0.62
                4.917     1.40 |10.917    2.66 |16.917    0.97 | 22.92    0.62
                5.000     1.40 |11.000    2.66 |17.000    0.97 | 23.00    0.62
                5.083     1.48 |11.083    2.53 |17.083    0.96 | 23.08    0.61
                5.167     1.48 |11.167    2.53 |17.167    0.96 | 23.17    0.61
                5.250     1.56 |11.250    2.41 |17.250    0.94 | 23.25    0.61
                5.333     1.56 |11.333    2.41 |17.333    0.94 | 23.33    0.61
                5.417     1.66 |11.417    2.30 |17.417    0.93 | 23.42    0.60
                5.500     1.66 |11.500    2.30 |17.500    0.93 | 23.50    0.60
                5.583     1.77 |11.583    2.20 |17.583    0.91 | 23.58    0.59
                5.667     1.77 |11.667    2.20 |17.667    0.91 | 23.67    0.59
                5.750     1.90 |11.750    2.11 |17.750    0.90 | 23.75    0.59
                5.833     1.90 |11.833    2.11 |17.833    0.90 | 23.83    0.59
                5.917     2.04 |11.917    2.03 |17.917    0.88 | 23.92    0.58
                6.000     2.04 |12.000    2.03 |18.000    0.88 | 24.00    0.58

     Max.Eff.Inten.(mm/hr)=     200.80       125.06
                over (min)        5.00         5.00
     Storage Coeff.  (min)=       0.91 (ii)    3.83 (ii)
     Unit Hyd. Tpeak (min)=       5.00         5.00
     Unit Hyd. peak  (cms)=       0.34         0.25
                                                           *TOTALS*
     PEAK FLOW       (cms)=       0.06         0.01          0.064 (iii)
     TIME TO PEAK    (hrs)=       8.00         8.00           8.00
     RUNOFF VOLUME    (mm)=      97.13        61.28          90.68
     TOTAL RAINFALL   (mm)=      98.13        98.13          98.13
     RUNOFF COEFFICIENT   =       0.99         0.62           0.92

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  82.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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| CALIB            |
| STANDHYD (  0002)|   Area    (ha)=   0.09
|ID= 1 DT= 5.0 min |   Total Imp(%)=  75.00   Dir. Conn.(%)=  75.00
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                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.07         0.02
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=      24.79        40.00
     Mannings n           =      0.013        0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                               ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083     0.59 | 6.083    2.22 |12.083    1.96 | 18.08    0.87
                0.167     0.59 | 6.167    2.22 |12.167    1.96 | 18.17    0.87
                0.250     0.60 | 6.250    2.43 |12.250    1.89 | 18.25    0.86
                0.333     0.60 | 6.333    2.43 |12.333    1.89 | 18.33    0.86
                0.417     0.61 | 6.417    2.70 |12.417    1.82 | 18.42    0.85
                0.500     0.61 | 6.500    2.70 |12.500    1.82 | 18.50    0.85
                0.583     0.63 | 6.583    3.03 |12.583    1.76 | 18.58    0.84
                0.667     0.63 | 6.667    3.03 |12.667    1.76 | 18.67    0.84
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0.750     0.64 | 6.750     3.46 |12.750     1.71 | 18.75     0.82
0.833     0.64 | 6.833     3.46 |12.833     1.71 | 18.83     0.82
0.917     0.65 | 6.917     4.04 |12.917     1.65 | 18.92     0.81
1.000     0.65 | 7.000     4.04 |13.000     1.65 | 19.00     0.81
1.083     0.67 | 7.083     4.89 |13.083     1.60 | 19.08     0.80
1.167     0.67 | 7.167     4.89 |13.167     1.60 | 19.17     0.80
1.250     0.68 | 7.250     6.21 |13.250     1.56 | 19.25     0.79
1.333     0.68 | 7.333     6.21 |13.333     1.56 | 19.33     0.79
1.417     0.70 | 7.417     8.59 |13.417     1.52 | 19.42     0.78
1.500     0.70 | 7.500     8.59 |13.500     1.52 | 19.50     0.78
1.583     0.71 | 7.583    14.09 |13.583     1.48 | 19.58     0.77
1.667     0.71 | 7.667    14.09 |13.667     1.48 | 19.67     0.77
1.750     0.73 | 7.750    39.57 |13.750     1.44 | 19.75     0.76
1.833     0.73 | 7.833    39.58 |13.833     1.44 | 19.83     0.76
1.917     0.75 | 7.917   200.80 |13.917     1.40 | 19.92     0.75
2.000     0.75 | 8.000   200.79 |14.000     1.40 | 20.00     0.75
2.083     0.77 | 8.083    54.10 |14.083     1.37 | 20.08     0.74
2.167     0.77 | 8.167    54.10 |14.167     1.37 | 20.17     0.74
2.250     0.79 | 8.250    25.64 |14.250     1.33 | 20.25     0.73
2.333     0.79 | 8.333    25.64 |14.333     1.33 | 20.33     0.73
2.417     0.81 | 8.417    16.48 |14.417     1.30 | 20.42     0.73
2.500     0.81 | 8.500    16.48 |14.500     1.30 | 20.50     0.73
2.583     0.83 | 8.583    12.09 |14.583     1.27 | 20.58     0.72
2.667     0.83 | 8.667    12.09 |14.667     1.27 | 20.67     0.72
2.750     0.85 | 8.750     9.54 |14.750     1.24 | 20.75     0.71
2.833     0.85 | 8.833     9.54 |14.833     1.24 | 20.83     0.71
2.917     0.88 | 8.917     7.88 |14.917     1.22 | 20.92     0.70
3.000     0.88 | 9.000     7.88 |15.000     1.22 | 21.00     0.70
3.083     0.91 | 9.083     6.73 |15.083     1.19 | 21.08     0.69
3.167     0.91 | 9.167     6.73 |15.167     1.19 | 21.17     0.69
3.250     0.94 | 9.250     5.87 |15.250     1.17 | 21.25     0.69
3.333     0.94 | 9.333     5.87 |15.333     1.17 | 21.33     0.69
3.417     0.97 | 9.417     5.22 |15.417     1.14 | 21.42     0.68
3.500     0.97 | 9.500     5.22 |15.500     1.14 | 21.50     0.68
3.583     1.00 | 9.583     4.70 |15.583     1.12 | 21.58     0.67
3.667     1.00 | 9.667     4.70 |15.667     1.12 | 21.67     0.67
3.750     1.04 | 9.750     4.28 |15.750     1.10 | 21.75     0.66
3.833     1.04 | 9.833     4.28 |15.833     1.10 | 21.83     0.66
3.917     1.08 | 9.917     3.93 |15.917     1.08 | 21.92     0.66
4.000     1.08 |10.000     3.93 |16.000     1.08 | 22.00     0.66
4.083     1.12 |10.083     3.63 |16.083     1.06 | 22.08     0.65
4.167     1.12 |10.167     3.63 |16.167     1.06 | 22.17     0.65
4.250     1.16 |10.250     3.38 |16.250     1.04 | 22.25     0.64
4.333     1.16 |10.333     3.38 |16.333     1.04 | 22.33     0.64
4.417     1.22 |10.417     3.16 |16.417     1.02 | 22.42     0.64
4.500     1.22 |10.500     3.16 |16.500     1.02 | 22.50     0.64
4.583     1.27 |10.583     2.97 |16.583     1.01 | 22.58     0.63
4.667     1.27 |10.667     2.97 |16.667     1.01 | 22.67     0.63
4.750     1.33 |10.750     2.81 |16.750     0.99 | 22.75     0.62
4.833     1.33 |10.833     2.81 |16.833     0.99 | 22.83     0.62
4.917     1.40 |10.917     2.66 |16.917     0.97 | 22.92     0.62
5.000     1.40 |11.000     2.66 |17.000     0.97 | 23.00     0.62
5.083     1.48 |11.083     2.53 |17.083     0.96 | 23.08     0.61
5.167     1.48 |11.167     2.53 |17.167     0.96 | 23.17     0.61
5.250     1.56 |11.250     2.41 |17.250     0.94 | 23.25     0.61
5.333     1.56 |11.333     2.41 |17.333     0.94 | 23.33     0.61
5.417     1.66 |11.417     2.30 |17.417     0.93 | 23.42     0.60
5.500     1.66 |11.500     2.30 |17.500     0.93 | 23.50     0.60
5.583     1.77 |11.583     2.20 |17.583     0.91 | 23.58     0.59
5.667     1.77 |11.667     2.20 |17.667     0.91 | 23.67     0.59
5.750     1.90 |11.750     2.11 |17.750     0.90 | 23.75     0.59
5.833     1.90 |11.833     2.11 |17.833     0.90 | 23.83     0.59
5.917     2.04 |11.917     2.03 |17.917     0.88 | 23.92     0.58
6.000     2.04 |12.000     2.03 |18.000     0.88 | 24.00     0.58
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     Max.Eff.Inten.(mm/hr)=     200.80       125.06
                over (min)        5.00         5.00
     Storage Coeff.  (min)=       0.84 (ii)    4.28 (ii)
     Unit Hyd. Tpeak (min)=       5.00         5.00
     Unit Hyd. peak  (cms)=       0.34         0.23
                                                       *TOTALS*
     PEAK FLOW       (cms)=       0.04         0.01      0.046 (iii)
     TIME TO PEAK    (hrs)=       8.00         8.00       8.00
     RUNOFF VOLUME    (mm)=      97.13        61.28      88.17
     TOTAL RAINFALL   (mm)=      98.13        98.13      98.13
     RUNOFF COEFFICIENT   =       0.99         0.62       0.90

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  82.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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| CALIB              |
| STANDHYD (  0003)|   Area    (ha)=   0.07
|ID= 1 DT= 5.0 min |   Total Imp(%)=  69.00   Dir. Conn.(%)=  69.00
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                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.05         0.02
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=      21.83        40.00
     Mannings n           =      0.013        0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                               ---- TRANSFORMED HYETOGRAPH ----
                  TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                   hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.083    0.59 | 6.083    2.22 |12.083    1.96 | 18.08    0.87
                 0.167    0.59 | 6.167    2.22 |12.167    1.96 | 18.17    0.87
                 0.250    0.60 | 6.250    2.43 |12.250    1.89 | 18.25    0.86
                 0.333    0.60 | 6.333    2.43 |12.333    1.89 | 18.33    0.86
                 0.417    0.61 | 6.417    2.70 |12.417    1.82 | 18.42    0.85
                 0.500    0.61 | 6.500    2.70 |12.500    1.82 | 18.50    0.85
                 0.583    0.63 | 6.583    3.03 |12.583    1.76 | 18.58    0.84
                 0.667    0.63 | 6.667    3.03 |12.667    1.76 | 18.67    0.84
                 0.750    0.64 | 6.750    3.46 |12.750    1.71 | 18.75    0.82
                 0.833    0.64 | 6.833    3.46 |12.833    1.71 | 18.83    0.82
                 0.917    0.65 | 6.917    4.04 |12.917    1.65 | 18.92    0.81
                 1.000    0.65 | 7.000    4.04 |13.000    1.65 | 19.00    0.81
                 1.083    0.67 | 7.083    4.89 |13.083    1.60 | 19.08    0.80
                 1.167    0.67 | 7.167    4.89 |13.167    1.60 | 19.17    0.80
                 1.250    0.68 | 7.250    6.21 |13.250    1.56 | 19.25    0.79
                 1.333    0.68 | 7.333    6.21 |13.333    1.56 | 19.33    0.79
                 1.417    0.70 | 7.417    8.59 |13.417    1.52 | 19.42    0.78
                 1.500    0.70 | 7.500    8.59 |13.500    1.52 | 19.50    0.78
                 1.583    0.71 | 7.583   14.09 |13.583    1.48 | 19.58    0.77
                 1.667    0.71 | 7.667   14.09 |13.667    1.48 | 19.67    0.77
                 1.750    0.73 | 7.750   39.57 |13.750    1.44 | 19.75    0.76
                 1.833    0.73 | 7.833   39.58 |13.833    1.44 | 19.83    0.76
                 1.917    0.75 | 7.917  200.80 |13.917    1.40 | 19.92    0.75
                 2.000    0.75 | 8.000  200.79 |14.000    1.40 | 20.00    0.75
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                2.083    0.77 | 8.083   54.10 |14.083    1.37 | 20.08    0.74
                2.167    0.77 | 8.167   54.10 |14.167    1.37 | 20.17    0.74
                2.250    0.79 | 8.250   25.64 |14.250    1.33 | 20.25    0.73
                2.333    0.79 | 8.333   25.64 |14.333    1.33 | 20.33    0.73
                2.417    0.81 | 8.417   16.48 |14.417    1.30 | 20.42    0.73
                2.500    0.81 | 8.500   16.48 |14.500    1.30 | 20.50    0.73
                2.583    0.83 | 8.583   12.09 |14.583    1.27 | 20.58    0.72
                2.667    0.83 | 8.667   12.09 |14.667    1.27 | 20.67    0.72
                2.750    0.85 | 8.750    9.54 |14.750    1.24 | 20.75    0.71
                2.833    0.85 | 8.833    9.54 |14.833    1.24 | 20.83    0.71
                2.917    0.88 | 8.917    7.88 |14.917    1.22 | 20.92    0.70
                3.000    0.88 | 9.000    7.88 |15.000    1.22 | 21.00    0.70
                3.083    0.91 | 9.083    6.73 |15.083    1.19 | 21.08    0.69
                3.167    0.91 | 9.167    6.73 |15.167    1.19 | 21.17    0.69
                3.250    0.94 | 9.250    5.87 |15.250    1.17 | 21.25    0.69
                3.333    0.94 | 9.333    5.87 |15.333    1.17 | 21.33    0.69
                3.417    0.97 | 9.417    5.22 |15.417    1.14 | 21.42    0.68
                3.500    0.97 | 9.500    5.22 |15.500    1.14 | 21.50    0.68
                3.583    1.00 | 9.583    4.70 |15.583    1.12 | 21.58    0.67
                3.667    1.00 | 9.667    4.70 |15.667    1.12 | 21.67    0.67
                3.750    1.04 | 9.750    4.28 |15.750    1.10 | 21.75    0.66
                3.833    1.04 | 9.833    4.28 |15.833    1.10 | 21.83    0.66
                3.917    1.08 | 9.917    3.93 |15.917    1.08 | 21.92    0.66
                4.000    1.08 |10.000    3.93 |16.000    1.08 | 22.00    0.66
                4.083    1.12 |10.083    3.63 |16.083    1.06 | 22.08    0.65
                4.167    1.12 |10.167    3.63 |16.167    1.06 | 22.17    0.65
                4.250    1.16 |10.250    3.38 |16.250    1.04 | 22.25    0.64
                4.333    1.16 |10.333    3.38 |16.333    1.04 | 22.33    0.64
                4.417    1.22 |10.417    3.16 |16.417    1.02 | 22.42    0.64
                4.500    1.22 |10.500    3.16 |16.500    1.02 | 22.50    0.64
                4.583    1.27 |10.583    2.97 |16.583    1.01 | 22.58    0.63
                4.667    1.27 |10.667    2.97 |16.667    1.01 | 22.67    0.63
                4.750    1.33 |10.750    2.81 |16.750    0.99 | 22.75    0.62
                4.833    1.33 |10.833    2.81 |16.833    0.99 | 22.83    0.62
                4.917    1.40 |10.917    2.66 |16.917    0.97 | 22.92    0.62
                5.000    1.40 |11.000    2.66 |17.000    0.97 | 23.00    0.62
                5.083    1.48 |11.083    2.53 |17.083    0.96 | 23.08    0.61
                5.167    1.48 |11.167    2.53 |17.167    0.96 | 23.17    0.61
                5.250    1.56 |11.250    2.41 |17.250    0.94 | 23.25    0.61
                5.333    1.56 |11.333    2.41 |17.333    0.94 | 23.33    0.61
                5.417    1.66 |11.417    2.30 |17.417    0.93 | 23.42    0.60
                5.500    1.66 |11.500    2.30 |17.500    0.93 | 23.50    0.60
                5.583    1.77 |11.583    2.20 |17.583    0.91 | 23.58    0.59
                5.667    1.77 |11.667    2.20 |17.667    0.91 | 23.67    0.59
                5.750    1.90 |11.750    2.11 |17.750    0.90 | 23.75    0.59
                5.833    1.90 |11.833    2.11 |17.833    0.90 | 23.83    0.59
                5.917    2.04 |11.917    2.03 |17.917    0.88 | 23.92    0.58
                6.000    2.04 |12.000    2.03 |18.000    0.88 | 24.00    0.58

     Max.Eff.Inten.(mm/hr)=     200.80       125.06
                over (min)        5.00         5.00
     Storage Coeff.  (min)=       0.78 (ii)    4.65 (ii)
     Unit Hyd. Tpeak (min)=       5.00         5.00
     Unit Hyd. peak  (cms)=       0.34         0.22
                                                           *TOTALS*
     PEAK FLOW       (cms)=       0.03         0.01          0.035 (iii)
     TIME TO PEAK    (hrs)=       8.00         8.00           8.00
     RUNOFF VOLUME    (mm)=      97.13        61.28          86.01
     TOTAL RAINFALL   (mm)=      98.13        98.13          98.13
     RUNOFF COEFFICIENT   =       0.99         0.62           0.88

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
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```
            CN*  =  82.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
--------------------
| CALIB             |
| STANDHYD (  0026)|   Area    (ha)=   0.02
|ID= 1 DT= 5.0 min |   Total Imp(%)=  84.00   Dir. Conn.(%)=  84.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        0.02         0.00
     Dep. Storage     (mm)=        1.00         1.50
     Average Slope     (%)=        1.00         2.00
     Length            (m)=       11.17        40.00
     Mannings n          =       0.013        0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                               ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    0.59 | 6.083    2.22 |12.083    1.96 | 18.08    0.87
                0.167    0.59 | 6.167    2.22 |12.167    1.96 | 18.17    0.87
                0.250    0.60 | 6.250    2.43 |12.250    1.89 | 18.25    0.86
                0.333    0.60 | 6.333    2.43 |12.333    1.89 | 18.33    0.86
                0.417    0.61 | 6.417    2.70 |12.417    1.82 | 18.42    0.85
                0.500    0.61 | 6.500    2.70 |12.500    1.82 | 18.50    0.85
                0.583    0.63 | 6.583    3.03 |12.583    1.76 | 18.58    0.84
                0.667    0.63 | 6.667    3.03 |12.667    1.76 | 18.67    0.84
                0.750    0.64 | 6.750    3.46 |12.750    1.71 | 18.75    0.82
                0.833    0.64 | 6.833    3.46 |12.833    1.71 | 18.83    0.82
                0.917    0.65 | 6.917    4.04 |12.917    1.65 | 18.92    0.81
                1.000    0.65 | 7.000    4.04 |13.000    1.65 | 19.00    0.81
                1.083    0.67 | 7.083    4.89 |13.083    1.60 | 19.08    0.80
                1.167    0.67 | 7.167    4.89 |13.167    1.60 | 19.17    0.80
                1.250    0.68 | 7.250    6.21 |13.250    1.56 | 19.25    0.79
                1.333    0.68 | 7.333    6.21 |13.333    1.56 | 19.33    0.79
                1.417    0.70 | 7.417    8.59 |13.417    1.52 | 19.42    0.78
                1.500    0.70 | 7.500    8.59 |13.500    1.52 | 19.50    0.78
                1.583    0.71 | 7.583   14.09 |13.583    1.48 | 19.58    0.77
                1.667    0.71 | 7.667   14.09 |13.667    1.48 | 19.67    0.77
                1.750    0.73 | 7.750   39.57 |13.750    1.44 | 19.75    0.76
                1.833    0.73 | 7.833   39.58 |13.833    1.44 | 19.83    0.76
                1.917    0.75 | 7.917  200.80 |13.917    1.40 | 19.92    0.75
                2.000    0.75 | 8.000  200.79 |14.000    1.40 | 20.00    0.75
                2.083    0.77 | 8.083   54.10 |14.083    1.37 | 20.08    0.74
                2.167    0.77 | 8.167   54.10 |14.167    1.37 | 20.17    0.74
                2.250    0.79 | 8.250   25.64 |14.250    1.33 | 20.25    0.73
                2.333    0.79 | 8.333   25.64 |14.333    1.33 | 20.33    0.73
                2.417    0.81 | 8.417   16.48 |14.417    1.30 | 20.42    0.73
                2.500    0.81 | 8.500   16.48 |14.500    1.30 | 20.50    0.73
                2.583    0.83 | 8.583   12.09 |14.583    1.27 | 20.58    0.72
                2.667    0.83 | 8.667   12.09 |14.667    1.27 | 20.67    0.72
                2.750    0.85 | 8.750    9.54 |14.750    1.24 | 20.75    0.71
                2.833    0.85 | 8.833    9.54 |14.833    1.24 | 20.83    0.71
                2.917    0.88 | 8.917    7.88 |14.917    1.22 | 20.92    0.70
                3.000    0.88 | 9.000    7.88 |15.000    1.22 | 21.00    0.70
                3.083    0.91 | 9.083    6.73 |15.083    1.19 | 21.08    0.69
                3.167    0.91 | 9.167    6.73 |15.167    1.19 | 21.17    0.69
                3.250    0.94 | 9.250    5.87 |15.250    1.17 | 21.25    0.69
                3.333    0.94 | 9.333    5.87 |15.333    1.17 | 21.33    0.69
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                3.417    0.97 | 9.417    5.22 |15.417    1.14 | 21.42    0.68
                3.500    0.97 | 9.500    5.22 |15.500    1.14 | 21.50    0.68
                3.583    1.00 | 9.583    4.70 |15.583    1.12 | 21.58    0.67
                3.667    1.00 | 9.667    4.70 |15.667    1.12 | 21.67    0.67
                3.750    1.04 | 9.750    4.28 |15.750    1.10 | 21.75    0.66
                3.833    1.04 | 9.833    4.28 |15.833    1.10 | 21.83    0.66
                3.917    1.08 | 9.917    3.93 |15.917    1.08 | 21.92    0.66
                4.000    1.08 |10.000    3.93 |16.000    1.08 | 22.00    0.66
                4.083    1.12 |10.083    3.63 |16.083    1.06 | 22.08    0.65
                4.167    1.12 |10.167    3.63 |16.167    1.06 | 22.17    0.65
                4.250    1.16 |10.250    3.38 |16.250    1.04 | 22.25    0.64
                4.333    1.16 |10.333    3.38 |16.333    1.04 | 22.33    0.64
                4.417    1.22 |10.417    3.16 |16.417    1.02 | 22.42    0.64
                4.500    1.22 |10.500    3.16 |16.500    1.02 | 22.50    0.64
                4.583    1.27 |10.583    2.97 |16.583    1.01 | 22.58    0.63
                4.667    1.27 |10.667    2.97 |16.667    1.01 | 22.67    0.63
                4.750    1.33 |10.750    2.81 |16.750    0.99 | 22.75    0.62
                4.833    1.33 |10.833    2.81 |16.833    0.99 | 22.83    0.62
                4.917    1.40 |10.917    2.66 |16.917    0.97 | 22.92    0.62
                5.000    1.40 |11.000    2.66 |17.000    0.97 | 23.00    0.62
                5.083    1.48 |11.083    2.53 |17.083    0.96 | 23.08    0.61
                5.167    1.48 |11.167    2.53 |17.167    0.96 | 23.17    0.61
                5.250    1.56 |11.250    2.41 |17.250    0.94 | 23.25    0.61
                5.333    1.56 |11.333    2.41 |17.333    0.94 | 23.33    0.61
                5.417    1.66 |11.417    2.30 |17.417    0.93 | 23.42    0.60
                5.500    1.66 |11.500    2.30 |17.500    0.93 | 23.50    0.60
                5.583    1.77 |11.583    2.20 |17.583    0.91 | 23.58    0.59
                5.667    1.77 |11.667    2.20 |17.667    0.91 | 23.67    0.59
                5.750    1.90 |11.750    2.11 |17.750    0.90 | 23.75    0.59
                5.833    1.90 |11.833    2.11 |17.833    0.90 | 23.83    0.59
                5.917    2.04 |11.917    2.03 |17.917    0.88 | 23.92    0.58
                6.000    2.04 |12.000    2.03 |18.000    0.88 | 24.00    0.58

     Max.Eff.Inten.(mm/hr)=     200.80       137.19
                over (min)        5.00         5.00
     Storage Coeff.  (min)=       0.52 (ii)    3.27 (ii)
     Unit Hyd. Tpeak (min)=       5.00         5.00
     Unit Hyd. peak  (cms)=       0.34         0.27
                                                           *TOTALS*
     PEAK FLOW       (cms)=       0.01         0.00          0.010 (iii)
     TIME TO PEAK    (hrs)=       8.00         8.00           8.00
     RUNOFF VOLUME    (mm)=      97.13        66.01          80.45
     TOTAL RAINFALL   (mm)=      98.13        98.13          98.13
     RUNOFF COEFFICIENT   =       0.99         0.67           0.82

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  85.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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--------------------
| CALIB            |
| STANDHYD (  0027)|   Area    (ha)=   0.40
|ID= 1 DT= 5.0 min |   Total Imp(%)=  99.00   Dir. Conn.(%)=  80.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.40         0.00
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=      51.83        40.00
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Mannings n          =      0.013       0.250

    NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                          ---- TRANSFORMED HYETOGRAPH ----
            TIME     RAIN | TIME     RAIN |'  TIME     RAIN |  TIME    RAIN
             hrs    mm/hr |  hrs    mm/hr |'   hrs    mm/hr |   hrs   mm/hr
           0.083     0.59 | 6.083     2.22 |12.083     1.96 | 18.08     0.87
           0.167     0.59 | 6.167     2.22 |12.167     1.96 | 18.17     0.87
           0.250     0.60 | 6.250     2.43 |12.250     1.89 | 18.25     0.86
           0.333     0.60 | 6.333     2.43 |12.333     1.89 | 18.33     0.86
           0.417     0.61 | 6.417     2.70 |12.417     1.82 | 18.42     0.85
           0.500     0.61 | 6.500     2.70 |12.500     1.82 | 18.50     0.85
           0.583     0.63 | 6.583     3.03 |12.583     1.76 | 18.58     0.84
           0.667     0.63 | 6.667     3.03 |12.667     1.76 | 18.67     0.84
           0.750     0.64 | 6.750     3.46 |12.750     1.71 | 18.75     0.82
           0.833     0.64 | 6.833     3.46 |12.833     1.71 | 18.83     0.82
           0.917     0.65 | 6.917     4.04 |12.917     1.65 | 18.92     0.81
           1.000     0.65 | 7.000     4.04 |13.000     1.65 | 19.00     0.81
           1.083     0.67 | 7.083     4.89 |13.083     1.60 | 19.08     0.80
           1.167     0.67 | 7.167     4.89 |13.167     1.60 | 19.17     0.80
           1.250     0.68 | 7.250     6.21 |13.250     1.56 | 19.25     0.79
           1.333     0.68 | 7.333     6.21 |13.333     1.56 | 19.33     0.79
           1.417     0.70 | 7.417     8.59 |13.417     1.52 | 19.42     0.78
           1.500     0.70 | 7.500     8.59 |13.500     1.52 | 19.50     0.78
           1.583     0.71 | 7.583    14.09 |13.583     1.48 | 19.58     0.77
           1.667     0.71 | 7.667    14.09 |13.667     1.48 | 19.67     0.77
           1.750     0.73 | 7.750    39.57 |13.750     1.44 | 19.75     0.76
           1.833     0.73 | 7.833    39.58 |13.833     1.44 | 19.83     0.76
           1.917     0.75 | 7.917   200.80 |13.917     1.40 | 19.92     0.75
           2.000     0.75 | 8.000   200.79 |14.000     1.40 | 20.00     0.75
           2.083     0.77 | 8.083    54.10 |14.083     1.37 | 20.08     0.74
           2.167     0.77 | 8.167    54.10 |14.167     1.37 | 20.17     0.74
           2.250     0.79 | 8.250    25.64 |14.250     1.33 | 20.25     0.73
           2.333     0.79 | 8.333    25.64 |14.333     1.33 | 20.33     0.73
           2.417     0.81 | 8.417    16.48 |14.417     1.30 | 20.42     0.73
           2.500     0.81 | 8.500    16.48 |14.500     1.30 | 20.50     0.73
           2.583     0.83 | 8.583    12.09 |14.583     1.27 | 20.58     0.72
           2.667     0.83 | 8.667    12.09 |14.667     1.27 | 20.67     0.72
           2.750     0.85 | 8.750     9.54 |14.750     1.24 | 20.75     0.71
           2.833     0.85 | 8.833     9.54 |14.833     1.24 | 20.83     0.71
           2.917     0.88 | 8.917     7.88 |14.917     1.22 | 20.92     0.70
           3.000     0.88 | 9.000     7.88 |15.000     1.22 | 21.00     0.70
           3.083     0.91 | 9.083     6.73 |15.083     1.19 | 21.08     0.69
           3.167     0.91 | 9.167     6.73 |15.167     1.19 | 21.17     0.69
           3.250     0.94 | 9.250     5.87 |15.250     1.17 | 21.25     0.69
           3.333     0.94 | 9.333     5.87 |15.333     1.17 | 21.33     0.69
           3.417     0.97 | 9.417     5.22 |15.417     1.14 | 21.42     0.68
           3.500     0.97 | 9.500     5.22 |15.500     1.14 | 21.50     0.68
           3.583     1.00 | 9.583     4.70 |15.583     1.12 | 21.58     0.67
           3.667     1.00 | 9.667     4.70 |15.667     1.12 | 21.67     0.67
           3.750     1.04 | 9.750     4.28 |15.750     1.10 | 21.75     0.66
           3.833     1.04 | 9.833     4.28 |15.833     1.10 | 21.83     0.66
           3.917     1.08 | 9.917     3.93 |15.917     1.08 | 21.92     0.66
           4.000     1.08 |10.000     3.93 |16.000     1.08 | 22.00     0.66
           4.083     1.12 |10.083     3.63 |16.083     1.06 | 22.08     0.65
           4.167     1.12 |10.167     3.63 |16.167     1.06 | 22.17     0.65
           4.250     1.16 |10.250     3.38 |16.250     1.04 | 22.25     0.64
           4.333     1.16 |10.333     3.38 |16.333     1.04 | 22.33     0.64
           4.417     1.22 |10.417     3.16 |16.417     1.02 | 22.42     0.64
           4.500     1.22 |10.500     3.16 |16.500     1.02 | 22.50     0.64
           4.583     1.27 |10.583     2.97 |16.583     1.01 | 22.58     0.63
           4.667     1.27 |10.667     2.97 |16.667     1.01 | 22.67     0.63
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                 4.750    1.33 |10.750    2.81 |16.750    0.99 | 22.75    0.62
                 4.833    1.33 |10.833    2.81 |16.833    0.99 | 22.83    0.62
                 4.917    1.40 |10.917    2.66 |16.917    0.97 | 22.92    0.62
                 5.000    1.40 |11.000    2.66 |17.000    0.97 | 23.00    0.62
                 5.083    1.48 |11.083    2.53 |17.083    0.96 | 23.08    0.61
                 5.167    1.48 |11.167    2.53 |17.167    0.96 | 23.17    0.61
                 5.250    1.56 |11.250    2.41 |17.250    0.94 | 23.25    0.61
                 5.333    1.56 |11.333    2.41 |17.333    0.94 | 23.33    0.61
                 5.417    1.66 |11.417    2.30 |17.417    0.93 | 23.42    0.60
                 5.500    1.66 |11.500    2.30 |17.500    0.93 | 23.50    0.60
                 5.583    1.77 |11.583    2.20 |17.583    0.91 | 23.58    0.59
                 5.667    1.77 |11.667    2.20 |17.667    0.91 | 23.67    0.59
                 5.750    1.90 |11.750    2.11 |17.750    0.90 | 23.75    0.59
                 5.833    1.90 |11.833    2.11 |17.833    0.90 | 23.83    0.59
                 5.917    2.04 |11.917    2.03 |17.917    0.88 | 23.92    0.58
                 6.000    2.04 |12.000    2.03 |18.000    0.88 | 24.00    0.58

      Max.Eff.Inten.(mm/hr)=     200.80      4000.88
                 over (min)        5.00         5.00
      Storage Coeff.  (min)=       1.30 (ii)    2.23 (ii)
      Unit Hyd. Tpeak (min)=       5.00         5.00
      Unit Hyd. peak  (cms)=       0.33         0.30
                                                            *TOTALS*
      PEAK FLOW       (cms)=       0.18         0.04          0.224 (iii)
      TIME TO PEAK    (hrs)=       8.00         8.00           8.00
      RUNOFF VOLUME    (mm)=      97.13        95.87          96.88
      TOTAL RAINFALL   (mm)=      98.13        98.13          98.13
      RUNOFF COEFFICIENT   =       0.99         0.98           0.99

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
             CN*  =  85.0    Ia = Dep. Storage  (Above)
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------


--------------------
| ADD HYD  (  0028)|
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
         ID1= 1 (  0001):     0.12   0.064     8.00    90.68
       + ID2= 2 (  0002):     0.09   0.046     8.00    88.17
         ==================================================
         ID = 3 (  0028):     0.22   0.111     8.00    89.61

      NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------


--------------------
| ADD HYD  (  0028)|
|   3 +  2 =  1    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
         ID1= 3 (  0028):     0.22   0.111     8.00    89.61
       + ID2= 2 (  0026):     0.02   0.010     8.00    80.45
         ==================================================
         ID = 1 (  0028):     0.23   0.121     8.00    88.88

      NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
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```
| ADD HYD  (  0028)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0028):     0.23   0.121     8.00    88.88
      + ID2= 2 (  0027):     0.40   0.224     8.00    96.88
        ==================================================
        ID = 3 (  0028):     0.64   0.345     8.00    93.93

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------


--------------------
| ADD HYD  (  0028)|
|   3 +  2 =  1    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 3 (  0028):     0.64   0.345     8.00    93.93
      + ID2= 2 (  0003):     0.07   0.035     8.00    86.01
        ==================================================
        ID = 1 (  0028):     0.71   0.380     8.00    93.13

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0025)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.1167      0.0112
                          0.0197     0.0036   |   0.1323      0.0134
                          0.0197     0.0036   |   0.1395      0.0146
                          0.0279     0.0038   |   0.1463      0.0157
                          0.0441     0.0045   |   0.1528      0.0168
                          0.0624     0.0056   |   0.1590      0.0179
                          0.0764     0.0067   |   0.1650      0.0190
                          0.0882     0.0078   |   0.1708      0.0202
                          0.0986     0.0090   |   0.1764      0.0213
                          0.1080     0.0101   |   0.1819      0.0224

                                 AREA     QPEAK     TPEAK       R.V.
                                 (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0028)       0.709      0.380      8.00       93.13
   OUTFLOW: ID= 1 (  0025)       0.709      0.166      8.08       93.08

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 43.62
                   TIME SHIFT OF PEAK FLOW         (min)=  5.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  0.0199

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0004)|   Area    (ha)=   0.09
|ID= 1 DT= 5.0 min |   Total Imp(%)=  33.00   Dir. Conn.(%)=  33.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.03          0.06
     Dep. Storage     (mm)=       1.00          1.50
     Average Slope     (%)=       1.00          2.00
     Length            (m)=      24.75         40.00
     Mannings n          =       0.013         0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                                ---- TRANSFORMED HYETOGRAPH ----
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```
  TIME     RAIN |  TIME     RAIN |'  TIME     RAIN |  TIME     RAIN
   hrs    mm/hr |   hrs    mm/hr |'   hrs    mm/hr |   hrs    mm/hr
 0.083     0.59 | 6.083     2.22 |12.083     1.96 | 18.08     0.87
 0.167     0.59 | 6.167     2.22 |12.167     1.96 | 18.17     0.87
 0.250     0.60 | 6.250     2.43 |12.250     1.89 | 18.25     0.86
 0.333     0.60 | 6.333     2.43 |12.333     1.89 | 18.33     0.86
 0.417     0.61 | 6.417     2.70 |12.417     1.82 | 18.42     0.85
 0.500     0.61 | 6.500     2.70 |12.500     1.82 | 18.50     0.85
 0.583     0.63 | 6.583     3.03 |12.583     1.76 | 18.58     0.84
 0.667     0.63 | 6.667     3.03 |12.667     1.76 | 18.67     0.84
 0.750     0.64 | 6.750     3.46 |12.750     1.71 | 18.75     0.82
 0.833     0.64 | 6.833     3.46 |12.833     1.71 | 18.83     0.82
 0.917     0.65 | 6.917     4.04 |12.917     1.65 | 18.92     0.81
 1.000     0.65 | 7.000     4.04 |13.000     1.65 | 19.00     0.81
 1.083     0.67 | 7.083     4.89 |13.083     1.60 | 19.08     0.80
 1.167     0.67 | 7.167     4.89 |13.167     1.60 | 19.17     0.80
 1.250     0.68 | 7.250     6.21 |13.250     1.56 | 19.25     0.79
 1.333     0.68 | 7.333     6.21 |13.333     1.56 | 19.33     0.79
 1.417     0.70 | 7.417     8.59 |13.417     1.52 | 19.42     0.78
 1.500     0.70 | 7.500     8.59 |13.500     1.52 | 19.50     0.78
 1.583     0.71 | 7.583    14.09 |13.583     1.48 | 19.58     0.77
 1.667     0.71 | 7.667    14.09 |13.667     1.48 | 19.67     0.77
 1.750     0.73 | 7.750    39.57 |13.750     1.44 | 19.75     0.76
 1.833     0.73 | 7.833    39.58 |13.833     1.44 | 19.83     0.76
 1.917     0.75 | 7.917   200.80 |13.917     1.40 | 19.92     0.75
 2.000     0.75 | 8.000   200.79 |14.000     1.40 | 20.00     0.75
 2.083     0.77 | 8.083    54.10 |14.083     1.37 | 20.08     0.74
 2.167     0.77 | 8.167    54.10 |14.167     1.37 | 20.17     0.74
 2.250     0.79 | 8.250    25.64 |14.250     1.33 | 20.25     0.73
 2.333     0.79 | 8.333    25.64 |14.333     1.33 | 20.33     0.73
 2.417     0.81 | 8.417    16.48 |14.417     1.30 | 20.42     0.73
 2.500     0.81 | 8.500    16.48 |14.500     1.30 | 20.50     0.73
 2.583     0.83 | 8.583    12.09 |14.583     1.27 | 20.58     0.72
 2.667     0.83 | 8.667    12.09 |14.667     1.27 | 20.67     0.72
 2.750     0.85 | 8.750     9.54 |14.750     1.24 | 20.75     0.71
 2.833     0.85 | 8.833     9.54 |14.833     1.24 | 20.83     0.71
 2.917     0.88 | 8.917     7.88 |14.917     1.22 | 20.92     0.70
 3.000     0.88 | 9.000     7.88 |15.000     1.22 | 21.00     0.70
 3.083     0.91 | 9.083     6.73 |15.083     1.19 | 21.08     0.69
 3.167     0.91 | 9.167     6.73 |15.167     1.19 | 21.17     0.69
 3.250     0.94 | 9.250     5.87 |15.250     1.17 | 21.25     0.69
 3.333     0.94 | 9.333     5.87 |15.333     1.17 | 21.33     0.69
 3.417     0.97 | 9.417     5.22 |15.417     1.14 | 21.42     0.68
 3.500     0.97 | 9.500     5.22 |15.500     1.14 | 21.50     0.68
 3.583     1.00 | 9.583     4.70 |15.583     1.12 | 21.58     0.67
 3.667     1.00 | 9.667     4.70 |15.667     1.12 | 21.67     0.67
 3.750     1.04 | 9.750     4.28 |15.750     1.10 | 21.75     0.66
 3.833     1.04 | 9.833     4.28 |15.833     1.10 | 21.83     0.66
 3.917     1.08 | 9.917     3.93 |15.917     1.08 | 21.92     0.66
 4.000     1.08 |10.000     3.93 |16.000     1.08 | 22.00     0.66
 4.083     1.12 |10.083     3.63 |16.083     1.06 | 22.08     0.65
 4.167     1.12 |10.167     3.63 |16.167     1.06 | 22.17     0.65
 4.250     1.16 |10.250     3.38 |16.250     1.04 | 22.25     0.64
 4.333     1.16 |10.333     3.38 |16.333     1.04 | 22.33     0.64
 4.417     1.22 |10.417     3.16 |16.417     1.02 | 22.42     0.64
 4.500     1.22 |10.500     3.16 |16.500     1.02 | 22.50     0.64
 4.583     1.27 |10.583     2.97 |16.583     1.01 | 22.58     0.63
 4.667     1.27 |10.667     2.97 |16.667     1.01 | 22.67     0.63
 4.750     1.33 |10.750     2.81 |16.750     0.99 | 22.75     0.62
 4.833     1.33 |10.833     2.81 |16.833     0.99 | 22.83     0.62
 4.917     1.40 |10.917     2.66 |16.917     0.97 | 22.92     0.62
 5.000     1.40 |11.000     2.66 |17.000     0.97 | 23.00     0.62
 5.083     1.48 |11.083     2.53 |17.083     0.96 | 23.08     0.61
 5.167     1.48 |11.167     2.53 |17.167     0.96 | 23.17     0.61
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                5.250    1.56 |11.250    2.41 |17.250    0.94 | 23.25    0.61
                5.333    1.56 |11.333    2.41 |17.333    0.94 | 23.33    0.61
                5.417    1.66 |11.417    2.30 |17.417    0.93 | 23.42    0.60
                5.500    1.66 |11.500    2.30 |17.500    0.93 | 23.50    0.60
                5.583    1.77 |11.583    2.20 |17.583    0.91 | 23.58    0.59
                5.667    1.77 |11.667    2.20 |17.667    0.91 | 23.67    0.59
                5.750    1.90 |11.750    2.11 |17.750    0.90 | 23.75    0.59
                5.833    1.90 |11.833    2.11 |17.833    0.90 | 23.83    0.59
                5.917    2.04 |11.917    2.03 |17.917    0.88 | 23.92    0.58
                6.000    2.04 |12.000    2.03 |18.000    0.88 | 24.00    0.58

     Max.Eff.Inten.(mm/hr)=     200.80       125.06
                over (min)        5.00        10.00
     Storage Coeff.  (min)=       0.84 (ii)    7.29 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.34         0.14
                                                         *TOTALS*
     PEAK FLOW       (cms)=       0.02         0.02        0.030 (iii)
     TIME TO PEAK    (hrs)=       8.00         8.08        8.00
     RUNOFF VOLUME    (mm)=      97.13        61.28       73.07
     TOTAL RAINFALL   (mm)=      98.13        98.13       98.13
     RUNOFF COEFFICIENT   =       0.99         0.62         0.74

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  82.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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--------------------
| ADD HYD  (  0024)|
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0025):     0.71   0.166     8.08    93.08
      + ID2= 2 (  0004):     0.09   0.030     8.00    73.07
        ====================================================
        ID = 3 (  0024):     0.80   0.185     8.08    90.78

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
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********************************
** SIMULATION:5-yr 24hr       **
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| CHICAGO STORM    |    IDF curve parameters: A=1170.000
| Ptotal= 60.87 mm |                          B=   5.800
--------------------                          C=   0.843
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  = 24.00 hrs
                        Storm time step    = 10.00 min
                        Time to peak ratio =  0.33

                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.00    0.41 |  6.00    1.50 | 12.00    1.32 | 18.00    0.60
                 0.17    0.42 |  6.17    1.64 | 12.17    1.28 | 18.17    0.59
                 0.33    0.43 |  6.33    1.81 | 12.33    1.24 | 18.33    0.59
                 0.50    0.44 |  6.50    2.02 | 12.50    1.20 | 18.50    0.58
                 0.67    0.44 |  6.67    2.30 | 12.67    1.16 | 18.67    0.57
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                 0.83     0.45 |  6.83     2.68 | 12.83     1.13 | 18.83     0.56
                 1.00     0.46 |  7.00     3.21 | 13.00     1.09 | 19.00     0.56
                 1.17     0.47 |  7.17     4.05 | 13.17     1.06 | 19.17     0.55
                 1.33     0.48 |  7.33     5.53 | 13.33     1.03 | 19.33     0.54
                 1.50     0.50 |  7.50     8.89 | 13.50     1.01 | 19.50     0.54
                 1.67     0.51 |  7.67    23.90 | 13.67     0.98 | 19.67     0.53
                 1.83     0.52 |  7.83   114.21 | 13.83     0.96 | 19.83     0.52
                 2.00     0.53 |  8.00    32.36 | 14.00     0.93 | 20.00     0.52
                 2.17     0.55 |  8.17    15.80 | 14.17     0.91 | 20.17     0.51
                 2.33     0.56 |  8.33    10.34 | 14.33     0.89 | 20.33     0.50
                 2.50     0.58 |  8.50     7.68 | 14.50     0.87 | 20.50     0.50
                 2.67     0.59 |  8.67     6.11 | 14.67     0.85 | 20.67     0.49
                 2.83     0.61 |  8.83     5.09 | 14.83     0.84 | 20.83     0.49
                 3.00     0.63 |  9.00     4.37 | 15.00     0.82 | 21.00     0.48
                 3.17     0.65 |  9.17     3.83 | 15.17     0.80 | 21.17     0.48
                 3.33     0.67 |  9.33     3.42 | 15.33     0.79 | 21.33     0.47
                 3.50     0.69 |  9.50     3.09 | 15.50     0.77 | 21.50     0.47
                 3.67     0.71 |  9.67     2.82 | 15.67     0.76 | 21.67     0.46
                 3.83     0.74 |  9.83     2.60 | 15.83     0.74 | 21.83     0.46
                 4.00     0.77 | 10.00     2.41 | 16.00     0.73 | 22.00     0.45
                 4.17     0.80 | 10.17     2.25 | 16.17     0.72 | 22.17     0.45
                 4.33     0.83 | 10.33     2.11 | 16.33     0.71 | 22.33     0.44
                 4.50     0.87 | 10.50     1.99 | 16.50     0.69 | 22.50     0.44
                 4.67     0.91 | 10.67     1.88 | 16.67     0.68 | 22.67     0.44
                 4.83     0.96 | 10.83     1.78 | 16.83     0.67 | 22.83     0.43
                 5.00     1.01 | 11.00     1.70 | 17.00     0.66 | 23.00     0.43
                 5.17     1.06 | 11.17     1.62 | 17.17     0.65 | 23.17     0.42
                 5.33     1.13 | 11.33     1.55 | 17.33     0.64 | 23.33     0.42
                 5.50     1.20 | 11.50     1.49 | 17.50     0.63 | 23.50     0.42
                 5.67     1.28 | 11.67     1.43 | 17.67     0.62 | 23.67     0.41
                 5.83     1.38 | 11.83     1.37 | 17.83     0.61 | 23.83     0.41


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| CALIB            |
| STANDHYD (  0001)|   Area    (ha)=   0.12
|ID= 1 DT= 5.0 min |   Total Imp(%)=  82.00   Dir. Conn.(%)=  82.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        0.10         0.02
     Dep. Storage     (mm)=        1.00         1.50
     Average Slope     (%)=        1.00         2.00
     Length            (m)=       28.75        40.00
     Mannings n           =       0.013        0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                                ---- TRANSFORMED HYETOGRAPH ----
                 TIME     RAIN |  TIME     RAIN |'  TIME     RAIN |  TIME    RAIN
                  hrs    mm/hr |   hrs    mm/hr |'   hrs    mm/hr |   hrs   mm/hr
                0.083     0.41 | 6.083     1.50 |12.083     1.32 | 18.08     0.60
                0.167     0.41 | 6.167     1.50 |12.167     1.32 | 18.17     0.60
                0.250     0.42 | 6.250     1.64 |12.250     1.28 | 18.25     0.59
                0.333     0.42 | 6.333     1.64 |12.333     1.28 | 18.33     0.59
                0.417     0.43 | 6.417     1.81 |12.417     1.24 | 18.42     0.59
                0.500     0.43 | 6.500     1.81 |12.500     1.24 | 18.50     0.59
                0.583     0.44 | 6.583     2.02 |12.583     1.20 | 18.58     0.58
                0.667     0.44 | 6.667     2.02 |12.667     1.20 | 18.67     0.58
                0.750     0.44 | 6.750     2.30 |12.750     1.16 | 18.75     0.57
                0.833     0.44 | 6.833     2.30 |12.833     1.16 | 18.83     0.57
                0.917     0.45 | 6.917     2.68 |12.917     1.13 | 18.92     0.56
                1.000     0.45 | 7.000     2.68 |13.000     1.13 | 19.00     0.56
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           1.083    0.46 | 7.083    3.21 |13.083    1.09 | 19.08    0.56
           1.167    0.46 | 7.167    3.21 |13.167    1.09 | 19.17    0.56
           1.250    0.47 | 7.250    4.05 |13.250    1.06 | 19.25    0.55
           1.333    0.47 | 7.333    4.05 |13.333    1.06 | 19.33    0.55
           1.417    0.48 | 7.417    5.53 |13.417    1.03 | 19.42    0.54
           1.500    0.48 | 7.500    5.53 |13.500    1.03 | 19.50    0.54
           1.583    0.50 | 7.583    8.89 |13.583    1.01 | 19.58    0.54
           1.667    0.50 | 7.667    8.89 |13.667    1.01 | 19.67    0.54
           1.750    0.51 | 7.750   23.90 |13.750    0.98 | 19.75    0.53
           1.833    0.51 | 7.833   23.91 |13.833    0.98 | 19.83    0.53
           1.917    0.52 | 7.917  114.21 |13.917    0.96 | 19.92    0.52
           2.000    0.52 | 8.000  114.21 |14.000    0.96 | 20.00    0.52
           2.083    0.53 | 8.083   32.36 |14.083    0.93 | 20.08    0.52
           2.167    0.53 | 8.167   32.35 |14.167    0.93 | 20.17    0.52
           2.250    0.55 | 8.250   15.80 |14.250    0.91 | 20.25    0.51
           2.333    0.55 | 8.333   15.80 |14.333    0.91 | 20.33    0.51
           2.417    0.56 | 8.417   10.34 |14.417    0.89 | 20.42    0.50
           2.500    0.56 | 8.500   10.34 |14.500    0.89 | 20.50    0.50
           2.583    0.58 | 8.583    7.68 |14.583    0.87 | 20.58    0.50
           2.667    0.58 | 8.667    7.68 |14.667    0.87 | 20.67    0.50
           2.750    0.59 | 8.750    6.11 |14.750    0.85 | 20.75    0.49
           2.833    0.59 | 8.833    6.11 |14.833    0.85 | 20.83    0.49
           2.917    0.61 | 8.917    5.09 |14.917    0.84 | 20.92    0.49
           3.000    0.61 | 9.000    5.09 |15.000    0.84 | 21.00    0.49
           3.083    0.63 | 9.083    4.37 |15.083    0.82 | 21.08    0.48
           3.167    0.63 | 9.167    4.37 |15.167    0.82 | 21.17    0.48
           3.250    0.65 | 9.250    3.83 |15.250    0.80 | 21.25    0.48
           3.333    0.65 | 9.333    3.83 |15.333    0.80 | 21.33    0.48
           3.417    0.67 | 9.417    3.42 |15.417    0.79 | 21.42    0.47
           3.500    0.67 | 9.500    3.42 |15.500    0.79 | 21.50    0.47
           3.583    0.69 | 9.583    3.09 |15.583    0.77 | 21.58    0.47
           3.667    0.69 | 9.667    3.09 |15.667    0.77 | 21.67    0.47
           3.750    0.71 | 9.750    2.82 |15.750    0.76 | 21.75    0.46
           3.833    0.71 | 9.833    2.82 |15.833    0.76 | 21.83    0.46
           3.917    0.74 | 9.917    2.60 |15.917    0.74 | 21.92    0.46
           4.000    0.74 |10.000    2.60 |16.000    0.74 | 22.00    0.46
           4.083    0.77 |10.083    2.41 |16.083    0.73 | 22.08    0.45
           4.167    0.77 |10.167    2.41 |16.167    0.73 | 22.17    0.45
           4.250    0.80 |10.250    2.25 |16.250    0.72 | 22.25    0.45
           4.333    0.80 |10.333    2.25 |16.333    0.72 | 22.33    0.45
           4.417    0.83 |10.417    2.11 |16.417    0.71 | 22.42    0.44
           4.500    0.83 |10.500    2.11 |16.500    0.71 | 22.50    0.44
           4.583    0.87 |10.583    1.99 |16.583    0.69 | 22.58    0.44
           4.667    0.87 |10.667    1.99 |16.667    0.69 | 22.67    0.44
           4.750    0.91 |10.750    1.88 |16.750    0.68 | 22.75    0.44
           4.833    0.91 |10.833    1.88 |16.833    0.68 | 22.83    0.44
           4.917    0.96 |10.917    1.78 |16.917    0.67 | 22.92    0.43
           5.000    0.96 |11.000    1.78 |17.000    0.67 | 23.00    0.43
           5.083    1.01 |11.083    1.70 |17.083    0.66 | 23.08    0.43
           5.167    1.01 |11.167    1.70 |17.167    0.66 | 23.17    0.43
           5.250    1.06 |11.250    1.62 |17.250    0.65 | 23.25    0.42
           5.333    1.06 |11.333    1.62 |17.333    0.65 | 23.33    0.42
           5.417    1.13 |11.417    1.55 |17.417    0.64 | 23.42    0.42
           5.500    1.13 |11.500    1.55 |17.500    0.64 | 23.50    0.42
           5.583    1.20 |11.583    1.49 |17.583    0.63 | 23.58    0.42
           5.667    1.20 |11.667    1.49 |17.667    0.63 | 23.67    0.42
           5.750    1.28 |11.750    1.43 |17.750    0.62 | 23.75    0.41
           5.833    1.28 |11.833    1.43 |17.833    0.62 | 23.83    0.41
           5.917    1.38 |11.917    1.37 |17.917    0.61 | 23.92    0.41
           6.000    1.38 |12.000    1.37 |18.000    0.61 | 24.00    0.41

Max.Eff.Inten.(mm/hr)=     114.21        54.30
           over (min)        5.00         5.00
Storage Coeff.  (min)=       1.15 (ii)    4.80 (ii)
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     Unit Hyd. Tpeak (min)=       5.00          5.00
     Unit Hyd. peak  (cms)=       0.34          0.22
                                                           *TOTALS*
     PEAK FLOW       (cms)=       0.03          0.00          0.035 (iii)
     TIME TO PEAK    (hrs)=       8.00          8.00           8.00
     RUNOFF VOLUME    (mm)=      59.87         30.62         54.60
     TOTAL RAINFALL   (mm)=      60.87         60.87         60.87
     RUNOFF COEFFICIENT   =       0.98          0.50           0.90

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  82.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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| CALIB             |
| STANDHYD (  0002)|   Area    (ha)=   0.09
|ID= 1 DT= 5.0 min |   Total Imp(%)=  75.00   Dir. Conn.(%)=  75.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.07          0.02
     Dep. Storage     (mm)=       1.00          1.50
     Average Slope     (%)=       1.00          2.00
     Length            (m)=      24.79         40.00
     Mannings n          =      0.013         0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                               ---- TRANSFORMED HYETOGRAPH ----
                 TIME     RAIN |  TIME     RAIN |'  TIME     RAIN |  TIME     RAIN
                  hrs    mm/hr |   hrs    mm/hr |'   hrs    mm/hr |   hrs    mm/hr
                0.083     0.41 | 6.083     1.50 |12.083     1.32 | 18.08     0.60
                0.167     0.41 | 6.167     1.50 |12.167     1.32 | 18.17     0.60
                0.250     0.42 | 6.250     1.64 |12.250     1.28 | 18.25     0.59
                0.333     0.42 | 6.333     1.64 |12.333     1.28 | 18.33     0.59
                0.417     0.43 | 6.417     1.81 |12.417     1.24 | 18.42     0.59
                0.500     0.43 | 6.500     1.81 |12.500     1.24 | 18.50     0.59
                0.583     0.44 | 6.583     2.02 |12.583     1.20 | 18.58     0.58
                0.667     0.44 | 6.667     2.02 |12.667     1.20 | 18.67     0.58
                0.750     0.44 | 6.750     2.30 |12.750     1.16 | 18.75     0.57
                0.833     0.44 | 6.833     2.30 |12.833     1.16 | 18.83     0.57
                0.917     0.45 | 6.917     2.68 |12.917     1.13 | 18.92     0.56
                1.000     0.45 | 7.000     2.68 |13.000     1.13 | 19.00     0.56
                1.083     0.46 | 7.083     3.21 |13.083     1.09 | 19.08     0.56
                1.167     0.46 | 7.167     3.21 |13.167     1.09 | 19.17     0.56
                1.250     0.47 | 7.250     4.05 |13.250     1.06 | 19.25     0.55
                1.333     0.47 | 7.333     4.05 |13.333     1.06 | 19.33     0.55
                1.417     0.48 | 7.417     5.53 |13.417     1.03 | 19.42     0.54
                1.500     0.48 | 7.500     5.53 |13.500     1.03 | 19.50     0.54
                1.583     0.50 | 7.583     8.89 |13.583     1.01 | 19.58     0.54
                1.667     0.50 | 7.667     8.89 |13.667     1.01 | 19.67     0.54
                1.750     0.51 | 7.750    23.90 |13.750     0.98 | 19.75     0.53
                1.833     0.51 | 7.833    23.91 |13.833     0.98 | 19.83     0.53
                1.917     0.52 | 7.917   114.21 |13.917     0.96 | 19.92     0.52
                2.000     0.52 | 8.000   114.21 |14.000     0.96 | 20.00     0.52
                2.083     0.53 | 8.083    32.36 |14.083     0.93 | 20.08     0.52
                2.167     0.53 | 8.167    32.35 |14.167     0.93 | 20.17     0.52
                2.250     0.55 | 8.250    15.80 |14.250     0.91 | 20.25     0.51
                2.333     0.55 | 8.333    15.80 |14.333     0.91 | 20.33     0.51
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                  2.417    0.56 | 8.417   10.34 |14.417    0.89 | 20.42    0.50
                  2.500    0.56 | 8.500   10.34 |14.500    0.89 | 20.50    0.50
                  2.583    0.58 | 8.583    7.68 |14.583    0.87 | 20.58    0.50
                  2.667    0.58 | 8.667    7.68 |14.667    0.87 | 20.67    0.50
                  2.750    0.59 | 8.750    6.11 |14.750    0.85 | 20.75    0.49
                  2.833    0.59 | 8.833    6.11 |14.833    0.85 | 20.83    0.49
                  2.917    0.61 | 8.917    5.09 |14.917    0.84 | 20.92    0.49
                  3.000    0.61 | 9.000    5.09 |15.000    0.84 | 21.00    0.49
                  3.083    0.63 | 9.083    4.37 |15.083    0.82 | 21.08    0.48
                  3.167    0.63 | 9.167    4.37 |15.167    0.82 | 21.17    0.48
                  3.250    0.65 | 9.250    3.83 |15.250    0.80 | 21.25    0.48
                  3.333    0.65 | 9.333    3.83 |15.333    0.80 | 21.33    0.48
                  3.417    0.67 | 9.417    3.42 |15.417    0.79 | 21.42    0.47
                  3.500    0.67 | 9.500    3.42 |15.500    0.79 | 21.50    0.47
                  3.583    0.69 | 9.583    3.09 |15.583    0.77 | 21.58    0.47
                  3.667    0.69 | 9.667    3.09 |15.667    0.77 | 21.67    0.47
                  3.750    0.71 | 9.750    2.82 |15.750    0.76 | 21.75    0.46
                  3.833    0.71 | 9.833    2.82 |15.833    0.76 | 21.83    0.46
                  3.917    0.74 | 9.917    2.60 |15.917    0.74 | 21.92    0.46
                  4.000    0.74 |10.000    2.60 |16.000    0.74 | 22.00    0.46
                  4.083    0.77 |10.083    2.41 |16.083    0.73 | 22.08    0.45
                  4.167    0.77 |10.167    2.41 |16.167    0.73 | 22.17    0.45
                  4.250    0.80 |10.250    2.25 |16.250    0.72 | 22.25    0.45
                  4.333    0.80 |10.333    2.25 |16.333    0.72 | 22.33    0.45
                  4.417    0.83 |10.417    2.11 |16.417    0.71 | 22.42    0.44
                  4.500    0.83 |10.500    2.11 |16.500    0.71 | 22.50    0.44
                  4.583    0.87 |10.583    1.99 |16.583    0.69 | 22.58    0.44
                  4.667    0.87 |10.667    1.99 |16.667    0.69 | 22.67    0.44
                  4.750    0.91 |10.750    1.88 |16.750    0.68 | 22.75    0.44
                  4.833    0.91 |10.833    1.88 |16.833    0.68 | 22.83    0.44
                  4.917    0.96 |10.917    1.78 |16.917    0.67 | 22.92    0.43
                  5.000    0.96 |11.000    1.78 |17.000    0.67 | 23.00    0.43
                  5.083    1.01 |11.083    1.70 |17.083    0.66 | 23.08    0.43
                  5.167    1.01 |11.167    1.70 |17.167    0.66 | 23.17    0.43
                  5.250    1.06 |11.250    1.62 |17.250    0.65 | 23.25    0.42
                  5.333    1.06 |11.333    1.62 |17.333    0.65 | 23.33    0.42
                  5.417    1.13 |11.417    1.55 |17.417    0.64 | 23.42    0.42
                  5.500    1.13 |11.500    1.55 |17.500    0.64 | 23.50    0.42
                  5.583    1.20 |11.583    1.49 |17.583    0.63 | 23.58    0.42
                  5.667    1.20 |11.667    1.49 |17.667    0.63 | 23.67    0.42
                  5.750    1.28 |11.750    1.43 |17.750    0.62 | 23.75    0.41
                  5.833    1.28 |11.833    1.43 |17.833    0.62 | 23.83    0.41
                  5.917    1.38 |11.917    1.37 |17.917    0.61 | 23.92    0.41
                  6.000    1.38 |12.000    1.37 |18.000    0.61 | 24.00    0.41

     Max.Eff.Inten.(mm/hr)=     114.21         54.30
                over (min)        5.00         10.00
     Storage Coeff.  (min)=       1.05 (ii)     5.36 (ii)
     Unit Hyd. Tpeak (min)=       5.00         10.00
     Unit Hyd. peak  (cms)=       0.34          0.16
                                                           *TOTALS*
     PEAK FLOW       (cms)=       0.02          0.00         0.024 (iii)
     TIME TO PEAK    (hrs)=       8.00          8.08          8.00
     RUNOFF VOLUME    (mm)=      59.87         30.62         52.42
     TOTAL RAINFALL   (mm)=      60.87         60.87         60.87
     RUNOFF COEFFICIENT   =       0.98          0.50          0.86

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  82.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
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| CALIB            |
| STANDHYD (  0003)|   Area    (ha)=   0.07
|ID= 1 DT= 5.0 min |   Total Imp(%)=  69.00   Dir. Conn.(%)=  69.00
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                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        0.05         0.02
     Dep. Storage     (mm)=        1.00         1.50
     Average Slope     (%)=        1.00         2.00
     Length            (m)=       21.83        40.00
     Mannings n          =       0.013        0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                               ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    0.41 | 6.083    1.50 |12.083    1.32 | 18.08    0.60
                0.167    0.41 | 6.167    1.50 |12.167    1.32 | 18.17    0.60
                0.250    0.42 | 6.250    1.64 |12.250    1.28 | 18.25    0.59
                0.333    0.42 | 6.333    1.64 |12.333    1.28 | 18.33    0.59
                0.417    0.43 | 6.417    1.81 |12.417    1.24 | 18.42    0.59
                0.500    0.43 | 6.500    1.81 |12.500    1.24 | 18.50    0.59
                0.583    0.44 | 6.583    2.02 |12.583    1.20 | 18.58    0.58
                0.667    0.44 | 6.667    2.02 |12.667    1.20 | 18.67    0.58
                0.750    0.44 | 6.750    2.30 |12.750    1.16 | 18.75    0.57
                0.833    0.44 | 6.833    2.30 |12.833    1.16 | 18.83    0.57
                0.917    0.45 | 6.917    2.68 |12.917    1.13 | 18.92    0.56
                1.000    0.45 | 7.000    2.68 |13.000    1.13 | 19.00    0.56
                1.083    0.46 | 7.083    3.21 |13.083    1.09 | 19.08    0.56
                1.167    0.46 | 7.167    3.21 |13.167    1.09 | 19.17    0.56
                1.250    0.47 | 7.250    4.05 |13.250    1.06 | 19.25    0.55
                1.333    0.47 | 7.333    4.05 |13.333    1.06 | 19.33    0.55
                1.417    0.48 | 7.417    5.53 |13.417    1.03 | 19.42    0.54
                1.500    0.48 | 7.500    5.53 |13.500    1.03 | 19.50    0.54
                1.583    0.50 | 7.583    8.89 |13.583    1.01 | 19.58    0.54
                1.667    0.50 | 7.667    8.89 |13.667    1.01 | 19.67    0.54
                1.750    0.51 | 7.750   23.90 |13.750    0.98 | 19.75    0.53
                1.833    0.51 | 7.833   23.91 |13.833    0.98 | 19.83    0.53
                1.917    0.52 | 7.917  114.21 |13.917    0.96 | 19.92    0.52
                2.000    0.52 | 8.000  114.21 |14.000    0.96 | 20.00    0.52
                2.083    0.53 | 8.083   32.36 |14.083    0.93 | 20.08    0.52
                2.167    0.53 | 8.167   32.35 |14.167    0.93 | 20.17    0.52
                2.250    0.55 | 8.250   15.80 |14.250    0.91 | 20.25    0.51
                2.333    0.55 | 8.333   15.80 |14.333    0.91 | 20.33    0.51
                2.417    0.56 | 8.417   10.34 |14.417    0.89 | 20.42    0.50
                2.500    0.56 | 8.500   10.34 |14.500    0.89 | 20.50    0.50
                2.583    0.58 | 8.583    7.68 |14.583    0.87 | 20.58    0.50
                2.667    0.58 | 8.667    7.68 |14.667    0.87 | 20.67    0.50
                2.750    0.59 | 8.750    6.11 |14.750    0.85 | 20.75    0.49
                2.833    0.59 | 8.833    6.11 |14.833    0.85 | 20.83    0.49
                2.917    0.61 | 8.917    5.09 |14.917    0.84 | 20.92    0.49
                3.000    0.61 | 9.000    5.09 |15.000    0.84 | 21.00    0.49
                3.083    0.63 | 9.083    4.37 |15.083    0.82 | 21.08    0.48
                3.167    0.63 | 9.167    4.37 |15.167    0.82 | 21.17    0.48
                3.250    0.65 | 9.250    3.83 |15.250    0.80 | 21.25    0.48
                3.333    0.65 | 9.333    3.83 |15.333    0.80 | 21.33    0.48
                3.417    0.67 | 9.417    3.42 |15.417    0.79 | 21.42    0.47
                3.500    0.67 | 9.500    3.42 |15.500    0.79 | 21.50    0.47
                3.583    0.69 | 9.583    3.09 |15.583    0.77 | 21.58    0.47
                3.667    0.69 | 9.667    3.09 |15.667    0.77 | 21.67    0.47
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                3.750    0.71 | 9.750    2.82 |15.750    0.76 | 21.75    0.46
                3.833    0.71 | 9.833    2.82 |15.833    0.76 | 21.83    0.46
                3.917    0.74 | 9.917    2.60 |15.917    0.74 | 21.92    0.46
                4.000    0.74 |10.000    2.60 |16.000    0.74 | 22.00    0.46
                4.083    0.77 |10.083    2.41 |16.083    0.73 | 22.08    0.45
                4.167    0.77 |10.167    2.41 |16.167    0.73 | 22.17    0.45
                4.250    0.80 |10.250    2.25 |16.250    0.72 | 22.25    0.45
                4.333    0.80 |10.333    2.25 |16.333    0.72 | 22.33    0.45
                4.417    0.83 |10.417    2.11 |16.417    0.71 | 22.42    0.44
                4.500    0.83 |10.500    2.11 |16.500    0.71 | 22.50    0.44
                4.583    0.87 |10.583    1.99 |16.583    0.69 | 22.58    0.44
                4.667    0.87 |10.667    1.99 |16.667    0.69 | 22.67    0.44
                4.750    0.91 |10.750    1.88 |16.750    0.68 | 22.75    0.44
                4.833    0.91 |10.833    1.88 |16.833    0.68 | 22.83    0.44
                4.917    0.96 |10.917    1.78 |16.917    0.67 | 22.92    0.43
                5.000    0.96 |11.000    1.78 |17.000    0.67 | 23.00    0.43
                5.083    1.01 |11.083    1.70 |17.083    0.66 | 23.08    0.43
                5.167    1.01 |11.167    1.70 |17.167    0.66 | 23.17    0.43
                5.250    1.06 |11.250    1.62 |17.250    0.65 | 23.25    0.42
                5.333    1.06 |11.333    1.62 |17.333    0.65 | 23.33    0.42
                5.417    1.13 |11.417    1.55 |17.417    0.64 | 23.42    0.42
                5.500    1.13 |11.500    1.55 |17.500    0.64 | 23.50    0.42
                5.583    1.20 |11.583    1.49 |17.583    0.63 | 23.58    0.42
                5.667    1.20 |11.667    1.49 |17.667    0.63 | 23.67    0.42
                5.750    1.28 |11.750    1.43 |17.750    0.62 | 23.75    0.41
                5.833    1.28 |11.833    1.43 |17.833    0.62 | 23.83    0.41
                5.917    1.38 |11.917    1.37 |17.917    0.61 | 23.92    0.41
                6.000    1.38 |12.000    1.37 |18.000    0.61 | 24.00    0.41

     Max.Eff.Inten.(mm/hr)=     114.21        54.30
                over (min)        5.00        10.00
     Storage Coeff.  (min)=       0.97 (ii)    5.83 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.34         0.15
                                                            *TOTALS*
     PEAK FLOW       (cms)=       0.02         0.00           0.018 (iii)
     TIME TO PEAK    (hrs)=       8.00         8.08            8.00
     RUNOFF VOLUME    (mm)=      59.87        30.62           48.77
     TOTAL RAINFALL   (mm)=      60.87        60.87           60.87
     RUNOFF COEFFICIENT   =       0.98         0.50            0.80

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  82.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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| CALIB             |
| STANDHYD (  0026)|   Area    (ha)=   0.02
|ID= 1 DT= 5.0 min |   Total Imp(%)=  84.00   Dir. Conn.(%)=  84.00
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                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.02         0.00
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=      11.17        40.00
     Mannings n           =      0.013        0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.
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                    ---- TRANSFORMED HYETOGRAPH ----
  TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
   hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
 0.083    0.41 | 6.083    1.50 |12.083    1.32 | 18.08    0.60
 0.167    0.41 | 6.167    1.50 |12.167    1.32 | 18.17    0.60
 0.250    0.42 | 6.250    1.64 |12.250    1.28 | 18.25    0.59
 0.333    0.42 | 6.333    1.64 |12.333    1.28 | 18.33    0.59
 0.417    0.43 | 6.417    1.81 |12.417    1.24 | 18.42    0.59
 0.500    0.43 | 6.500    1.81 |12.500    1.24 | 18.50    0.59
 0.583    0.44 | 6.583    2.02 |12.583    1.20 | 18.58    0.58
 0.667    0.44 | 6.667    2.02 |12.667    1.20 | 18.67    0.58
 0.750    0.44 | 6.750    2.30 |12.750    1.16 | 18.75    0.57
 0.833    0.44 | 6.833    2.30 |12.833    1.16 | 18.83    0.57
 0.917    0.45 | 6.917    2.68 |12.917    1.13 | 18.92    0.56
 1.000    0.45 | 7.000    2.68 |13.000    1.13 | 19.00    0.56
 1.083    0.46 | 7.083    3.21 |13.083    1.09 | 19.08    0.56
 1.167    0.46 | 7.167    3.21 |13.167    1.09 | 19.17    0.56
 1.250    0.47 | 7.250    4.05 |13.250    1.06 | 19.25    0.55
 1.333    0.47 | 7.333    4.05 |13.333    1.06 | 19.33    0.55
 1.417    0.48 | 7.417    5.53 |13.417    1.03 | 19.42    0.54
 1.500    0.48 | 7.500    5.53 |13.500    1.03 | 19.50    0.54
 1.583    0.50 | 7.583    8.89 |13.583    1.01 | 19.58    0.54
 1.667    0.50 | 7.667    8.89 |13.667    1.01 | 19.67    0.54
 1.750    0.51 | 7.750   23.90 |13.750    0.98 | 19.75    0.53
 1.833    0.51 | 7.833   23.91 |13.833    0.98 | 19.83    0.53
 1.917    0.52 | 7.917  114.21 |13.917    0.96 | 19.92    0.52
 2.000    0.52 | 8.000  114.21 |14.000    0.96 | 20.00    0.52
 2.083    0.53 | 8.083   32.36 |14.083    0.93 | 20.08    0.52
 2.167    0.53 | 8.167   32.35 |14.167    0.93 | 20.17    0.52
 2.250    0.55 | 8.250   15.80 |14.250    0.91 | 20.25    0.51
 2.333    0.55 | 8.333   15.80 |14.333    0.91 | 20.33    0.51
 2.417    0.56 | 8.417   10.34 |14.417    0.89 | 20.42    0.50
 2.500    0.56 | 8.500   10.34 |14.500    0.89 | 20.50    0.50
 2.583    0.58 | 8.583    7.68 |14.583    0.87 | 20.58    0.50
 2.667    0.58 | 8.667    7.68 |14.667    0.87 | 20.67    0.50
 2.750    0.59 | 8.750    6.11 |14.750    0.85 | 20.75    0.49
 2.833    0.59 | 8.833    6.11 |14.833    0.85 | 20.83    0.49
 2.917    0.61 | 8.917    5.09 |14.917    0.84 | 20.92    0.49
 3.000    0.61 | 9.000    5.09 |15.000    0.84 | 21.00    0.49
 3.083    0.63 | 9.083    4.37 |15.083    0.82 | 21.08    0.48
 3.167    0.63 | 9.167    4.37 |15.167    0.82 | 21.17    0.48
 3.250    0.65 | 9.250    3.83 |15.250    0.80 | 21.25    0.48
 3.333    0.65 | 9.333    3.83 |15.333    0.80 | 21.33    0.48
 3.417    0.67 | 9.417    3.42 |15.417    0.79 | 21.42    0.47
 3.500    0.67 | 9.500    3.42 |15.500    0.79 | 21.50    0.47
 3.583    0.69 | 9.583    3.09 |15.583    0.77 | 21.58    0.47
 3.667    0.69 | 9.667    3.09 |15.667    0.77 | 21.67    0.47
 3.750    0.71 | 9.750    2.82 |15.750    0.76 | 21.75    0.46
 3.833    0.71 | 9.833    2.82 |15.833    0.76 | 21.83    0.46
 3.917    0.74 | 9.917    2.60 |15.917    0.74 | 21.92    0.46
 4.000    0.74 |10.000    2.60 |16.000    0.74 | 22.00    0.46
 4.083    0.77 |10.083    2.41 |16.083    0.73 | 22.08    0.45
 4.167    0.77 |10.167    2.41 |16.167    0.73 | 22.17    0.45
 4.250    0.80 |10.250    2.25 |16.250    0.72 | 22.25    0.45
 4.333    0.80 |10.333    2.25 |16.333    0.72 | 22.33    0.45
 4.417    0.83 |10.417    2.11 |16.417    0.71 | 22.42    0.44
 4.500    0.83 |10.500    2.11 |16.500    0.71 | 22.50    0.44
 4.583    0.87 |10.583    1.99 |16.583    0.69 | 22.58    0.44
 4.667    0.87 |10.667    1.99 |16.667    0.69 | 22.67    0.44
 4.750    0.91 |10.750    1.88 |16.750    0.68 | 22.75    0.44
 4.833    0.91 |10.833    1.88 |16.833    0.68 | 22.83    0.44
 4.917    0.96 |10.917    1.78 |16.917    0.67 | 22.92    0.43
 5.000    0.96 |11.000    1.78 |17.000    0.67 | 23.00    0.43
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                5.083    1.01 |11.083    1.70 |17.083    0.66 | 23.08    0.43
                5.167    1.01 |11.167    1.70 |17.167    0.66 | 23.17    0.43
                5.250    1.06 |11.250    1.62 |17.250    0.65 | 23.25    0.42
                5.333    1.06 |11.333    1.62 |17.333    0.65 | 23.33    0.42
                5.417    1.13 |11.417    1.55 |17.417    0.64 | 23.42    0.42
                5.500    1.13 |11.500    1.55 |17.500    0.64 | 23.50    0.42
                5.583    1.20 |11.583    1.49 |17.583    0.63 | 23.58    0.42
                5.667    1.20 |11.667    1.49 |17.667    0.63 | 23.67    0.42
                5.750    1.28 |11.750    1.43 |17.750    0.62 | 23.75    0.41
                5.833    1.28 |11.833    1.43 |17.833    0.62 | 23.83    0.41
                5.917    1.38 |11.917    1.37 |17.917    0.61 | 23.92    0.41
                6.000    1.38 |12.000    1.37 |18.000    0.61 | 24.00    0.41

     Max.Eff.Inten.(mm/hr)=     114.21        61.46
                over (min)        5.00         5.00
     Storage Coeff.  (min)=       0.65 (ii)    4.10 (ii)
     Unit Hyd. Tpeak (min)=       5.00         5.00
     Unit Hyd. peak  (cms)=       0.34         0.24
                                                           *TOTALS*
     PEAK FLOW       (cms)=       0.00         0.00          0.005 (iii)
     TIME TO PEAK    (hrs)=       8.00         8.00           8.00
     RUNOFF VOLUME    (mm)=      59.87        33.83          45.39
     TOTAL RAINFALL   (mm)=      60.87        60.87          60.87
     RUNOFF COEFFICIENT   =       0.98         0.56           0.75

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  85.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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--------------------
| CALIB              |
| STANDHYD (  0027)|   Area    (ha)=   0.40
|ID= 1 DT= 5.0 min |   Total Imp(%)=  99.00   Dir. Conn.(%)=  80.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.40         0.00
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=      51.83        40.00
     Mannings n           =      0.013        0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                               ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    0.41 | 6.083    1.50 |12.083    1.32 | 18.08    0.60
                0.167    0.41 | 6.167    1.50 |12.167    1.32 | 18.17    0.60
                0.250    0.42 | 6.250    1.64 |12.250    1.28 | 18.25    0.59
                0.333    0.42 | 6.333    1.64 |12.333    1.28 | 18.33    0.59
                0.417    0.43 | 6.417    1.81 |12.417    1.24 | 18.42    0.59
                0.500    0.43 | 6.500    1.81 |12.500    1.24 | 18.50    0.59
                0.583    0.44 | 6.583    2.02 |12.583    1.20 | 18.58    0.58
                0.667    0.44 | 6.667    2.02 |12.667    1.20 | 18.67    0.58
                0.750    0.44 | 6.750    2.30 |12.750    1.16 | 18.75    0.57
                0.833    0.44 | 6.833    2.30 |12.833    1.16 | 18.83    0.57
                0.917    0.45 | 6.917    2.68 |12.917    1.13 | 18.92    0.56
                1.000    0.45 | 7.000    2.68 |13.000    1.13 | 19.00    0.56
```

```
                1.083    0.46 | 7.083    3.21 |13.083    1.09 | 19.08    0.56
                1.167    0.46 | 7.167    3.21 |13.167    1.09 | 19.17    0.56
                1.250    0.47 | 7.250    4.05 |13.250    1.06 | 19.25    0.55
                1.333    0.47 | 7.333    4.05 |13.333    1.06 | 19.33    0.55
                1.417    0.48 | 7.417    5.53 |13.417    1.03 | 19.42    0.54
                1.500    0.48 | 7.500    5.53 |13.500    1.03 | 19.50    0.54
                1.583    0.50 | 7.583    8.89 |13.583    1.01 | 19.58    0.54
                1.667    0.50 | 7.667    8.89 |13.667    1.01 | 19.67    0.54
                1.750    0.51 | 7.750   23.90 |13.750    0.98 | 19.75    0.53
                1.833    0.51 | 7.833   23.91 |13.833    0.98 | 19.83    0.53
                1.917    0.52 | 7.917  114.21 |13.917    0.96 | 19.92    0.52
                2.000    0.52 | 8.000  114.21 |14.000    0.96 | 20.00    0.52
                2.083    0.53 | 8.083   32.36 |14.083    0.93 | 20.08    0.52
                2.167    0.53 | 8.167   32.35 |14.167    0.93 | 20.17    0.52
                2.250    0.55 | 8.250   15.80 |14.250    0.91 | 20.25    0.51
                2.333    0.55 | 8.333   15.80 |14.333    0.91 | 20.33    0.51
                2.417    0.56 | 8.417   10.34 |14.417    0.89 | 20.42    0.50
                2.500    0.56 | 8.500   10.34 |14.500    0.89 | 20.50    0.50
                2.583    0.58 | 8.583    7.68 |14.583    0.87 | 20.58    0.50
                2.667    0.58 | 8.667    7.68 |14.667    0.87 | 20.67    0.50
                2.750    0.59 | 8.750    6.11 |14.750    0.85 | 20.75    0.49
                2.833    0.59 | 8.833    6.11 |14.833    0.85 | 20.83    0.49
                2.917    0.61 | 8.917    5.09 |14.917    0.84 | 20.92    0.49
                3.000    0.61 | 9.000    5.09 |15.000    0.84 | 21.00    0.49
                3.083    0.63 | 9.083    4.37 |15.083    0.82 | 21.08    0.48
                3.167    0.63 | 9.167    4.37 |15.167    0.82 | 21.17    0.48
                3.250    0.65 | 9.250    3.83 |15.250    0.80 | 21.25    0.48
                3.333    0.65 | 9.333    3.83 |15.333    0.80 | 21.33    0.48
                3.417    0.67 | 9.417    3.42 |15.417    0.79 | 21.42    0.47
                3.500    0.67 | 9.500    3.42 |15.500    0.79 | 21.50    0.47
                3.583    0.69 | 9.583    3.09 |15.583    0.77 | 21.58    0.47
                3.667    0.69 | 9.667    3.09 |15.667    0.77 | 21.67    0.47
                3.750    0.71 | 9.750    2.82 |15.750    0.76 | 21.75    0.46
                3.833    0.71 | 9.833    2.82 |15.833    0.76 | 21.83    0.46
                3.917    0.74 | 9.917    2.60 |15.917    0.74 | 21.92    0.46
                4.000    0.74 |10.000    2.60 |16.000    0.74 | 22.00    0.46
                4.083    0.77 |10.083    2.41 |16.083    0.73 | 22.08    0.45
                4.167    0.77 |10.167    2.41 |16.167    0.73 | 22.17    0.45
                4.250    0.80 |10.250    2.25 |16.250    0.72 | 22.25    0.45
                4.333    0.80 |10.333    2.25 |16.333    0.72 | 22.33    0.45
                4.417    0.83 |10.417    2.11 |16.417    0.71 | 22.42    0.44
                4.500    0.83 |10.500    2.11 |16.500    0.71 | 22.50    0.44
                4.583    0.87 |10.583    1.99 |16.583    0.69 | 22.58    0.44
                4.667    0.87 |10.667    1.99 |16.667    0.69 | 22.67    0.44
                4.750    0.91 |10.750    1.88 |16.750    0.68 | 22.75    0.44
                4.833    0.91 |10.833    1.88 |16.833    0.68 | 22.83    0.44
                4.917    0.96 |10.917    1.78 |16.917    0.67 | 22.92    0.43
                5.000    0.96 |11.000    1.78 |17.000    0.67 | 23.00    0.43
                5.083    1.01 |11.083    1.70 |17.083    0.66 | 23.08    0.43
                5.167    1.01 |11.167    1.70 |17.167    0.66 | 23.17    0.43
                5.250    1.06 |11.250    1.62 |17.250    0.65 | 23.25    0.42
                5.333    1.06 |11.333    1.62 |17.333    0.65 | 23.33    0.42
                5.417    1.13 |11.417    1.55 |17.417    0.64 | 23.42    0.42
                5.500    1.13 |11.500    1.55 |17.500    0.64 | 23.50    0.42
                5.583    1.20 |11.583    1.49 |17.583    0.63 | 23.58    0.42
                5.667    1.20 |11.667    1.49 |17.667    0.63 | 23.67    0.42
                5.750    1.28 |11.750    1.43 |17.750    0.62 | 23.75    0.41
                5.833    1.28 |11.833    1.43 |17.833    0.62 | 23.83    0.41
                5.917    1.38 |11.917    1.37 |17.917    0.61 | 23.92    0.41
                6.000    1.38 |12.000    1.37 |18.000    0.61 | 24.00    0.41

     Max.Eff.Inten.(mm/hr)=     114.21      2263.68
               over (min)         5.00         5.00
     Storage Coeff.  (min)=       1.63 (ii)    2.79 (ii)
```

```
     Unit Hyd. Tpeak (min)=       5.00          5.00
     Unit Hyd. peak  (cms)=       0.32          0.28
                                                           *TOTALS*
     PEAK FLOW       (cms)=       0.10          0.02         0.127 (iii)
     TIME TO PEAK    (hrs)=       8.00          8.00          8.00
     RUNOFF VOLUME    (mm)=      59.87         58.64         59.62
     TOTAL RAINFALL   (mm)=      60.87         60.87         60.87
     RUNOFF COEFFICIENT   =       0.98          0.96          0.98

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  85.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------


--------------------
| ADD HYD  (  0028)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0001):     0.12   0.035     8.00    54.60
      + ID2= 2 (  0002):     0.09   0.024     8.00    52.42
        ===================================================
        ID = 3 (  0028):     0.22   0.060     8.00    53.67

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
-------------------------------------------------------------------------------


--------------------
| ADD HYD  (  0028)|
|   3 +  2 =  1    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 3 (  0028):     0.22   0.060     8.00    53.67
      + ID2= 2 (  0026):     0.02   0.005     8.00    45.39
        ===================================================
        ID = 1 (  0028):     0.23   0.065     8.00    53.01

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
-------------------------------------------------------------------------------


--------------------
| ADD HYD  (  0028)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0028):     0.23   0.065     8.00    53.01
      + ID2= 2 (  0027):     0.40   0.127     8.00    59.62
        ===================================================
        ID = 3 (  0028):     0.64   0.192     8.00    57.19

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
-------------------------------------------------------------------------------


--------------------
| ADD HYD  (  0028)|
|   3 +  2 =  1    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 3 (  0028):     0.64   0.192     8.00    57.19
      + ID2= 2 (  0003):     0.07   0.018     8.00    48.77
        ===================================================
        ID = 1 (  0028):     0.71   0.210     8.00    56.34
```

```
     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
-------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0025)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.1167      0.0112
                          0.0197     0.0036   |   0.1323      0.0134
                          0.0197     0.0036   |   0.1395      0.0146
                          0.0279     0.0038   |   0.1463      0.0157
                          0.0441     0.0045   |   0.1528      0.0168
                          0.0624     0.0056   |   0.1590      0.0179
                          0.0764     0.0067   |   0.1650      0.0190
                          0.0882     0.0078   |   0.1708      0.0202
                          0.0986     0.0090   |   0.1764      0.0213
                          0.1080     0.0101   |   0.1819      0.0224

                                AREA     QPEAK     TPEAK        R.V.
                                (ha)     (cms)     (hrs)        (mm)
   INFLOW : ID= 2 (  0028)      0.709      0.210      8.00       56.34
   OUTFLOW: ID= 1 (  0025)      0.709      0.109      8.08       56.29

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 52.05
                   TIME SHIFT OF PEAK FLOW        (min)=  5.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  0.0108

-------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0004)|   Area    (ha)=   0.09
|ID= 1 DT= 5.0 min |   Total Imp(%)=  33.00   Dir. Conn.(%)=  33.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.03          0.06
     Dep. Storage     (mm)=       1.00          1.50
     Average Slope     (%)=       1.00          2.00
     Length            (m)=      24.75         40.00
     Mannings n          =       0.013         0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                               ---- TRANSFORMED HYETOGRAPH ----
                 TIME     RAIN |  TIME     RAIN |'  TIME     RAIN |  TIME    RAIN
                  hrs    mm/hr |   hrs    mm/hr |'   hrs    mm/hr |   hrs   mm/hr
                0.083     0.41 | 6.083     1.50 |12.083     1.32 | 18.08    0.60
                0.167     0.41 | 6.167     1.50 |12.167     1.32 | 18.17    0.60
                0.250     0.42 | 6.250     1.64 |12.250     1.28 | 18.25    0.59
                0.333     0.42 | 6.333     1.64 |12.333     1.28 | 18.33    0.59
                0.417     0.43 | 6.417     1.81 |12.417     1.24 | 18.42    0.59
                0.500     0.43 | 6.500     1.81 |12.500     1.24 | 18.50    0.59
                0.583     0.44 | 6.583     2.02 |12.583     1.20 | 18.58    0.58
                0.667     0.44 | 6.667     2.02 |12.667     1.20 | 18.67    0.58
                0.750     0.44 | 6.750     2.30 |12.750     1.16 | 18.75    0.57
                0.833     0.44 | 6.833     2.30 |12.833     1.16 | 18.83    0.57
                0.917     0.45 | 6.917     2.68 |12.917     1.13 | 18.92    0.56
                1.000     0.45 | 7.000     2.68 |13.000     1.13 | 19.00    0.56
                1.083     0.46 | 7.083     3.21 |13.083     1.09 | 19.08    0.56
                1.167     0.46 | 7.167     3.21 |13.167     1.09 | 19.17    0.56
                1.250     0.47 | 7.250     4.05 |13.250     1.06 | 19.25    0.55
                1.333     0.47 | 7.333     4.05 |13.333     1.06 | 19.33    0.55
                1.417     0.48 | 7.417     5.53 |13.417     1.03 | 19.42    0.54
                1.500     0.48 | 7.500     5.53 |13.500     1.03 | 19.50    0.54
```

```
           1.583    0.50 | 7.583    8.89 |13.583    1.01 | 19.58    0.54
           1.667    0.50 | 7.667    8.89 |13.667    1.01 | 19.67    0.54
           1.750    0.51 | 7.750   23.90 |13.750    0.98 | 19.75    0.53
           1.833    0.51 | 7.833   23.91 |13.833    0.98 | 19.83    0.53
           1.917    0.52 | 7.917  114.21 |13.917    0.96 | 19.92    0.52
           2.000    0.52 | 8.000  114.21 |14.000    0.96 | 20.00    0.52
           2.083    0.53 | 8.083   32.36 |14.083    0.93 | 20.08    0.52
           2.167    0.53 | 8.167   32.35 |14.167    0.93 | 20.17    0.52
           2.250    0.55 | 8.250   15.80 |14.250    0.91 | 20.25    0.51
           2.333    0.55 | 8.333   15.80 |14.333    0.91 | 20.33    0.51
           2.417    0.56 | 8.417   10.34 |14.417    0.89 | 20.42    0.50
           2.500    0.56 | 8.500   10.34 |14.500    0.89 | 20.50    0.50
           2.583    0.58 | 8.583    7.68 |14.583    0.87 | 20.58    0.50
           2.667    0.58 | 8.667    7.68 |14.667    0.87 | 20.67    0.50
           2.750    0.59 | 8.750    6.11 |14.750    0.85 | 20.75    0.49
           2.833    0.59 | 8.833    6.11 |14.833    0.85 | 20.83    0.49
           2.917    0.61 | 8.917    5.09 |14.917    0.84 | 20.92    0.49
           3.000    0.61 | 9.000    5.09 |15.000    0.84 | 21.00    0.49
           3.083    0.63 | 9.083    4.37 |15.083    0.82 | 21.08    0.48
           3.167    0.63 | 9.167    4.37 |15.167    0.82 | 21.17    0.48
           3.250    0.65 | 9.250    3.83 |15.250    0.80 | 21.25    0.48
           3.333    0.65 | 9.333    3.83 |15.333    0.80 | 21.33    0.48
           3.417    0.67 | 9.417    3.42 |15.417    0.79 | 21.42    0.47
           3.500    0.67 | 9.500    3.42 |15.500    0.79 | 21.50    0.47
           3.583    0.69 | 9.583    3.09 |15.583    0.77 | 21.58    0.47
           3.667    0.69 | 9.667    3.09 |15.667    0.77 | 21.67    0.47
           3.750    0.71 | 9.750    2.82 |15.750    0.76 | 21.75    0.46
           3.833    0.71 | 9.833    2.82 |15.833    0.76 | 21.83    0.46
           3.917    0.74 | 9.917    2.60 |15.917    0.74 | 21.92    0.46
           4.000    0.74 |10.000    2.60 |16.000    0.74 | 22.00    0.46
           4.083    0.77 |10.083    2.41 |16.083    0.73 | 22.08    0.45
           4.167    0.77 |10.167    2.41 |16.167    0.73 | 22.17    0.45
           4.250    0.80 |10.250    2.25 |16.250    0.72 | 22.25    0.45
           4.333    0.80 |10.333    2.25 |16.333    0.72 | 22.33    0.45
           4.417    0.83 |10.417    2.11 |16.417    0.71 | 22.42    0.44
           4.500    0.83 |10.500    2.11 |16.500    0.71 | 22.50    0.44
           4.583    0.87 |10.583    1.99 |16.583    0.69 | 22.58    0.44
           4.667    0.87 |10.667    1.99 |16.667    0.69 | 22.67    0.44
           4.750    0.91 |10.750    1.88 |16.750    0.68 | 22.75    0.44
           4.833    0.91 |10.833    1.88 |16.833    0.68 | 22.83    0.44
           4.917    0.96 |10.917    1.78 |16.917    0.67 | 22.92    0.43
           5.000    0.96 |11.000    1.78 |17.000    0.67 | 23.00    0.43
           5.083    1.01 |11.083    1.70 |17.083    0.66 | 23.08    0.43
           5.167    1.01 |11.167    1.70 |17.167    0.66 | 23.17    0.43
           5.250    1.06 |11.250    1.62 |17.250    0.65 | 23.25    0.42
           5.333    1.06 |11.333    1.62 |17.333    0.65 | 23.33    0.42
           5.417    1.13 |11.417    1.55 |17.417    0.64 | 23.42    0.42
           5.500    1.13 |11.500    1.55 |17.500    0.64 | 23.50    0.42
           5.583    1.20 |11.583    1.49 |17.583    0.63 | 23.58    0.42
           5.667    1.20 |11.667    1.49 |17.667    0.63 | 23.67    0.42
           5.750    1.28 |11.750    1.43 |17.750    0.62 | 23.75    0.41
           5.833    1.28 |11.833    1.43 |17.833    0.62 | 23.83    0.41
           5.917    1.38 |11.917    1.37 |17.917    0.61 | 23.92    0.41
           6.000    1.38 |12.000    1.37 |18.000    0.61 | 24.00    0.41

Max.Eff.Inten.(mm/hr)=     114.21        54.30
           over (min)        5.00        15.00
Storage Coeff.  (min)=       1.05 (ii)   10.06 (ii)
Unit Hyd. Tpeak (min)=       5.00        15.00
Unit Hyd. peak  (cms)=       0.34         0.10
                                                      *TOTALS*
PEAK FLOW       (cms)=       0.01         0.01          0.013 (iii)
TIME TO PEAK    (hrs)=       8.00         8.17           8.00
RUNOFF VOLUME    (mm)=      59.87        30.62          39.40
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     TOTAL RAINFALL   (mm)=      60.87         60.87            60.87
     RUNOFF COEFFICIENT   =       0.98          0.50             0.65

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
             CN*  =  82.0    Ia = Dep. Storage  (Above)
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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--------------------
| ADD HYD  (  0024)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0025):     0.71   0.109     8.08    56.29
      + ID2= 2 (  0004):     0.09   0.013     8.00    39.40
        ==================================================
        ID = 3 (  0024):     0.80   0.117     8.08    54.35

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
-------------------------------------------------------------------------------
```

SANITARY SEWER DESIGN SHEET

BRONTE GREEN BLK C (CAIVAN)

REGIONAL MUNICIPALITY OF HALTON

PROJECT DETAILS

Project No: 21-696
Date: 13-May-22
Designed by: DY
Checked by: JO

DESIGN CRITERIA

Min Diameter = 200 mm
Mannings 'n'= 0.013
Min. Velocity = 0.6 m/s
Max. Velocity = 3.0 m/s
Factor of Safety = 15 %
Avg. Domestic Flow = 275.0 l/c/d
Infiltration = 0.286 l/s/ha
Max. Peaking Factor = 4.50
Min. Peaking Factor= 2.00

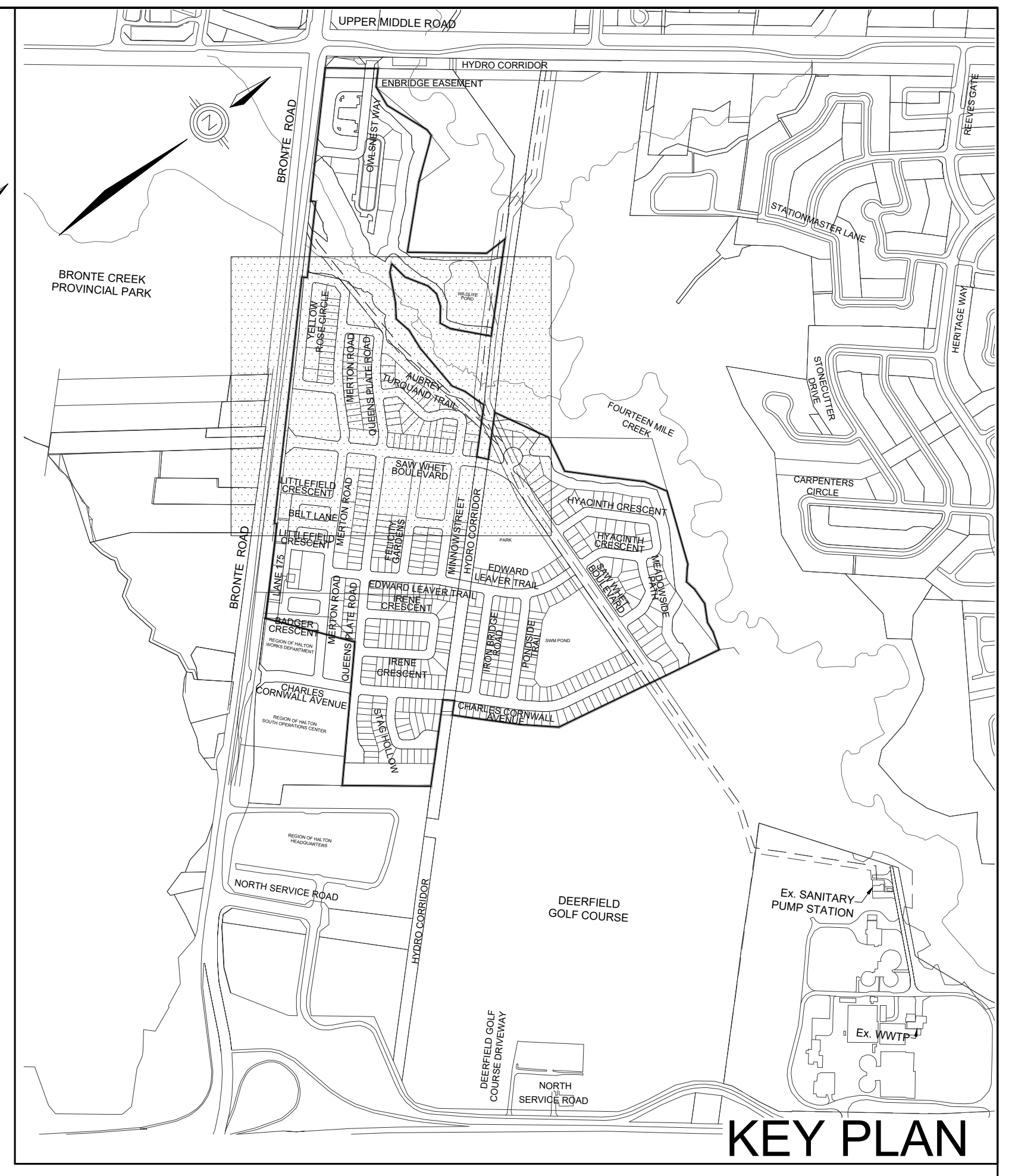
NOMINAL PIPE SIZE USED

			RESIDENTIAL							COMMERCIAL/INDUSTRIAL/INSTITUTIONAL						FLOW CALCULATIONS							PIPE DATA					
STREET	FROM MH	TO MH	AREA (ha)	ACC. AREA (ha)	UNITS (#)	DENISTY (P/ha)	DENSITY (P/unit)	POP	ACCUM. RES. POP.	AREA (ha)	ACC. AREA (ha)	EQUIV. POP. (p/ha)	FLOW RATE (l/s/ha)	EQUIV. POP.	ACCUM. EQUIV. POP.	INFILTRATION (l/s)	TOTAL ACCUM. POP.	PEAKING FACTOR	RES. FLOW (l/s)	COMM. FLOW (l/s)	ACCUM. COMM. FLOW (l/s)	TOTAL FLOW (l/s)	SLOPE (%)	PIPE DIAMETER (mm)	FULL FLOW CAPACITY (l/s)	FULL FLOW VELOCITY (m/s)	ACTUAL VELOCITY (m/s)	PERCENT FULL (%)
BLOCK 451	BLDG	CTRL MH1A			333		1.578	526	526								526	3.96	6.6			6.6	1.00	200	32.8	1.0	0.8	20%
	CTRL MH1A	MH10A							526								526	3.96	6.6			6.6	1.11	200	34.6	1.1	0.8	19%

BLOCK 474/501/502/503/504 POTENTIAL FUTURE RESIDENTIAL OPTION
SCALE: 1:1000

LEGEND

0.82Ha	AREA IN HECTARES
135	POPULATION DENSITY (PERSONS PER HECTARE)
111	POPULATION
0.82Ha	EXTERNAL AREA IN HECTARES
135	EXTERNAL POPULATION DENSITY (PERSONS PER HECTARE)
111	EXTERNAL POPULATION
⅂⎸	SANITARY SINGLE HOUSE CONNECTION
▬ ▬ ▬	SANITARY SEWER TRIBUTARY BOUNDARY
▬ ▬ ▬	SANITARY TRIBUTARY SUB-CATCHMENT BOUNDARY
▬	PHASE LINE
▨	NOT PART OF THIS APPROVAL APPLICATION



KEY PLAN

TOPOGRAPHIC INFORMATION

TOPOGRAPHIC INFORMATION PROVIDED BY J.D. BARNES LTD., PROJECT No. 12–30–371–02–TOPO–COMBINED, TOPOGRAPHIC SURVEY DATED MAY 25, 2017.

LEGAL INFORMATION

CALCULATED M–PLAN PROVIDED BY J.D. BARNES LTD.,
PROJECT No. 12–30–371–00, SURVEY DATED NOVEMBER 29, 2018.
CALCULATED R–PLAN PROVIDED BY J.D. BARNES LTD.,
PROJECT No. 12–30–371–09, SURVEY DATED AUGUST 09, 2017,
PROJECT No. 12–30–371–09–RPLAN, SURVEY DATED SEPTEMBER 14, 2017,
PROJECT No. 12–30–371–11, SURVEY DATED JANUARY 2, 2018.
PROJECT No. 12–30–371–11–D, SURVEY DATED DECEMBER 04, 2018.
PROJECT No. 12–30–371–11–F, SURVEY DATED APRIL 29, 2019.

AS-CONSTRUCTED

BENCHMARK No. 101 ELEVATION = 115.838m

ELEVATIONS SHOWN ON THIS PLAN ARE RELATED TO GEODETIC DATUM AND ARE DERIVED FROM THE TOWN OF OAKVILLE BENCHMARK No. 101, HAVING A PUBLISHED ELEVATION OF 115.838 METRES.

No.	DATE	BY	REVISIONS	APPROVED
12.	20–08–21	T.M.	AS–CONSTRUCTED SUBMISSION (UNDERGROUNDS ONLY)	
11.	19–06–21	W.L.	MOE SUBMISSION 2 AMENDMENT	
10.	19–03–29	W.L.	3rd RESUBMISSION TO CH	
9.	19–03–13	W.L.	MOE SUBMISSION 2	
8.	19–02–12	W.L.	4th SUBMISSION TO REGION	
7.	18–11–19	W.L.	3rd RESUBMISSION FOR SIGNATURE	
6.	18–11–06	W.L.	3rd RESUBMISSION TO REGION	
5.	18–10–09	W.L.	3rd SUBMISSION TO REGION	
4.	18–09–12	W.L.	MOE SUBMISSION	
3.	18–06–29	W.L.	3rd SUBMISSION TO TOWN	
2.	18–03–23	W.L.	2nd SUBMISSION	

DESIGNED BY:	C.M./K.M.	CHECKED BY:	W.L.
DRAWN BY:	D.A.	CHECKED BY:	W.L.

DATE
JUNE 2017

SCALE
HORIZ. 1:1000 0 10 20 30 40

REFERENCES

APPROVALS

FIELD NOTES

MUNICIPAL APPROVAL

APPROVED IN PRINCIPLE SUBJECT TO DETAIL CONSTRUCTION CONFORMING TO TOWN OF OAKVILLE STANDARDS AND SPECIFICATIONS

MANAGER OF DEVELOPMENT ENGINEERING DATE

BELL	☐	HYDRO	☐
GAS	☐	CABLE	☐
TRAFFIC	☐	WATER	☐

STAMP

ORIGINALLY SIGNED BY
WILL LIU, P.ENG
DATED SEPTEMBER 30,
2019

DSEL
david schaeffer engineering ltd

600 Alden Road, Suite 500
Markham, Ontario, L3R 0E7
Tel. (905) 475-3080
Fax. (905) 475-3081
www.DSEL.ca

MUNICIPALITY
OAKVILLE
DEVELOPMENT ENGINEERING

REGION
Halton REGION
The Regional
Municipality
of Halton

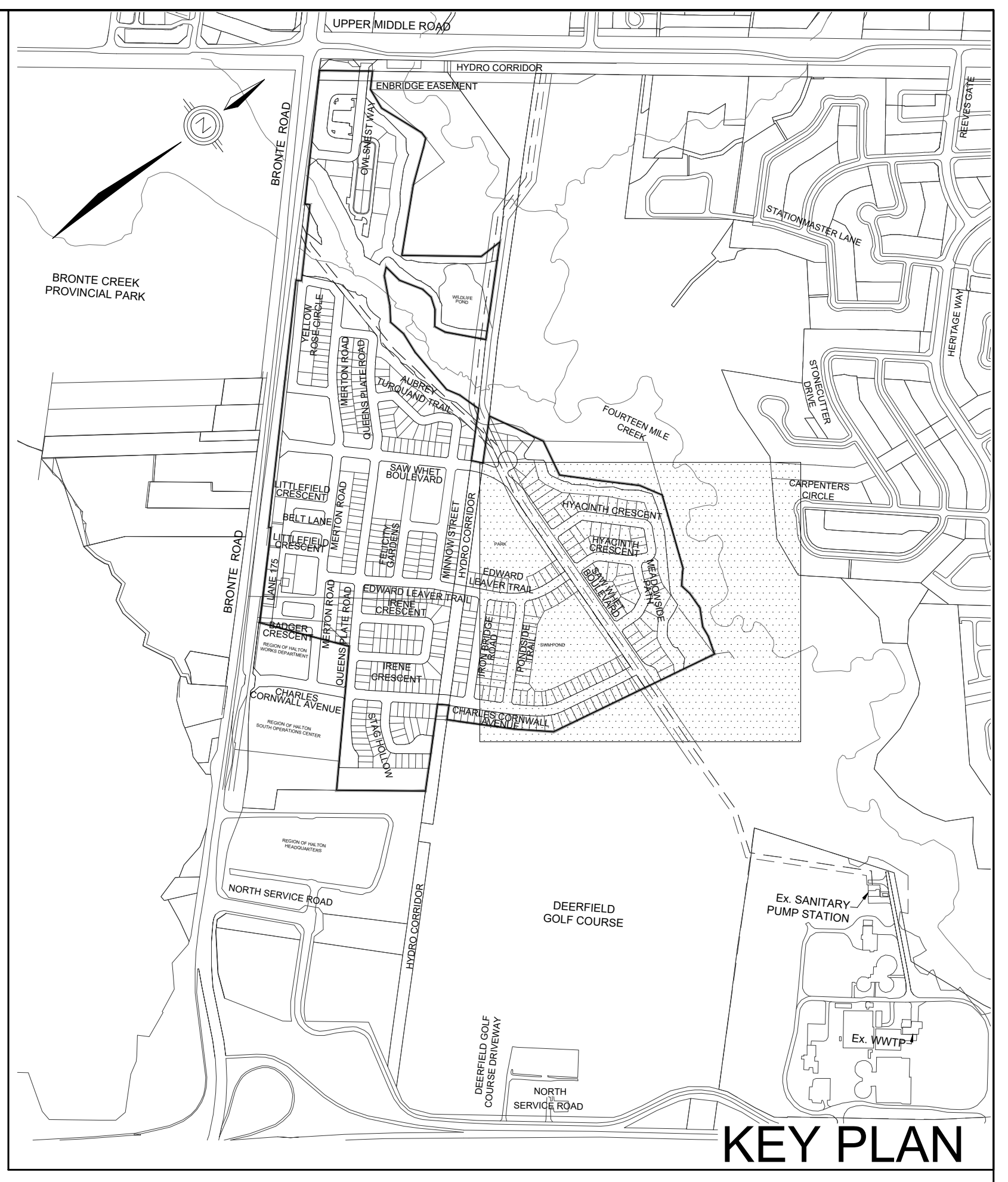
DEVELOPER
BRONTE GREEN CORPORATION

PROJECT
BRONTE GREEN SUBDIVISION
24T–14004

TITLE

SANITARY DRAINAGE PLAN

MUNICIPAL FILE NO. SD–XXX.X	REGIONAL FILE NO. DO–1040
PROJECT NO. 12–601	SHEET 27 OF 145



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5.	18–10–09	W.L.	3rd SUBMISSION TO REGION	
4.	18–09–12	W.L.	MOE SUBMISSION	
3.	18–06–29	W.L.	3rd SUBMISSION TO TOWN	
2.	18–03–23	W.L.	2nd SUBMISSION	

DESIGNED BY:	C.M./K.M.	CHECKED BY:	W.L.
DRAWN BY:	D.A.	CHECKED BY:	W.L.

DATE
JUNE 2017

SCALE
HORIZ. 1:1000 0 10 20 30 40

REFERENCES

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MUNICIPAL APPROVAL

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MANAGER OF DEVELOPMENT ENGINEERING DATE

FIELD NOTES

BELL	☐	HYDRO	☐
GAS	☐	CABLE	☐
TRAFFIC	☐	WATER	☐

STAMP

ORIGINALLY SIGNED BY
WILL LIU, P.ENG
DATED SEPTEMBER 30, 2019

DSEL
david schaeffer engineering ltd

600 Alden Road, Suite 500
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MUNICIPALITY
OAKVILLE
DEVELOPMENT ENGINEERING

REGION
Halton REGION
The Regional Municipality of Halton

DEVELOPER
BRONTE GREEN CORPORATION

PROJECT
BRONTE GREEN SUBDIVISION
24T–14004

TITLE
SANITARY DRAINAGE PLAN

MUNICIPAL FILE No. SD–XXX.X
REGIONAL FILE No. DO–1040
PROJECT No. 12–601
SHEET 29 OF 145

DAVID SCHAEFFER ENGINEERING LTD.
600 ALDEN ROAD, SUITE 500
MARKHAM, ONTARIO
L3R 0E7
TEL: (905) 475-3080
FAX: (905) 475-3081

Note: To be conservative, industrial K_{av} is considered to be 1

THE REGIONAL MUNICIPALITY OF HALTON

SANITARY SEWER DESIGN

BRONTE GREEN

Single Family: 55 pph
Semi-detached: 100 pph
Townhouse: 135 pph
Commercial: 90 pph
Community Services 40 pph
n (PVC): 0.010
n (Conc): 0.013
Infil.Flow (INF): 0.286 L/s/ha

SHEET No.: 1 OF 5
LOCATION: BRONTE GREEN
PROJECT No.: 12-601
DATE: FEBRUARY, 2020
DESIGNED BY: K.M.
CHECKED BY: W.L.
AS-BUILT BY: K.P.
CHECKED BY: D.P.

STREET	MANHOLE		LENGTH	TRIBUTARY AREA HECTARE							TOTAL	POPULATION TRIBUTARY						TOTAL	AVG.	AVG.	PEAKING	MAX	INF.	MAX	SEWER					PIPE		REMARKS
				INCREMENT								INCREMENT							m^3/s	m^3/s				FLOW			Q	VEL (m/s)				
	FROM	TO	(m)	SINGLE F.	SEMI.	TOWNHOUSE	CONDO	COMMERC	COMM. SERV.	INFILT		SINGLE F.	SEMI.	TOWNHOUSE	CONDO	COMMERC	COMM. SERV.		INC.	TOTAL	FACTOR	m^3/s	m^3/s	EXP.	SIZE	SLOPE	m^3/s	FULL	ACT.	TYPE	CLASS	
OWL SNEST WAY																																
Contribution From BLOCK 444 (RESIDENTIAL CONDO), Pipe CONTROL MH 7A - 201A			10.0				1.15				1.15				490			490	0.0016	0.0016	3.98	0.0062	0.0003	0.0065	200	1.10	0.045	1.42	1.01	PVC	SDR-35	
Contribution From BLOCK 445 (RESIDENTIAL CONDO), Pipe CONTROL MH 8A - 201A			11.1			1.32					1.32			179				179	0.0006	0.0006	4.17	0.0024	0.0004	0.0028	200	0.99	0.042	1.35	0.75	PVC	SDR-36	
	201A	202A	31.2			0.08				0.21	2.76			11				680	0.0000	0.0022	3.90	0.0084	0.0008	0.0092	200	0.42	0.028	0.88	0.79	PVC	SDR-35	
	202A	203A	12.1							0.02	2.78							680	0.0000	0.0022	3.90	0.0084	0.0008	0.0092	200	0.58	0.032	1.03	0.88	PVC	SDR-35	
Contribution From BLOCK 445 (RESIDENTIAL CONDO), Pipe CONTROL MH 9A - 203A			12.3			0.41					0.41			56				56	0.0002	0.0002	4.30	0.0008	0.0001	0.0009	200	0.57	0.032	1.02	0.44	PVC	SDR-36	
	203A	204A	79.5			0.32					3.51			44				780	0.0001	0.0025	3.87	0.0096	0.0010	0.0106	200	0.40	0.027	0.86	0.81	PVC	SDR-35	
	204A	Ex. Trunk	8.0								3.51							780	0.0000	0.0025	3.87	0.0096	0.0010	0.0106	200	1.00	0.043	1.36	1.12	PVC	SDR-36	
To EXISTING SANITARY TRUNK, Ex. MH 4 - Ex. MH 3											3.51							780														
YELLOW ROSE CIRCLE																																
	1A	2A	83.7			0.45					0.45			61				61	0.0002	0.0002	4.30	0.0008	0.0001	0.0010	200	1.00	0.043	1.36	0.54	PVC	SDR-35	
	2A	3A	102.8			0.48					0.93			65				126	0.0002	0.0004	4.21	0.0017	0.0003	0.0020	200	0.55	0.032	1.01	0.55	PVC	SDR-35	
Contribution From External, Pipe PLUG - 3A			15.5	3.10		1.07	1.88		0.34		6.39	171		145	812		14	1142	0.0036	0.0036	3.76	0.0137	0.0018	0.0155	200	0.32	0.024	0.77	0.81	PVC	SDR-35	
	3A	9A	78.2							0.12	7.44							1268	0.0000	0.0040	3.73	0.0151	0.0021	0.0172	200	0.36	0.026	0.81	0.87	PVC	SDR-35	
To MERTON ROAD , Pipe 9A - 10A											7.44							1268														
QUEENS PLATE ROAD																																
Contribution from BLOCK 484 (URBAN SQUARE)										0.19	0.19							0														
	5A	7A	50.1	0.33							0.52	19						19	0.0001	0.0001	4.38	0.0003	0.0001	0.0004	200	1.04	0.043	1.38	0.42	PVC	SDR-35	
To MERTON ROAD , Pipe 7A - 8A											0.52							19														
	120A	12A	43.7	0.31							0.31	18						18	0.0001	0.0001	4.39	0.0003	0.0001	0.0003	200	0.98	0.042	1.34	0.39	PVC	SDR-35	
	12A	13A	102.5	0.74							1.05	41						59	0.0001	0.0002	4.30	0.0008	0.0003	0.0011	200	0.75	0.037	1.18	0.51	PVC	SDR-35	
	13A	89A	34.7							0.05	1.10							59	0.0000	0.0002	4.30	0.0008	0.0003	0.0011	200	0.72	0.036	1.15	0.52	PVC	SDR-35	
To SAW WHET BOULEVARD, Pipe 89A - 90A											1.10							59														
	35A	36A	75.6	0.46							0.46	26						26	0.0001	0.0001	4.36	0.0004	0.0001	0.0005	200	0.89	0.040	1.28	0.43	PVC	SDR-35	
	36A	37A	85.5	0.56							1.02	31						57	0.0001	0.0002	4.30	0.0008	0.0003	0.0011	200	0.96	0.042	1.33	0.57	PVC	SDR-35	
	37A	56A	28.9	0.11							1.13	7						64	0.0000	0.0002	4.29	0.0009	0.0003	0.0012	200	1.04	0.043	1.38	0.59	PVC	SDR-35	
To EDWARD LEAVER TRAIL , Pipe 56A - 57A											1.13							64														
	71A	56A	72.1	0.41							0.41	23						23	0.0001	0.0001	4.37	0.0003	0.0001	0.0004	200	1.75	0.056	1.80	0.52	PVC	SDR-35	
To EDWARD LEAVER TRAIL , Pipe 56A - 57A											0.41							23														
Contribution From IRENE CRESCENT, Pipe 680A - 71A											0.90							51														
				0.05							0.05	3						3														
	71A	72A	72.1	0.45							1.40	25						79	0.0001	0.0003	4.27	0.0011	0.0004	0.0015	200	0.51	0.030	0.97	0.49	PVC	SDR-35	
Contribution From IRENE CRESCENT, Pipe 70A - 72A											1.18							66														
				0.16							0.16	9						9														
	72A	81A	70.3	0.27							3.01	15						169	0.0000	0.0005	4.17	0.0022	0.0009	0.0031	200	1.91	0.059	1.88	0.99	PVC	SDR-35	
To CHARLES CORNWALL AVENUE , Pipe 81A - 82A											3.01							169														
Contribution From BLOCK 500 (OPEN SPACE)									0.73		0.73						30	30														
	73A	74A	85.6	0.45							1.18	25						55	0.0001	0.0002	4.31	0.0008	0.0003	0.0011	200	1.02	0.043	1.37	0.57	PVC	SDR-35	
	74A	81A	58.6	0.23							1.41	13						68	0.0000	0.0002	4.29	0.0009	0.0004	0.0013	200	0.70	0.036	1.14	0.54	PVC	SDR-35	
To CHARLES CORNWALL AVENUE , Pipe 81A - 82A											1.41							68														
MERTON ROAD																																
	6A	7A	56.5	0.48							0.48	27						27	0.0001	0.0001	4.36	0.0004	0.0001	0.0005	200	1.70	0.056	1.77	0.54	PVC	SDR-35	
Contribution From QUEENS PLATE ROAD , Pipe 5A - 7A											0.52							19														
	7A	8A	69.1	0.35							1.35	20						66	0.0001	0.0002	4.29	0.0009	0.0004	0.0013	200	0.30	0.023	0.74	0.39	PVC	SDR-35	
	8A	9A	47.6	0.37							1.72	21						87	0.0001	0.0003	4.26	0.0012	0.0005	0.0017	200	0.36	0.026	0.81	0.45	PVC	SDR-35	
Contribution From YELLOW ROSE CIRCLE, Pipe 3A - 9A											7.44							1268														
	9A	10A	63.2	0.27							9.43	15						1370	0.0000	0.0044	3.71	0.0162	0.0027	0.0189	200	0.35	0.025	0.80	0.88	PVC	SDR-36	

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Note: To be conservative, industrial K_{av} is considered to be 1

THE REGIONAL MUNICIPALITY OF HALTON

SANITARY SEWER DESIGN

BRONTE GREEN

Single Family: 55 pph
Semi-detached: 100 pph
Townhouse: 135 pph
Commercial: 90 pph
Community Services 40 pph
n (PVC): 0.010
n (Conc): 0.013
Infil.Flow (INF): 0.286 L/s/ha

SHEET No.: 2 OF 5
LOCATION: BRONTE GREEN
PROJECT No.: 12-601
DATE: FEBRUARY, 2020
DESIGNED BY: K.M.
CHECKED BY: W.L.
AS-BUILT BY: K.P.
CHECKED BY: D.P.

STREET	MANHOLE		LENGTH	TRIBUTARY AREA HECTARE							TOTAL	POPULATION TRIBUTARY						TOTAL	AVG.	AVG.	PEAKING	MAX	INF.	MAX	SEWER					PIPE		REMARKS
				INCREMENT								INCREMENT							m^3/s	m^3/s				FLOW			Q	VEL (m/s)				
	FROM	TO	(m)	SINGLE F.	SEMI.	TOWNHOUSE	CONDO	COMMERC	COMM. SERV.	INFILT		SINGLE F.	SEMI.	TOWNHOUSE	CONDO	COMMERC	COMM. SERV.		INC.	TOTAL	FACTOR	m^3/s	m^3/s	EXP.	SIZE	SLOPE	m^3/s	FULL	ACT.	TYPE	CLASS	
Contribution from BLOCK 451 (RESIDENTIAL CONDO), Pipe CONTROL MH 1A - 10A			11.7				0.85				0.85				400			400	0.0013	0.0013	4.02	0.0051	0.0002	0.0054	200	1.11	0.045	1.43	0.95	PVC	SDR-35	
	10A	11A	20.4	0.08							10.36	5						1775	0.0000	0.0056	3.63	0.0205	0.0030	0.0235	250	0.44	0.051	1.04	1.02	PVC	SDR-35	
	11A	88A	27.4							0.04	10.40							1775	0.0000	0.0056	3.63	0.0205	0.0030	0.0235	250	0.51	0.055	1.12	1.08	PVC	SDR-35	
To SAW WHET BOULEVARD, Pipe 88A - 89A											10.40							1775														
Contribution From BADGER CRESCENT, Pipe 45A - 49A											0.24							33														
	49A	50A	44.4			0.20					0.44			27				60	0.0001	0.0002	4.30	0.0008	0.0001	0.0009	200	1.42	0.051	1.62	0.61	PVC	SDR-35	
Contribution From BADGER CRESCENT, Pipe 48A - 50A											0.82							111														
	50A	55A	46.5			0.19					1.45			26				197	0.0001	0.0006	4.15	0.0026	0.0004	0.0030	200	1.53	0.053	1.68	0.90	PVC	SDR-35	
To EDWARD LEAVER TRAIL, Pipe 55A - 56A											1.45							197														
	52A	51A	66.4			0.28					0.28			38				38	0.0001	0.0001	4.34	0.0005	0.0001	0.0006	200	2.35	0.065	2.08	0.63	PVC	SDR-35	
Contribution From BLOCK 452 (RESIDENTIAL CONDO), Pipe CONTROL MH 2A - 51A			11.0				0.91				0.91				494			494	0.0016	0.0016	3.98	0.0063	0.0003	0.0065	200	1.73	0.056	1.79	1.19	PVC	SDR-35	
	51A	88A	44.9							0.07	1.26							532	0.0000	0.0017	3.96	0.0067	0.0004	0.0071	200	2.90	0.073	2.31	1.46	PVC	SDR-35	
To SAW WHET BOULEVARD, Pipe 88A - 89A											1.26							532														
Contribution From LITTLEFIELD CRESCENT, Pipe 40A - 52A											0.26							36														
	52A	53A	43.5			0.20					0.46			27				63	0.0001	0.0002	4.29	0.0009	0.0001	0.0010	200	1.79	0.057	1.82	0.68	PVC	SDR-35	
Contribution From BELT LANE, Pipe 44A - 53A											0.26							36														
	53A	54A	43.9			0.20					0.92			27				126	0.0001	0.0004	4.21	0.0017	0.0003	0.0020	200	1.03	0.043	1.38	0.68	PVC	SDR-35	
Contribution From LITTLEFIELD CRESCENT, Pipe 43A - 54A											0.54							71														
	54A	55A	42.9			0.15					1.61			21				218	0.0001	0.0007	4.13	0.0029	0.0005	0.0033	200	1.61	0.054	1.72	0.94	PVC	SDR-35	
To EDWARD LEAVER TRAIL, Pipe 55A - 56A											1.61							218														
						0.22					0.22			30				30														
	FUT 100A	FUT 80A	100.0			0.09				0.15	0.46			13				43	0.0000	0.0001	4.33	0.0006	0.0001	0.0007	200	3.50	0.080	2.54	0.77	PVC	SDR-35	
To CHARLES CORNWALL AVENUE, Pipe 80A - 81A											0.46							43														
AUBREY TURQUAND TRAIL																																
	14A	16A	73.3	0.68							0.68	38						38	0.0001	0.0001	4.34	0.0005	0.0002	0.0007	200	0.95	0.042	1.32	0.50	PVC	SDR-35	
	16A	17A	35.2	0.2							0.88	11						49	0.0000	0.0002	4.32	0.0007	0.0003	0.0009	200	0.43	0.028	0.89	0.40	PVC	SDR-35	
	17A	18A	24.3							0.05	0.93							49	0.0000	0.0002	4.32	0.0007	0.0003	0.0009	200	0.41	0.027	0.87	0.40	PVC	SDR-35	
	18A	19A	14.8							0.03	0.96							49	0.0000	0.0002	4.32	0.0007	0.0003	0.0009	200	0.34	0.025	0.79	0.37	PVC	SDR-35	
	19A	90A	73.5	0.31							1.27	18						67	0.0001	0.0002	4.29	0.0009	0.0004	0.0013	200	0.39	0.027	0.85	0.43	PVC	SDR-35	
To SAW WHET BOULEVARD , Pipe 90A - 91A											1.27							67														
HYACINTH CRESCENT																																
	21A	22A	104.5	0.76							0.76	42						42	0.0001	0.0001	4.33	0.0006	0.0002	0.0008	200	0.97	0.042	1.34	0.52	PVC	SDR-35	
	22A	94A	69.4	0.44							1.20	25						67	0.0001	0.0002	4.29	0.0009	0.0003	0.0013	200	0.74	0.037	1.17	0.54	PVC	SDR-35	
To SAW WHET BOULEVARD, Pipe 94A - 95A											1.20							67														
	23A	24A	35.3	0.25							0.25	14						14	0.0000	0.0000	4.40	0.0002	0.0001	0.0003	200	1.05	0.044	1.39	0.38	PVC	SDR-35	
	24A	25A	13.7							0.02	0.27							14	0.0000	0.0000	4.40	0.0002	0.0001	0.0003	200	0.95	0.042	1.32	0.36	PVC	SDR-35	
	25A	26A	34.4							0.07	0.34							14	0.0000	0.0000	4.40	0.0002	0.0001	0.0003	200	0.90	0.040	1.29	0.37	PVC	SDR-35	
	26A	27A	67.2	0.42							0.76	24						38	0.0001	0.0001	4.34	0.0005	0.0002	0.0007	200	0.94	0.041	1.32	0.49	PVC	SDR-35	
	27A	95A	47.0	0.17							0.93	10						48	0.0000	0.0002	4.32	0.0007	0.0003	0.0009	200	0.85	0.039	1.25	0.52	PVC	SDR-35	
To SAW WHET BOULEVARD , Pipe 95A - 96A											0.93							48														
MEADOWSIDE PATH																																
	28A	29A	50.4	0.45							0.45	25						25	0.0001	0.0001	4.37	0.0003	0.0001	0.0005	200	1.05	0.044	1.39	0.44	PVC	SDR-35	
	29A	30A	36.8	0.34							0.79	19						44	0.0001	0.0001	4.33	0.0006	0.0002	0.0008	200	0.43	0.028	0.89	0.39	PVC	SDR-26	
	30A	96A	51.1	0.24							1.03	14						58	0.0000	0.0002	4.30	0.0008	0.0003	0.0011	200	0.35	0.025	0.80	0.40	PVC	SDR-26	
To SAW WHET BOULEVARD, Pipe 96A - 98A											1.03							58														
MINNOW STREET																																
	32A	58A	117.2	0.78					1.86		2.64	43					75	118	0.0004	0.0004	4.22	0.0016	0.0008	0.0023	200	0.38	0.026	0.84	0.51	PVC	SDR-35	
To EDWARD LEAVER TRAIL , Pipe 58A - 59A											2.64							118														

DAVID SCHAEFFER ENGINEERING LTD.
600 ALDEN ROAD, SUITE 500
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TEL: (905) 475-3080
FAX: (905) 475-3081

Note: To be conservative, industrial K_{av} is considered to be 1

THE REGIONAL MUNICIPALITY OF HALTON

SANITARY SEWER DESIGN

BRONTE GREEN

Commercial: 55 pph
Community Services 100 pph
0 135 pph
Infil.Flow (INF): 90 pph
0 40 pph
n (PVC): 0.010
n (Conc): 0.013
Infil.Flow (INF): 0.286 L/s/ha

SHEET No.: 3 OF 5
LOCATION: BRONTE GREEN
PROJECT No.: 12-601
DATE: FEBRUARY, 2020
DESIGNED BY: K.M.
CHECKED BY: W.L.
AS-BUILT BY: K.P.
CHECKED BY: D.P.

STREET	MANHOLE		LENGTH	TRIBUTARY AREA HECTARE							TOTAL	POPULATION TRIBUTARY						TOTAL	AVG.	AVG.	PEAKING	MAX	INF.	MAX	SEWER					PIPE		REMARKS
				INCREMENT								INCREMENT							m^3/s	m^3/s				FLOW			Q	VEL (m/s)				
	FROM	TO	(m)	SINGLE F.	SEMI.	TOWNHOUSE	CONDO	COMMERC	COMM. SERV.	INFILT		SINGLE F.	SEMI.	TOWNHOUSE	CONDO	COMMERC	COMM. SERV.		INC.	TOTAL	FACTOR	m^3/s	m^3/s	EXP.	SIZE	SLOPE	m^3/s	FULL	ACT.	TYPE	CLASS	
FELICITY GARDENS																																
	34A	340A	55.9	0.45							0.45	25						25	0.0001	0.0001	4.37	0.0003	0.0001	0.0005	200	1.02	0.043	1.37	0.44	PVC	SDR-35	
	340A	57A	59.8	0.26							0.71	15						40	0.0000	0.0001	4.33	0.0006	0.0002	0.0008	200	0.40	0.027	0.86	0.37	PVC	SDR-35	
To EDWARD LEAVER TRAIL , Pipe 57A - 58A											0.71							40														
LANE 175																																
	39A	38A	78.8			0.43					0.43			59				59	0.0002	0.0002	4.30	0.0008	0.0001	0.0009	200	0.98	0.042	1.34	0.54	PVC	SDR-35	
	38A	48A	11.9			0.04					0.47			6				65	0.0000	0.0002	4.29	0.0009	0.0001	0.0010	200	0.84	0.039	1.24	0.53	PVC	SDR-35	
To BADGER CRESCENT , Pipe 48A - 50A											0.47							65														
LITTLEFIELD CRESCENT																																
	41A	40A	12.3			0.07					0.07			10				10	0.0000	0.0000	4.41	0.0001	0.0000	0.0002	200	0.73	0.036	1.16	0.28	PVC	SDR-35	
	40A	52A	69.0			0.19					0.26			26				36	0.0001	0.0001	4.34	0.0005	0.0001	0.0006	200	0.70	0.036	1.14	0.41	PVC	SDR-35	
To MERTON ROAD, Pipe 52A - 53A											0.26							36														
	41A	42A	72.2			0.33					0.33			45				45	0.0001	0.0001	4.32	0.0006	0.0001	0.0007	200	0.97	0.042	1.34	0.50	PVC	SDR-35	
	42A	43A	10.6							0.02	0.35							45	0.0000	0.0001	4.32	0.0006	0.0001	0.0007	200	2.93	0.073	2.32	0.74	PVC	SDR-35	
	43A	54A	66.5			0.19					0.54			26				71	0.0001	0.0002	4.28	0.0010	0.0002	0.0011	200	1.29	0.048	1.54	0.64	PVC	SDR-35	
To MERTON ROAD, Pipe 54A - 55A											0.54							71														
BELT LANE																																
	44A	53A	58.8			0.26					0.26			36				36	0.0001	0.0001	4.34	0.0005	0.0001	0.0006	200	1.87	0.058	1.86	0.59	PVC	SDR-35	
To MERTON ROAD, Pipe 53A - 54A											0.26							36														
BADGER CRESCENT																																
	46A	45A	11.1			0.05					0.05			7				7	0.0000	0.0000	4.43	0.0001	0.0000	0.0001	200	1.35	0.050	1.58	0.32	PVC	SDR-35	
	45A	49A	69.8			0.19					0.24			26				33	0.0001	0.0001	4.35	0.0005	0.0001	0.0005	200	1.36	0.050	1.58	0.51	PVC	SDR-35	
To MERTON ROAD, Pipe 49A - 50A											0.24							33														
	46A	47A	28.9			0.14					0.14			19				19	0.0001	0.0001	4.38	0.0003	0.0000	0.0003	200	2.42	0.066	2.11	0.51	PVC	SDR-35	
	47A	48A	11.0							0.01	0.15							19	0.0000	0.0001	4.38	0.0003	0.0000	0.0003	200	2.55	0.068	2.17	0.52	PVC	SDR-35	
Contribution From LANE 175, Pipe 38A - 48A											0.47							65														
	48A	50A	69.6			0.20					0.82			27				111	0.0001	0.0004	4.23	0.0015	0.0002	0.0017	200	1.05	0.044	1.39	0.67	PVC	SDR-35	
To MERTON ROAD, Pipe 50A - 55A											0.82							111														
IRENE CRESCENT	67A	68A	12.9	0.17							0.17	10						10	0.0000	0.0000	4.41	0.0001	0.0000	0.0002	200	1.09	0.045	1.42	0.34	PVC	SDR-35	
	68A	680A	38.1	0.26							0.43	15						25	0.0000	0.0001	4.37	0.0003	0.0001	0.0005	200	0.94	0.041	1.32	0.42	PVC	SDR-35	
	680A	71A	92.2	0.47							0.90	26						51	0.0001	0.0002	4.31	0.0007	0.0003	0.0010	200	0.53	0.031	0.99	0.44	PVC	SDR-35	
To QUEENS PLATE ROAD , Pipe 71A - 72A											0.90							51														
	67A	69A	55.9	0.27							0.27	15						15	0.0000	0.0000	4.40	0.0002	0.0001	0.0003	200	0.81	0.038	1.22	0.35	PVC	SDR-35	
	69A	70A	12.1	0.17							0.44	10						25	0.0000	0.0001	4.37	0.0003	0.0001	0.0005	200	0.74	0.037	1.17	0.39	PVC	SDR-35	
	70A	72A	127.4	0.74							1.18	41						66	0.0001	0.0002	4.29	0.0009	0.0003	0.0012	200	0.53	0.031	0.99	0.48	PVC	SDR-35	
To QUEENS PLATE ROAD , Pipe 72A - 81A											1.18							66														
PONDSIDE TRAIL	64A	65A	75.5	0.64							0.64	36						36	0.0001	0.0001	4.34	0.0005	0.0002	0.0007	200	1.07	0.044	1.40	0.51	PVC	SDR-26	
	65A	61A	86.8	0.40							1.04	22						58	0.0001	0.0002	4.30	0.0008	0.0003	0.0011	200	0.39	0.027	0.85	0.41	PVC	SDR-26	
To EDWARD LEAVER TRAIL , Pipe 61A - 62A											1.04							58														
IRON BRIDGE ROAD																																
	660A	66A	62.7	0.54							0.54	30						30	0.0001	0.0001	4.35	0.0004	0.0002	0.0006	200	1.10	0.045	1.42	0.48	PVC	SDR-35	
	66A	59A	98.6	0.47							1.01	26						56	0.0001	0.0002	4.30	0.0008	0.0003	0.0011	200	0.41	0.027	0.87	0.41	PVC	SDR-35	
To EDWARD LEAVER TRAIL , Pipe 59A - 60A											1.01							56														

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Note: To be conservative, industrial K_{av} is considered to be 1

THE REGIONAL MUNICIPALITY OF HALTON

SANITARY SEWER DESIGN

BRONTE GREEN

0.010612 55 pph
0.010612 100 pph
0 135 pph
0 90 pph
0 40 pph
n (PVC): 0.010
n (Conc): 0.013
Infil.Flow (INF): 0.286 L/s/ha

SHEET No.: 4 OF 5
LOCATION: BRONTE GREEN
PROJECT No.: 12-601
DATE: FEBRUARY, 2020
DESIGNED BY: K.M.
CHECKED BY: W.L.
AS-BUILT BY: K.P.
CHECKED BY: D.P.

STREET	MANHOLE		LENGTH	TRIBUTARY AREA HECTARE							TOTAL	POPULATION TRIBUTARY						TOTAL	AVG.	AVG.	PEAKING	MAX	INF.	MAX	SEWER					PIPE		REMARKS
				INCREMENT								INCREMENT							m^3/s	m^3/s				FLOW			Q	VEL (m/s)				
	FROM	TO	(m)	SINGLE F.	SEMI.	TOWNHOUSE	CONDO	COMMERC	COMM. SERV.	INFILT		SINGLE F.	SEMI.	TOWNHOUSE	CONDO	COMMERC	COMM. SERV.		INC.	TOTAL	FACTOR	m^3/s	m^3/s	EXP.	SIZE	SLOPE	m^3/s	FULL	ACT.	TYPE	CLASS	
EDWARD LEAVER TRAIL																																
Contribution From MERTON ROAD , Pipe 54A - 55A											1.61							218														
Contribution From MERTON ROAD , Pipe 50A - 55A											1.45							197														
Contribution From BLOCK 475 (URBAN SQUARE)										0.31	0.31							0														
	55A	56A	72.3							0.10	3.47							415	0.0000	0.0013	4.01	0.0053	0.0010	0.0063	200	3.18	0.076	2.42	1.44	PVC	SDR-35	
Contribution From QUEENS PLATE ROAD , Pipe 37A - 56A											1.13							64														
Contribution From QUEENS PLATE ROAD , Pipe 71A - 56A											0.41							23														
	56A	57A	69.1	0.32							5.33	18						520	0.0001	0.0017	3.97	0.0066	0.0015	0.0081	200	0.32	0.024	0.77	0.69	PVC	SDR-35	
Contribution From FELICITY GARDENS, Pipe 340A - 57A											0.71							40														
	57A	58A	73.9	0.38							6.42	21						581	0.0001	0.0018	3.94	0.0073	0.0018	0.0091	200	0.37	0.026	0.83	0.75	PVC	SDR-35	
Contribution From MINNOW STREET, Pipe 32A - 58A											2.64							118														
	58A	59A	94.7	0.44							9.50	25						724	0.0001	0.0023	3.89	0.0090	0.0027	0.0117	200	0.49	0.030	0.95	0.89	PVC	SDR-35	
Contribution From IRON BRIDGE ROAD, Pipe 66A - 59A											1.01							56														
	59A	61A	70.4	0.42							10.93	24						804	0.0001	0.0026	3.86	0.0099	0.0031	0.0130	200	0.36	0.026	0.81	0.81	PVC	SDR-26	
Contribution From PONDSIDE TRAIL, Pipe 65A - 61A											1.04							58														
	61A	62A	48.9	0.31							12.28	18						880	0.0001	0.0028	3.84	0.0108	0.0035	0.0143	200	0.39	0.027	0.85	0.86	PVC	SDR-26	
	62A	63A	47.8	0.36							12.64	20						900	0.0001	0.0029	3.83	0.0110	0.0036	0.0146	200	0.40	0.027	0.86	0.87	PVC	SDR-26	
	63A	Ex. Trunk	6.5								12.64							900	0.0000	0.0029	3.83	0.0110	0.0036	0.0146	200	0.50	0.030	0.96	0.95	PVC	SDR-26	
To EXISTING SANITARY TRUNK , Pipe Ex. MH 4 - Ex. MH 3											12.64							900														
STAG HOLLOW																																
	75A	76A	26.6	0.40							0.40	22						22	0.0001	0.0001	4.37	0.0003	0.0001	0.0004	200	0.94	0.041	1.32	0.42	PVC	SDR-35	
	76A	77A	38.6	0.21							0.61	12						34	0.0000	0.0001	4.35	0.0005	0.0002	0.0006	200	0.47	0.029	0.93	0.37	PVC	SDR-35	
	77A	78A	9.1	0.09							0.70	5						39	0.0000	0.0001	4.34	0.0005	0.0002	0.0007	200	0.66	0.035	1.10	0.44	PVC	SDR-35	
	78A	79A	40.1	0.28							0.98	16						55	0.0001	0.0002	4.31	0.0008	0.0003	0.0010	200	0.42	0.028	0.88	0.42	PVC	SDR-35	
	79A	82A	56.5	0.30							1.28	17						72	0.0001	0.0002	4.28	0.0010	0.0004	0.0013	200	0.46	0.029	0.92	0.47	PVC	SDR-35	
To CHARLES CORNWALL AVENUE , Pipe 82A - 83A											1.28							72														
CHARLES CORNWALL AVENUE																																
								0.09			0.09					9		9														
Contribution From FUTURE COMMERCIAL, Pipe CONTROL MH 6A - 80A			16.5					0.92			1.01					83		92	0.0003	0.0003	4.25	0.0012	0.0003	0.0015	200	1.00	0.043	1.36	0.63	PVC	SDR-35	
Contribution From MERTON ROAD , FUTURE Pipe 100A - 80A											0.46							43														
	80A	81A	74.0							0.37	1.84							135	0.0000	0.0004	4.21	0.0018	0.0005	0.0023	200	0.35	0.025	0.80	0.50	PVC	SDR-35	
Contribution From QUEENS PLATE ROAD , Pipe 72A - 81A											3.01							169														
Contribution From QUEENS PLATE ROAD , Pipe 74A - 81A											1.41							68														
	81A	82A	72.1	0.18							6.44	10						382	0.0000	0.0012	4.03	0.0049	0.0018	0.0067	200	0.35	0.025	0.80	0.68	PVC	SDR-35	
Contribution From STAG HOLLOW, Pipe 79A - 82A											1.28							72														
	82A	83A	92.1	0.73							8.45	41						495	0.0001	0.0016	3.98	0.0063	0.0024	0.0087	200	0.37	0.026	0.83	0.74	PVC	SDR-35	
	83A	84A	149.9	0.97							9.42	54						549	0.0002	0.0017	3.95	0.0069	0.0027	0.0096	200	0.31	0.024	0.76	0.71	PVC	SDR-26	
	84A	85A	64.5	0.45							9.87	25						574	0.0001	0.0018	3.94	0.0072	0.0028	0.0100	200	0.37	0.026	0.83	0.77	PVC	SDR-26	
	85A	86A	87.7	0.73							10.60	41						615	0.0001	0.0020	3.93	0.0077	0.0030	0.0107	200	0.35	0.025	0.80	0.77	PVC	SDR-26	
	86A	87A	88.7	0.63							11.23	35						650	0.0001	0.0021	3.91	0.0081	0.0032	0.0113	200	0.36	0.026	0.81	0.79	PVC	SDR-26	
	87A	Ex. Trunk	7.6								11.23							650	0.0000	0.0021	3.91	0.0081	0.0032	0.0113	200	1.59	0.054	1.71	1.35	PVC	SDR-26	
To EXISTING SANITARY TRUNK , Pipe Ex. MH 4 - Ex. MH 3											11.23							650														

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Note: To be conservative, industrial K_{av} is considered to be 1

THE REGIONAL MUNICIPALITY OF HALTON

SANITARY SEWER DESIGN

BRONTE GREEN

Single Family: 55 pph
Semi-detached: 100 pph
Townhouse: 135 pph
Commercial: 90 pph
Community Services 40 pph
n (PVC): 0.010
n (Conc): 0.013
Infil.Flow (INF): 0.286 L/s/ha

SHEET No.: 5 OF 5
LOCATION: BRONTE GREEN
PROJECT No.: 12-601
DATE: FEBRUARY, 2020
DESIGNED BY: K.M.
CHECKED BY: W.L.
AS-BUILT BY: K.P.
CHECKED BY: D.P.

STREET	MANHOLE		LENGTH	TRIBUTARY AREA HECTARE							TOTAL	POPULATION TRIBUTARY						TOTAL	AVG.	AVG.	PEAKING	MAX	INF.	MAX	SEWER					PIPE		REMARKS
				INCREMENT								INCREMENT							m^3/s	m^3/s				FLOW			Q	VEL (m/s)				
	FROM	TO	(m)	SINGLE F.	SEMI.	TOWNHOUSE	CONDO	COMMERC	COMM. SERV.	INFILT		SINGLE F.	SEMI.	TOWNHOUSE	CONDO	COMMERC	COMM. SERV.		INC.	TOTAL	FACTOR	m^3/s	m^3/s	EXP.	SIZE	SLOPE	m^3/s	FULL	ACT.	TYPE	CLASS	
SAW WHET BOULEVARD																																
	20A	92A	37.7	0.52							0.52	29						29	0.0001	0.0001	4.36	0.0004	0.0001	0.0006	200	1.03	0.043	1.38	0.46	PVC	SDR-35	
To SAW WHET BOULEVARD , Pipe 92A - 93A											0.52							29														
Contribution From MERTON ROAD , Pipe 11A - 88A											10.40							1775														
Contribution From MERTON ROAD , Pipe 51A - 88A											1.26							532														
	88A	89A	72.4			0.43				0.27	12.36			59				2366	0.0002	0.0075	3.53	0.0266	0.0035	0.0301	250	0.26	0.039	0.80	0.88	PVC	SDR-35	
Contribution From QUEENS PLATE ROAD , Pipe 13A - 89A											1.10							59														
	89A	90A	145.1	0.62							14.08	35						2460	0.0001	0.0078	3.51	0.0275	0.0040	0.0315	250	0.31	0.043	0.88	0.96	PVC	SDR-35	
Contribution From AUBREY TURQUAND TRAIL, Pipe 19A - 90A											1.27							67														
	90A	91A	34.0	0.15							15.50	9						2536	0.0000	0.0081	3.50	0.0283	0.0044	0.0327	250	0.29	0.042	0.85	0.94	PVC	SDR-35	
	91A	92A	60.7	0.20							15.70	11						2547	0.0000	0.0081	3.50	0.0284	0.0045	0.0329	250	0.33	0.044	0.90	0.99	PVC	SDR-35	
Contribution From SAW WHET BOULEVARD, Pipe 20A - 92A											0.52							29														
Contribution From BLOCK 477 (PARK), Pipe CONTROL MH 4A - 92A			17.9						2.13		2.13						86	86	0.0003	0.0003	4.26	0.0012	0.0006	0.0018	200	0.73	0.036	1.16	0.60	PVC	SDR-35	
	92A	93A	55.0	0.18							18.53	10						2672	0.0000	0.0085	3.48	0.0296	0.0053	0.0349	250	0.42	0.050	1.02	1.10	PVC	SDR-35	
	93A	94A	96.9	0.61							19.14	34						2706	0.0001	0.0086	3.48	0.0300	0.0055	0.0354	250	0.78	0.068	1.39	1.40	PVC	SDR-35	
Contribution From HYACINTH CRESCENT, Pipe 22A - 94A											1.20							67														
	94A	95A	78.8	0.35							20.69	20						2793	0.0001	0.0089	3.47	0.0308	0.0059	0.0368	250	0.36	0.046	0.94	1.05	PVC	SDR-26	
Contribution From HYACINTH CRESCENT, Pipe 27A - 95A											0.93							48														
	95A	96A	131.7	0.67							22.29	37						2878	0.0001	0.0092	3.46	0.0317	0.0064	0.0381	300	0.23	0.060	0.85	0.90	PVC	SDR-26	
Contribution From MEADOWSIDE PATH, Pipe 30A - 96A											1.03							58														
	96A	98A	118.0	0.80							24.12	44						2980	0.0001	0.0095	3.44	0.0326	0.0069	0.0395	300	0.20	0.056	0.80	0.86	PVC	SDR-26	
	98A	Ex. Trunk	17.2								24.12							2980	0.0000	0.0095	3.44	0.0326	0.0069	0.0395	300	0.12	0.044	0.62	0.70	PVC	SDR-26	
To EXISTING SANITARY TRUNK , Pipe Ex. MH 3 - Ex. MH 2											24.12							2980														

TOPOGRAPHIC INFORMATION

TOPOGRAPHIC INFORMATION PROVIDED BY J.D. BARNES LTD., PROJECT No. 12-30-371-02-TOPO-COMBINED, TOPOGRAPHIC SURVEY DATED MAY 25, 2017.

LEGAL INFORMATION

CALCULATED M-PLAN PROVIDED BY J.D. BARNES LTD.,
PROJECT No. 12-30-371-00, SURVEY DATED NOVEMBER 29, 2018.
CALCULATED R-PLAN PROVIDED BY J.D. BARNES LTD.,
PROJECT No. 12-30-371-09, SURVEY DATED AUGUST 09, 2017,
PROJECT No. 12-30-371-09-RPLAN, SURVEY DATED SEPTEMBER 14, 2017,
PROJECT No. 12-30-371-11, SURVEY DATED JANUARY 2, 2018.
PROJECT No. 12-30-371-11-D, SURVEY DATED DECEMBER 04, 2018.
PROJECT No. 12-30-371-11-F, SURVEY DATED APRIL 29, 2019.

AS-CONSTRUCTED

BENCHMARK No. 101 ELEVATION = 115.838m

ELEVATIONS SHOWN ON THIS PLAN ARE RELATED TO GEODETIC DATUM AND ARE DERIVED FROM THE TOWN OF OAKVILLE BENCHMARK No. 101, HAVING A PUBLISHED ELEVATION OF 115.838 METRES.

No.	DATE	BY	REVISIONS	APPROVED
12.	20-08-21	T.M.	AS-CONSTRUCTED SUBMISSION (UNDERGROUNDS ONLY)	
11.	19-06-21	W.L.	MOE SUBMISSION 2 AMENDMENT	
10.	19-03-29	W.L.	3rd RESUBMISSION TO CH	
9.	19-03-13	W.L.	MOE SUBMISSION 2	
8.	19-02-12	W.L.	4th SUBMISSION TO REGION	
7.	18-11-19	W.L.	3rd RESUBMISSION FOR SIGNATURE	
6.	18-11-06	W.L.	3rd RESUBMISSION TO REGION	
5.	18-10-09	W.L.	3rd SUBMISSION TO REGION	
4.	18-09-12	W.L.	MOE SUBMISSION	
3.	18-06-29	W.L.	3rd SUBMISSION TO TOWN	
2.	18-03-23	W.L.	2nd SUBMISSION	

DESIGNED BY: C.M./K.M. CHECKED BY: W.L.
DRAWN BY: D.A. CHECKED BY: W.L.
DATE JUNE 2017
SCALE
REFERENCES
FIELD NOTES

APPROVALS

MUNICIPAL APPROVAL

APPROVED IN PRINCIPLE SUBJECT TO DETAIL CONSTRUCTION CONFORMING TO TOWN OF OAKVILLE STANDARDS AND SPECIFICATIONS

MANAGER OF DEVELOPMENT ENGINEERING DATE

BELL ☐ HYDRO ☐
GAS ☐ CABLE ☐
TRAFFIC ☐ WATER ☐

REGIONAL APPROVAL

APPROVED DESIGN OF SANITARY, WATER SERVICES AND REGIONAL ROAD WORKS APPROVED SUBJECT TO DETAIL CONSTRUCTION CONFORMING TO HALTON REGION STANDARDS & SPECIFICATIONS & LOCATIONAL APPROVAL FROM AREA MUNICIPALITY

RONALD MACKENZIE (ORIGINALLY SIGNED) FEB. 15/19
LEGISLATIVE AND PLANNING SERVICES DATE

STAMP

ORIGINALLY SIGNED BY
WILL LIU, P.ENG
DATED SEPTEMBER 30,
2019

DSEL
david schaeffer engineering ltd
600 Alden Road, Suite 500
Markham, Ontario, L3R 0E7
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Fax. (905) 475-3081
www.DSEL.ca

MUNICIPALITY
OAKVILLE
DEVELOPMENT ENGINEERING

REGION
Halton REGION
The Regional
Municipality
of Halton

DEVELOPER
BRONTE GREEN CORPORATION

PROJECT
BRONTE GREEN SUBDIVISION
24T-14004

TITLE

SANITARY DESIGN SHEETS

MUNICIPAL FILE NO. SD-XXX.X
REGIONAL FILE NO. DO-1040
PROJECT NO. 12-601
SHEET 30 OF 145

APPENDIX B

WATER ANALYSIS

Water Analysis (To Be Completed)

APPENDIX C

GEOTECHNICAL INVESTIGATION

Geotechnical Investigation (Soil-Mat Engineers & Consultants Ltd.)

Soil Engineers Ltd.
CONSULTING ENGINEERS
GEOTECHNICAL • ENVIRONMENTAL • HYDROGEOLOGICAL • BUILDING SCIENCE
100 NUGGET AVENUE, TORONTO, ONTARIO M1S 3A7 • TEL: (416) 754-8515 • FAX: (416) 754-8516

BARRIE	MISSISSAUGA	OSHAWA	NEWMARKET	GRAVENHURST	PETERBOROUGH	HAMILTON
TEL: (705) 721-7863	TEL: (905) 542-7605	TEL: (905) 440-2040	TEL: (905) 853-0647	TEL: (705) 684-4242	TEL: (905) 440-2040	TEL: (905) 777-7956
FAX: (705) 721-7864	FAX: (905) 542-2769	FAX: (905) 725-1315	FAX: (416) 754-8516	FAX: (705) 684-8522	FAX: (905) 725-1315	FAX: (905) 542-2769

A REPORT TO
BRONTE GREEN CORPORATION

A SOIL INVESTIGATION FOR PROPOSED RESIDENTIAL DEVELOPMENT

BRONTE GREEN - 1401 BRONTE ROAD
SOUTHEAST CORNER OF BRONTE ROAD AND UPPER MIDDLE ROAD

TOWN OF OAKVILLE

REFERENCE NO. 1611-S034(A)

APRIL 2017
(REVISION OF REPORT DATED JANUARY 2017)

DISTRIBUTION

3 Copies - Bronte Green Corporation
1 Copy - Soil Engineers Ltd. (Mississauga)
1 Copy - Soil Engineers Ltd. (Toronto)

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DIAGRAMS

ENCLOSURES

1.0 **INTRODUCTION**

Further to the meeting held on October 27, 2016 and as per the proposal dated November 8, 2016, addressed to Mr. Sang Kim, of Bronte Green Corporation, a soil investigation was carried out at 1401 Bronte Road, in the Town of Oakville, for a proposed Residential Development.

A Geotechnical Investigation and Slope Stability Assessment was previously conducted at the site, of which the results and recommendations were presented in separate Reports, Reference No. 1207-S148. The Borehole Logs and the Borehole Location Plan of the previous investigation are included in the Appendix.

The purpose of the current investigation was to reveal the subsurface conditions and determine the engineering properties of the disclosed soils for the design and construction of the proposed project, particularly at the locations of the proposed condominium buildings, bridge, and stormwater management pond and outfall. This report, however, will focus on the subdivision, bridge, and stormwater management pond and outfall; a separate report will be provided focussing on the condominium buildings.

The geotechnical findings and resulting recommendations are presented in this Report. In addition, soil investigation was also conducted at locations specified by the hydrogeological consultant, R.J. Burnside & Associates Limited; those results are also presented in this Report.

2.0 SITE AND PROJECT DESCRIPTION

The Town of Oakville is situated on Iroquois Lake plain where a drift overburden overlies a shale bedrock which occurs at a shallow depth. The drift has been partly eroded by the past glaciation and, in places, filled with lacustrine clay, silt, sand and reworked till.

The investigated site consists of a former golf course (Saw Whet Golf Course). The old clubhouse and other structures associated with the golf course have since been demolished. The site borders the western bank of the Fourteen Mile Creek Valley on the east side of Bronte Road, south of Upper Middle Road. The site is currently comprised of man-made berms as part of the former golf course layout, with the remainder of the site around the berms being relatively flat and grass-covered. In addition, an existing pond is present in the west portion of the site.

It is understood that the proposed project consists of a residential subdivision comprising of townhouse units, detached homes and residential condominiums. A channel traverses the north portion of the site in the east-west direction; therefore, it is understood that a bridge is proposed at this crossing. In addition, a stormwater management pond is to be situated in the east portion of the site, with an outfall proposed from the pond to the creek. The development is to be provided with municipal services and roadways meeting current standards.

3.0 FIELD WORK

The field work, consisting of 26 boreholes to depths ranging from 4.9 to 20.0 m, was performed during the period between November 15 and 29, 2016, at the locations shown on the Borehole and Monitoring Well Location Plan, Drawing No. 1. The boreholes requested by R.J. Burnside & Associates Limited are labelled in accordance with their work plan provided prior to conducting the field work; these boreholes are also denoted by the letters 'RJ'. The boreholes conducted for geotechnical purposes are denoted by the letter 'S'. Refusal to augering was encountered at Boreholes S14 and S16.

The holes were advanced at intervals to the sampling depths by a track-mounted, continuous-flight power-auger machine equipped for soil sampling. Standard Penetration Tests, using the procedures described on the enclosed "List of Abbreviations and Terms", were performed at the sampling depths. The test results are recorded as the Standard Penetration Resistance (or 'N' values) of the subsoil. The relative density of the granular strata and the consistency of the cohesive strata are inferred from the 'N' values. Split-spoon samples were recovered for soil classification and laboratory testing.

A 50-mm diameter groundwater monitoring well was installed at 5 of the R.J. Burnside borehole locations, with a shallower nested well installed at 2 of the 5 locations. The suffix 'd' or 's' on the borehole logs denotes a deep or shallow nested well, respectively.

In addition, 'NQ' size (47.6 mm) rock coring was carried out in Boreholes RJMW3 and S15 to assess the quality and soundness of the encountered shale bedrock. The quality of the rock has been assessed by applying the 'Rock Quality Designation'

(RQD) classification, considering the total length of the recovered pieces 10 cm or longer against the length of the core run. The results are expressed as a percentage and are recorded on the Borehole Logs.

Furthermore, test pits were conducted at the site prior to mobilization of the drilling equipment. The information from one test pit, STP29, conducted within the proposed stormwater management pond area has been included in this report to assess the excavation requirements for the proposed pond.

The field work was supervised and the findings were recorded by a Geotechnical Technician.

The elevation at each of the borehole locations was interpreted from the spot elevations and contours shown on the provided topographic plan.

4.0 SUBSURFACE CONDITIONS

Detailed descriptions of the encountered subsurface conditions at the boreholes from the current investigation are presented on the Borehole Logs, comprising Figures 1 to 26, inclusive. The revealed stratigraphy is plotted on the Subsurface Profile, Drawing Nos. 2, 3, 4 and 5, and the engineering properties of the disclosed soils are discussed herein. In addition, the subsurface condition at the test pit location is also discussed herein.

This investigation has disclosed that beneath a veneer of topsoil, and a layer of earth fill in places, the site is generally underlain by strata of silty clay till, sandy silt till, silty sand till, fine to coarse and medium to coarse grained sand, gravelly sand, silty clay, silt, sandy silt and/or silty fine sand at various locations and depths. The soil overlies shale bedrock within the eastern portion of the site at shallow depths.

4.1 **Topsoil** (All Boreholes, except Borehole RJBH3)

The revealed topsoil layer is approximately 8 to 30 cm thick. It is dark brown in colour, indicating that it contains appreciable amounts of roots and humus. These materials are compressible under loads; therefore, the topsoil is considered to be void of engineering value. Due to its humus content, the topsoil will generate an offensive odour and may produce volatile gases under anaerobic conditions. Therefore, the topsoil must not be buried below any structures or deeper than 1.2 m below the exterior finished grade so it will not have an adverse impact on the environmental well-being of the developed area.

Topsoil thicker than that found in the boreholes may occur in places. In order to prevent overstripping, diligent control of the stripping operation will be required.

Since the topsoil is void of engineering value, it can only be used for general landscape contouring purposes. Its suitability for planting and sodding purposes can be further assessed by fertility testing.

4.2 **Earth Fill** (Boreholes RJMW3, RJTW1, RJBH3, S3, S8, S9, S12 and S13)

The earth fill was found beneath the topsoil layer, extending to depths ranging from 0.8± to 2.3± m below the prevailing ground surface. The earth fill consists of silty, sandy, and/or clayey material with traces of gravel and occasional topsoil/organic inclusions.

The obtained ‘N’ values range from 4 to 12, with a median of 7 blows per 30 cm of penetration, indicating that the earth fill was loosely placed, and has since self-consolidated in places.

The natural water content of the samples was determined and the results are plotted on the Borehole Logs; the values range from 9% to 21%, with a median of 15%, indicating that the earth fill is in a moist to wet condition.

Due to the unknown history of the earth fill, its loose density, and the presence of topsoil and organic inclusions, the fill is unsuitable for supporting any structures in its current condition. In using the fill for structural backfill, or in pavement or slab-on-grade construction, it should be subexcavated, inspected, sorted free of topsoil inclusions and any deleterious materials, aerated and properly recompacted in thin lifts. If it is impractical to sort the topsoil and other deleterious materials from the fill, the fill must be wasted and replaced with properly compacted inorganic earth fill.

The fill is amorphous in structure; it will ravel and is susceptible to collapse in steep cuts, particularly if the fill is in a wet condition.

One must be aware that the samples retrieved from boreholes 10 cm in diameter may not be truly representative of the geotechnical and environmental quality of the fill, and do not indicate whether the topsoil beneath the earth fill was completely stripped. This should be further assessed by laboratory testing and/or test pits.

4.3 **Silty Clay Till** (All Boreholes, except Boreholes S9 and S17)

The silty clay till was generally encountered in the upper soil stratigraphy beneath the topsoil and/or earth fill; in some places, the till is overlain with strata of silt, sand or clay. The silty clay till consists of a random mixture of soils; the particle sizes range from clay to gravel, with the clay fraction exerting the dominant influence on its soil properties. The till is embedded with occasional wet sand and silt seams and layers, cobbles and boulders. The structure of the till is heterogeneous and amorphous, in places, indicating that it is a glacial deposit.

The till within a depth of 0.4± to 1.5± m below the prevailing ground surface is permeated with fissures, showing it has been fractured by the weathering process.

The obtained ‘N’ values range from 6 per 30 cm to 50 per 3 cm, with a median of 37 per 30 cm, showing the consistency of the till is firm to hard, being generally hard. The firm to stiff till is generally restricted to the weathered zone.

The Atterberg Limits of 1 representative sample and the water content of all of the silty clay till samples were determined. The results are plotted on the Borehole Logs and summarized below:

Liquid Limit	29%
Plastic Limit	17%
Natural Water Content	6% to 32% (median 12%)

The above results show that the till is a cohesive material with low plasticity. The natural water content generally lies below its plastic limit, confirming the generally hard consistency of the till as disclosed by the 'N' values.

Grain size analyses were performed on 5 representative samples of the silty clay till; the results are plotted on Figures 27 and 28.

Based on the above findings, the deduced engineering properties pertaining to the project are given below:

- High frost susceptibility and low soil-adfreezing potential.
- Low water erodibility.
- Low permeability, with an estimated coefficient of permeability of 10^{-7} cm/sec, and runoff coefficients of:

Slope	
0% - 2%	0.15
2% - 6%	0.20
6% +	0.28

- A cohesive-frictional soil, its shear strength is primarily derived from consistency and is augmented by internal friction. The strength is, therefore, inversely dependent on the soil moisture and, to a lesser degree, directly dependent on the soil density.

- It will generally be stable in a relatively steep cut. However, prolonged exposure will allow infiltrating precipitation to saturate the soil fissures and the sand and silt seams and layers; this may lead to localized sloughing.
- A very poor pavement-supportive material, with an estimated California Bearing Ratio (CBR) value of 3% or less.
- Moderately high corrosivity to buried metal, with an estimated electrical resistivity of 3500 ohm·cm.

4.4 **Sandy Silt Till** (Boreholes RJMW1d, RJMW2d, S1, S3, S4, S5 and S6) **Silty Sand Till** (Boreholes RJMW1d, RJMW2d, RJBH1, RJBH2, RJBH3, and S1 to S12, inclusive, except Boreholes S3, S5 and S8)

The sandy silt till and silty sand till were encountered at various locations and depths, generally within the lower soil stratigraphy. The tills consist of a random mixture of soils; the particle sizes range from clay to gravel, with either the silt or sand fraction exerting the dominant influence on their soil properties. The tills are heterogeneous and amorphous, in places, with occasional wet sand and silt seams and layers, cobbles and boulders, showing they are glacial deposits.

The obtained 'N' values for the sandy silt till range from 65 per 30 cm to 50 per 10 cm, with a median of 50 per 15 cm, and the 'N' values for the silty sand till range from 5 per 30 cm to 50 per 3 cm, with a median of 50 per 13 cm. This indicates that the relative density of the tills is loose to very dense, being generally very dense. The loose silty sand till was encountered directly beneath the topsoil at one location, which has also been loosened by the weathered process.

The natural water content of the samples was determined and the results are plotted on the Borehole Logs; the values for the sandy silt till range from 6% to 18%, with a median of 10%, and the values for the silty sand till range from 6% to 15%, with a median of 8%. This indicates that the tills are in a damp to very moist, generally moist condition.

Grain size analyses were performed on 1 representative sample of the sandy silt till and 2 representative samples of the silty sand till; the results are plotted on Figure 29.

Based on the above findings, the deduced engineering properties pertaining to the project are given below:

- High frost susceptibility and moderately low water erodibility.
- Relatively low to low permeability, with an estimated coefficient of permeability of 10^{-5} to 10^{-6} cm/sec, and runoff coefficients of:

Slope	
0% - 2%	0.11 to 0.15
2% - 6%	0.16 to 0.20
6% +	0.23 to 0.28

- Frictional soils, their shear strength is primarily derived from internal friction and is augmented by cementation. Therefore, their strength is primarily soil density dependent.
- In steep cuts, they will be stable; however, under prolonged exposure, localized sheet collapse will occur, particularly in the weathered zone and where the wet sand and silt layers are prevalent.
- Fair pavement-supportive materials, with an estimated CBR value of 8% to 10%.

- Moderate to moderately low corrosivity to buried metal, with an estimated electrical resistivity of 4000 to 5000 ohm·cm.

4.5 **Sand** (Boreholes RJMW1d, RJMW2d, RJBH2, S11 and S13) and **Gravelly Sand** (Boreholes RJMW1d, RJMW2d, RJBH3, and S6 to S13, inclusive)

The sand deposits were generally encountered within the lower soil stratigraphy, except at Boreholes S11 and S13, where sand was encountered closer to the ground surface; the sands tend to extend to the maximum investigated depth at most of the borehole locations where they were encountered. The sand was primarily fine to coarse or medium to coarse grained and contained traces to some silt and gravel in places. The gravelly sand particles are subangular in shape. The sorted structure shows that the sands are glaciolacustrine deposits.

The obtained 'N' values for the sand range from 11 per 30 cm to 50 per 5 cm, with a medium of 49 per 30 cm, and the 'N' values for the gravelly sand range from 40 per 30 cm to 50 per 5 cm, with a median of 50 per 15 cm. This indicates that the relative density of the sand is compact to very dense, being generally dense, while the relative density of the gravelly sand is dense to very dense, being generally very dense.

The natural water content of the samples was determined and the results are plotted on the Borehole Logs; the values for the sand range from 6% to 18%, with a median of 12%, and the values for the gravelly sand range from 6% to 15%, with a median of 10%. This indicates that the sands are in a moist to wet, generally wet condition and are water-bearing. Due to the pervious nature of the sands, some of the water may have drained during sample retrieval and, therefore, the determined value may not represent the actual water content.

A grain size analysis was performed on 1 representative sample of the sand; the result is plotted on Figure 30.

Based on the above findings, the deduced engineering properties pertaining to the project are given below:

- Low to moderate frost susceptibility, depending on the silt content.
- High water erodibility.
- Susceptible to migration through small openings under seepage pressure.
- Pervious, with an estimated coefficient of permeability of 10^{-2} to 10^{-3} cm/sec, and runoff coefficients of:

Slope	
0% - 2%	0.04
2% - 6%	0.09
6% +	0.13

- Frictional soils, their shear strength is derived from internal friction and is soil density dependent.
- In steep cuts, the sands will slough; they will run with seepage and boil under a piezometric head of 0.4 m.
- Good pavement-supportive materials, with an estimated CBR value of 25% to 30%.
- Low corrosivity to buried metal, with an estimated electrical resistivity of 6500 to 7000 ohm·cm.

4.6 **Silty Clay** (Boreholes RJMW1d, S8, S11 and S17)

The silty clay was found in the upper zone of the soil stratigraphy, in most cases beneath the topsoil or earth fill layers; it contains a trace to some sand and is laminated with occasional wet silt seams and layers. The laminated structure shows that the silty clay is a lacustrine deposit.

The clay within a depth of 0.8± to 1.0± m below the prevailing ground surface, in places, is permeated with fissures, showing it has been fractured by the weathering process.

The obtained 'N' values range from 7 per 30 cm to 50 per 10 cm, with a median of 13 per 30 cm, indicating that the consistency of the silty clay is firm to hard, being generally stiff.

The Atterberg Limits of 1 representative sample and the water content of all of the silty clay samples were determined. The results are plotted on the Borehole Logs and summarized below:

Liquid Limit	25%
Plastic Limit	15%
Natural Water Content	11% to 22% (median 19%)

The above results show that the clay is a cohesive material with low plasticity. The natural water content generally lies between its plastic and liquid limits, confirming the consistency of the clay as disclosed by the 'N' values.

A grain size analysis was performed on 1 representative sample of the silty clay; the result is plotted on Figure 31.

Based on the above findings, the deduced engineering properties pertaining to the project are given below:

- High frost susceptibility and high soil-adfreezing potential.
- Low water erodibility, with the laminated silt layers being erodible.
- Low permeability, with an estimated coefficient of permeability of 10^{-7} cm/sec, and runoff coefficients of:

Slope	
0% - 2%	0.15
2% - 6%	0.20
6% +	0.28

- A cohesive soil, its shear strength is derived from consistency and augmented by the internal friction of the silt. Its shear strength is moisture dependent and, due to the dilatancy of the silt, the overall shear strength of the wet silty clay is susceptible to impact disturbance; i.e., the disturbance will induce a build-up of pore pressure within the soil mantle, resulting in soil dilation and a reduction of shear strength.
- In steep cuts, the sound clay may collapse as the wet silt slowly sloughs.
- A very poor pavement-supportive material, with an estimated CBR value of 3% or less.
- Moderately high corrosivity to buried metal, with an estimated electrical resistivity of 2500 to 3000 ohm·cm.

4.7 **Silt** (Boreholes RJMW1d, RJTW1, RJBH1, S8, S9, S10, S12 and S13)

The silt was found at various boreholes and depths; it contains traces of clay to being clayey and a trace to some sand, with a trace of gravel and occasional sand layers in places. The laminated structure shows that the silt is a glaciolacustrine deposit.

The obtained 'N' values range from 6 per 30 cm to 50 per 10 cm, with a median of 15 per 30 cm, indicating that the relative density of the silt is loose to very dense, being generally compact.

The natural water content of the samples was determined and the results are plotted on the Borehole Logs; the values range from 14% to 22%, with a median of 18%, indicating that the silt is in a very moist to wet, generally wet condition. The wet samples displayed dilatancy when shaken by hand.

Grain size analyses were performed on 2 representative samples of the silt; the results are plotted on Figure 32.

Based on the above findings, the deduced engineering properties pertaining to the project are given below:

- High frost susceptibility and high soil-adfreezing potential.
- High water erodibility; it is susceptible to migration through small openings under seepage pressure.
- A soil of high capillarity and water retention capacity.
- Relatively low permeability, with an estimated coefficient of permeability of 10^{-5} to 10^{-6} cm/sec, and runoff coefficients of:

Slope	
0% - 2%	0.11 to 0.15
2% - 6%	0.16 to 0.20
6% +	0.23 to 0.28

- A frictional soil, its shear strength is derived from internal friction; therefore, its shear strength is density dependent. Due to its dilatancy, the strength of the wet silt is susceptible to impact disturbance; i.e., the disturbance will induce a build-up of pore pressure within the soil mantle, resulting in soil dilation and a reduction of shear strength.

- In excavation, the very moist to wet silt will slough and run slowly with seepage bleeding from the cut face. It will boil under a piezometric head of 0.4 m.
- A poor pavement-supportive material, with an estimated CBR value of 5%.
- Moderate to moderately low corrosivity to buried metal, with an estimated electrical resistivity of 4500 to 5000 ohm·cm.

4.8 **Sandy Silt** (Borehole S10) and **Silty Fine Sand** (Borehole S12)

The sandy silt deposit was encountered beneath the topsoil whereas the silty fine sand layer was found in the mid zone of the revealed soil stratigraphy beneath a layer of silt and overlying the silty clay till. The deposits contain a trace of clay, with topsoil inclusions within the sandy silt layer. The sorted structure indicates that the sandy silt and silty fine sand are glaciolacustrine deposits. The sandy silt has been loosened by the weathering process.

The obtained ‘N’ value for the sandy silt is 9 per 30 cm indicating that its relative density is loose. From sample examinations, the silty fine sand appears to be in a fairly compact state as confirmed by the soil conditions encountered above and below the sand.

The natural water content of the samples was determined and the results are plotted on the Borehole Logs; the value for the sandy silt is 17%, and the value for the silty fine sand is 19%. This indicates that the sandy silt and silty fine sand are in a wet condition; they displayed dilatancy when shaken by hand.

Based on the above findings, the deduced engineering properties pertaining to the project are given below:

- High frost susceptibility and high soil-adfreezing potential.
- High water erodibility; they are susceptible to migration through small openings under low to moderate seepage pressure.
- Soils of high capillarity and water retention capacity.
- Relatively pervious, with an estimated coefficient of permeability of 10^{-4} cm/sec, and runoff coefficients of:

Slope	
0% - 2%	0.07
2% - 6%	0.12
6% +	0.18

- Frictional soils, their shear strength is primarily derived from internal friction and is soil density dependent. Due to their dilatancy, the strength of the wet silt and sand is susceptible to impact disturbance; i.e., the disturbance will induce a build-up of pore pressure within the soil mantle, resulting in soil dilation and a reduction of shear strength.
- In excavation, the wet silt and sand will slough in steep cuts, run slowly with water seepage, and boil under a piezometric head of 0.4 m.
- Poor pavement-supportive materials, with estimated CBR values of 5%.
- Moderately low corrosivity to buried metal, with an estimated electrical resistivity of 5500 to 6000 ohm·cm.

4.9 **Shale Bedrock** (Boreholes RJMW3, RJMW5. RJMW6, S14, S15, S16 and S17)

Shale bedrock was encountered in the boreholes in the eastern portion of the site at depths ranging from 0.8± to 8.5± m below the prevailing ground surface; the shallower bedrock was generally encountered with the southeast portion of the site. The lower zone of the silty clay till above the shale bedrock, in places, appears to be derived from a clay-shale reversion.

The shale is reddish-brown in colour, indicating that it is of Queenston Formation. It is thinly to thickly bedded and consists predominantly of mudstone with occasional hard limestone and dolomite bands. The presence of shale fragments found in the lower layer of the overlying soils render it difficult to delineate the surface of the bedrock. The shale is susceptible to disintegration and swelling upon exposure to air and water, with subsequent reversion to a clay soil, but the laminated limy and sandy layers would remain as rock slabs.

The bedrock within the investigated depth can be penetrated by power-augering with some difficulty in grinding through the hard layers found at lower depths. The water content values of the samples obtained from the sampler range from 4% to 11%, with a median of 5%. The obtained ‘N’ values from the shale bedrock range from 52 per 30 cm to 50 per 3 cm, with a median of 50 per 15 cm. The upper layer of the shale within depths ranging from 1.0± to 3.0± m from the surface of the bedrock generally is in a weathered condition, becoming sound with depth.

Rock coring was carried out in the shale bedrock starting at depths of 8.5± m and 6.1± m below the prevailing ground surface at Boreholes RJMW3 and S15, respectively. The recovery of NQ rock cores range from 50% to 100%; however, the RQD values range from 0% to 70%, indicating the shale is a very poor to fair rock.

From examinations, the encountered shale is well cemented with intermittent limestone layers. Uniaxial Compressive Strength (UCS) tests were carried out on

3 core samples. The tested specimens, taken at varying depths, were selected and the results are presented in Table 1.

Table 1 - UCS Results

Specimen	**Borehole**	**Depth (m)**	**UCS (MPa)**
RC1	RJMW3	9.3	27.9
RC2	S15	8.7	27.2
RC3	S15	10.7	37.9

The results of the UCS tests indicate that the inherent compressive strength of the tested specimens is relatively low.

The shale has low permeability, and occasional pockets of groundwater may be trapped in its fissures. This water is often under moderate subterranean artesian pressure, which is reflected by the groundwater observed in Boreholes RJMW5 and RJMW6. Upon release through excavation, the water is likely to drain readily with a limited yield.

The weathered rock can be excavated with considerable effort by a heavy-duty backhoe equipped with a rock-ripper; however, excavation will become progressively more difficult with depth into the sound shale. Efficient removal of the sound shale may require the aid of pneumatic hammering.

The excavated spoil may contain large amounts of hard limy and sandy rock slabs, rendering it virtually impossible to obtain uniform compaction. Therefore, unless the spoil is sorted, it is considered unsuitable for engineering applications. Limy shale fragments larger than 15 cm should either be pulverized by mechanical means or left exposed for weathering by freezing, thawing and wetting. The shale will revert to a clayey soil which can be properly compacted using mechanical means.

In sound shale excavation, slight lateral displacement of the excavation walls is often experienced. This is due to the release of residual stress stored in the bedrock mantle and the swelling characteristics of the rock.

4.10 **Interpretation of Refusal to Augering** (Boreholes S14 and S16)

Refusal to augering in the shale was encountered at a depth of 4.9± m below the prevailing ground surface. It is inferred that due to the difficulty augering through the shale, the bedrock was becoming sound with depth.

4.11 **Test Pit Subsurface Conditions** (STP29)

One (1) test pit, STP29, was conducted within the proposed stormwater management pond envelope slightly west of Borehole S15, using an excavator equipped with a rock-ripper. The purpose of the test pit was to determine the excavation condition in the shale bedrock using an excavator which will be used for the pond construction.

The results of the test pit indicated that weathered shale bedrock was encountered at a depth of 1.4± m below the ground surface. Difficulty in excavating the bedrock was encountered at a depth of 3.7± m, with the bedrock becoming sound at a depth of 4.0± m, at which point the test pit was terminated.

The bedrock properties at the test pit are the same as described in Section 4.9 of this report.

4.12 Compaction Characteristics of the Revealed Soils

The obtainable degree of compaction is primarily dependent on the soil moisture and, to a lesser extent, on the type of compactor used and the effort applied. As a general guide, the typical water content values of the revealed soils for Standard Proctor compaction are presented in Table 2.

Table 2 - Estimated Water Content for Compaction

Soil Type	**Determined Natural Water Content (%)**	**Water Content (%) for Standard Proctor Compaction**	
		100% (optimum)	**Range for 95% or +**
Earth Fill	9 to 21 (median 15)	12 to 14	8 to 19
Silty Clay Till	6 to 32 (median 12)	16	12 to 21
Sandy Silt Till	6 to 18 (median 10)	12	8 to 16
Silty Sand Till	6 to 15 (median 8)	10 to 11	6 to 16
Sand	6 to 18 (median 12)	10	5 to 15
Gravelly Sand	6 to 15 (median 10)	7	3 to 12
Silty Clay	11 to 22 (median 19)	15 to 18	11 to 23
Silt	14 to 22 (median 18)	13	8 to 17
Sandy Silt	17	12	8 to 16
Silty Fine Sand	19	11	6 to 16
Broken Shale	4 to 11 (median 5)	16	12 to 21

The above values show that the majority of the in situ soils are suitable for a 95% or + Standard Proctor compaction. However, the excavated shale and a portion of the silty clay till is too dry and will require the addition of water prior to structural compaction. In addition, the weathered soils and a portion of the silts and sands are too wet and will require aeration or mixing with drier soils prior to structural compaction. Aeration of these materials can be achieved by spreading them thinly on the ground in the dry, warm weather.

The earth fill and weathered soils should be sorted free of organic inclusions and any deleterious material prior to structural compaction.

The tills and clay should be compacted using a heavy-weight, kneading-type roller. The silts and sands can be compacted by a smooth roller with or without vibration, depending on the moisture content of the soils being compacted. The lifts for compaction should be limited to 20 cm, or to a suitable thickness as assessed by test strips performed by the equipment which will be used at the time of construction.

When compacting the very stiff to hard silty clay till and cemented, dense to very dense sandy silt till and silty sand till on the dry side of the optimum, the compactive energy will frequently bridge over the chunks in the soils and be transmitted laterally into the soil mantle. Therefore, the lifts must be limited to 20 cm or less (before compaction). It is difficult to monitor the lifts of backfill placed in deep trenches; therefore, it is preferable that the compaction of backfill at depths over 1.0 m below the subgrade be carried out on the wet side of the optimum. This would allow a wider latitude of lift thickness. Wetting of the sound clay till may be required.

One should be aware that with considerable effort, a 90%± Standard Proctor compaction of the wet silts and sands is achievable. Further densification is prevented by the pore pressure induced by the compactive effort; however, large random voids will have been expelled and, with time, the pore pressure will dissipate and the percentage of compaction will increase. There are many cases on record where after a few months of rest, the density of the compacted mantle had increased to over 95% of its maximum Standard Proctor dry density.

If the compaction of the soils is carried out with the water content within the range for 95% Standard Proctor dry density but on the wet side of the optimum, the surface of the compacted soil mantle will roll under the dynamic compactive load. This is unsuitable for road construction since each component of the pavement structure is to be placed under dynamic conditions which will induce the rolling action of the subgrade surface and cause structural failure of the new pavement. The slab-on-grade, foundations or bedding of the underground services will be placed on a subgrade which will not be subjected to impact loads. Therefore, the structurally compacted soil mantle with the water content on the wet side or dry side of the optimum will provide adequate subgrade strength for the project construction.

The presence of boulders and large shale fragments will prevent transmission of the compactive energy into the underlying material to be compacted. If an appreciable amount of boulders and shale fragments over 15 cm in size is mixed with the material, it must either be sorted or must not be used for structural backfill and/or construction of engineered fill.

As noted, the shale is susceptible to disintegration and will revert to a clay soil. The shale spoil which has been exposed to weathering may be selected for use as structural fill. To achieve this, the shale must be excavated by a rock-ripper to break up the limy shale and sandstone slabs and piled thinly on the ground for optimum exposure to weathering. If shale spoil is to be used immediately for structural fill, it should be pulverized to sizes of 15 cm or less and must be compacted with lifts of 15 cm or less and consistently wetted. It should be compacted to achieve at least 95% of its maximum Standard Proctor dry density. The structurally compacted shale debris fill must be left for a period of at least 1 winter, preferably 2 winters, to allow the shale to swell prior to the construction of the foundations. In order to reduce the time required for the shale to swell, the shale to be reused must be pulverized and mixed with the clayey soil under the supervision of a geotechnical firm prior to its use as an engineered fill material.

It should be noted that if the shale spoil is to be left on the ground surface for a period of 1 or 2 winters for weathering, its swelling characteristic will result in a significant increase in soil volume, even in a compacted state. This phenomenon must be considered in the cut and fill calculations.

5.0 GROUNDWATER CONDITIONS

The boreholes were checked for the presence of groundwater and the occurrence of cave-in upon their completion. The data are plotted on the Borehole Logs and summarized in Table 3.

Table 3 - Groundwater Levels

BH No.	Borehole Depth (m)	Soil Colour Changes Brown/Red to Grey Depth (m)	Measured Groundwater/ Cave-in* Level On Completion	
			Depth (m)	El. (m)
RJMW1d	16.8	10.6**	N/A	-
RJMW2d	20.0	12.2	N/A	-
RJMW3	13.1	13.1+	Dry	-
RJMW5	7.6	7.6+	5.8	116.4
RJMW6	6.1	6.1+	5.5	117.9
RJTW1	4.9	2.3	Dry	-
RJBH1	8.1	4.6	7.3	120.2
RJBH2	7.8	7.8+	5.2/7.3*	120.6/118.5*
RJBH3	7.7	7.7+	2.1	124.5
S1	7.7	7.7+	7.3	122.0
S2	7.7	7.7+	7.3	122.0
S3	7.8	7.8+	Dry	-
S4	8.1	8.1+	7.3*	121.6*
S5	7.7	7.7+	7.3*	122.3*
S6	7.7	7.7+	5.8	120.8
S7	7.8	7.8+	7.0	120.0
S8	7.9	2.3	6.1*	122.4*

Table 3 - Groundwater Levels (cont'd)

BH No.	Borehole Depth (m)	Soil Colour Changes Brown/Red to Grey Depth (m)	Measured Groundwater/ Cave-in* Level On Completion	
			Depth (m)	**El. (m)**
S9	8.1	1.9	5.2/7.0*	122.7/120.9*
S10	8.1	8.1+	5.8	121.8
S11	7.8	2.3	1.5	127.7
S12	7.8	3.3	6.4*	123.7*
S13	7.7	3.0	3.0*	126.8*
S14	4.9	4.9+	Dry	-
S15	11.2	11.2+	Dry	-
S16	4.9	4.9+	Dry	-
S17	6.2	6.2+	Dry	-

* Cave-in level (In wet sand and silt layers, the level generally represents the groundwater at the time of investigation.)

** Soil changes back to brown/red and then potentially to grey again at a lower depth.

As shown above, the measured groundwater levels range from 1.5± to 7.3± m below the prevailing ground surface in 12 out of 26 boreholes. In addition, 7 out of 26 boreholes caved at depths ranging from 3.0± to 7.3± m below the prevailing ground surface. The rest of the boreholes remained dry upon completion of the field work. The groundwater level will fluctuate with the seasons and may be affected by the water level at Fourteen Mile Creek.

The soil colour changes from brown or red to grey at depths ranging from 1.9± to 12.2± m below the prevailing ground surface, at select locations; however, the colour of the revealed soils throughout the majority of the site remained brown or red to the maximum investigated depth. The brown/red colour indicates that the soils have oxidized.

During the wet season, infiltrated precipitation may, in places, be trapped in the soil fissures, and in the sand and silt layers embedded in the tills, rendering the occurrence of perched groundwater at shallower depths. Its yield, if any, will generally be limited and it will often dissipate in dry seasons.

It should be noted that the groundwater levels stated above were measured upon completion of the boreholes prior to stabilization. For further detailed groundwater activity, please refer to the hydrogeological work being undertaken by R.J. Burnside & Associates Limited. In order to facilitate the study, a 50-mm diameter groundwater monitoring well was installed at 5 borehole locations: RJMW1d (with a shallower nested well, RJMW1s), RJMW2d (with a shallower nested well, RJMW2s), RJMW3, RJMW5 and RJMW6. The well construction information is provided on the respective borehole logs.

If groundwater is encountered from the silty clay till and silty clay, the yield is expected to be small and limited, due to the low permeability of the soils, and the yield of groundwater from the silty sand till and sandy silt till may be some to moderate, while the yield of groundwater from the silts and sands will be moderate to appreciable, and likely persistent, depending on their extent and continuity. Groundwater under subterranean artesian pressure may occur in places within the shale bedrock, which is generally considered to be a poor aquifer. Therefore, the yield of groundwater from the bedrock, if encountered, will be appreciable initially; however, if allowed to drain freely, it will often dissipate or be depleted with time.

6.0 DISCUSSION AND RECOMMENDATIONS

This investigation has disclosed that beneath a veneer of topsoil, and a layer of earth fill in places, the site is generally underlain by strata of firm to hard, generally hard silty clay till; loose to very dense, generally very dense sandy silt till and silty sand till; compact to very dense, generally dense fine to coarse and medium to coarse grained sand; dense to very dense, generally very dense gravelly sand; firm to hard, generally stiff silty clay; loose to very dense, generally compact silt; loose sandy silt and/or compact silty fine sand at various locations and depths. The soils within a depth of 0.4± to 1.5± m from the prevailing ground surface have generally been weathered. The soil overlies shale bedrock within the eastern portion of the site at depths ranging from 0.8± to 8.5± m below the prevailing ground surface; the upper layer of the shale bedrock within a depth of 1.0± to 3.0± m from the bedrock surface is in a weathered condition.

Groundwater/cave-in levels were detected in 17 of the 26 boreholes upon completion of the field work at depths of 1.5± to 7.3± m below the prevailing ground surface. The rest of the boreholes remained dry upon their completion. The groundwater level will fluctuate with the seasons and may be affected by the water level at Fourteen Mile Creek. Perched groundwater derived from infiltrated precipitation may occur at shallow depths during wet seasons.

If groundwater is encountered from the silty clay till and silty clay, the yield is expected to be small and limited, and the yield of groundwater from the silty sand till and sandy silt till may be some to moderate, while the yield of groundwater from the silts and sands will be moderate to appreciable, and likely persistent, depending on their extent and continuity. In the shale bedrock, the yield may be appreciable initially in localized places due to possible occurrence of groundwater pockets under subterranean artesian pressure; however, if allowed to drain freely, it will often dissipate or be depleted with time.

The geotechnical findings which warrant special consideration are presented below:

1. The topsoil is unsuitable for engineering applications and must be removed. For the environmental as well as the geotechnical well-being of the future development, it should not be buried below any structures or deeper than 1.2 m below the exterior finished grade. Fertility testing can be carried out to assess the suitability of the topsoil as landscaping material.
2. Due to its unknown history, loose density and the presence of topsoil and organic inclusions, the earth fill is unsuitable for supporting any structures in its current condition. In using the fill for structural backfill, or in pavement or slab-on-grade construction, it should be subexcavated, inspected, sorted free of topsoil inclusions and any deleterious materials, aerated and properly recompacted in thin lifts. If it is impractical to sort the topsoil and other deleterious materials from the fill, the fill must be wasted and replaced with properly compacted inorganic earth fill.
3. The badly weathered soils are not suitable to support any structural loads. The weathered soils must be subexcavated, sorted free of any topsoil inclusions or deleterious material and aerated before being used as structural backfill or for the construction of engineered fill at the site.
4. The sound natural soils below the topsoil, earth fill and weathered soils are suitable for normal spread and strip footing construction. The footing subgrade must be inspected by a geotechnical engineer, or a geotechnical technician under the supervision of a geotechnical engineer, or a building inspector with geotechnical experience, to ensure that its condition is compatible with the design of the foundation.

5. Extended footings and/or cut and fill may be required for the site grading. It is generally more economical to place engineered fill for normal footing, sewer and road construction.
6. Some of the in situ soils have high soil-adfreezing potential. Special measures must be implemented in the project construction to minimize the risk of damage to the foundations caused by frost action.
7. Existing ponds must be properly decommissioned and backfilled for the construction of the project.
8. For slab-on-grade construction, the slab should be constructed on a granular base, 20 cm thick, consisting of 20-mm Crusher-Run Limestone, or equivalent, compacted to its maximum Standard Proctor dry density.
9. A Class 'B' bedding, consisting of compacted 20-mm Crusher-Run (graded) Limestone, is recommended for the construction of the underground services. Where water-bearing silts and sands are present, the pipe joints should be leak-proof, or wrapped with an appropriate waterproof membrane. Where extensive dewatering is required, a Class 'A' bedding should be considered.
10. Where underground services or building foundations are to be placed into the shale bedrock, the trench sides should be slightly sloped rather than vertical due to the residual stress relief and the swelling characteristics of the shale. The side slopes should be lined with a cushioning layer such as compressible Styrofoam.
11. Where the proposed services are to be constructed adjacent to and/or beneath the existing services, the existing services must be properly secured.
12. Excavation should be carried out in accordance with Ontario Regulation 213/91.
13. In general, open-cut excavation can be carried out in the weathered shale by using a backhoe equipped with a rock-ripper; however, where deep excavation is required, pneumatic hammering with chisel points may be necessary for efficient rock removal.

The recommendations appropriate for the project described in Section 2.0 are presented herein. One must be aware that the subsurface conditions may vary between boreholes. Should subsurface variances become apparent during construction, a geotechnical engineer must be consulted to determine whether the following recommendations require revision.

6.1 **Foundations**

The borehole logs and borehole plan for the geotechnical investigation conducted in 2012 are presented in the Appendix.

For the proposed subdivision, it is recommended that the normal spread and strip footings be placed below the topsoil, earth fill and weathered soils onto the sound natural soils, engineered fill or shale bedrock. Based on the borehole findings of the 2012 investigation and the current investigation, a Maximum Allowable Soil Pressure (SLS) of 300 kPa and a Factored Ultimate Soil Bearing Pressure (ULS) of 500 kPa are recommended for design of the footings for the proposed residential subdivision at a founding level of 1.0 to 1.5 m or + below the prevailing ground surface at most borehole locations. At Boreholes 22, 24 and MW25, due to the depth of the fill and relatively loose sand encountered in these areas, the recommended founding levels are at depth of 3.0 to 7.5 m or + below the prevailing ground surface.

One must be aware the recommended soil pressures and corresponding founding depths are given as a guide for foundation design and must be confirmed by a subgrade inspection performed by a geotechnical engineer at each of the building locations.

In areas where foundations are to be extended, it may be more cost effective to subexcavate to a size 30% larger than the designed footing width and fill with lean concrete up to the normal footing elevation immediately after the suitable founding soil is exposed.

The existing fill and weathered soils can be subexcavated and replaced with engineered fill. Furthermore, where extended footings are required or where fill is required to raise the grade, engineered fill suitable for normal footing construction can be considered. A Maximum Allowable Soil Pressure (SLS) of 150 kPa and a Factored Ultimate Soil Bearing Pressure (ULS) of 250 kPa are recommended for footings founded on engineered fill. The fill must be certified by the geotechnical consultant that supervised and inspected the fill placement. Details of engineered fill are provided in Section 6.2 of this report.

The recommended bearing pressures (SLS) for normal footings incorporate a safety factor of 3. The total and differential settlements of the footings are estimated to be 25 mm and 15 mm, respectively.

Due to the presence of topsoil, earth fill and weathered soils, the footing subgrade must be inspected by a geotechnical engineer, or a geotechnical technician under the supervision of a geotechnical engineer, or a building inspector with geotechnical experience, to assess its suitability for bearing the designed foundations.

Footings exposed to weathering, and in unheated areas, should have at least 1.2 m of earth cover for protection against frost action.

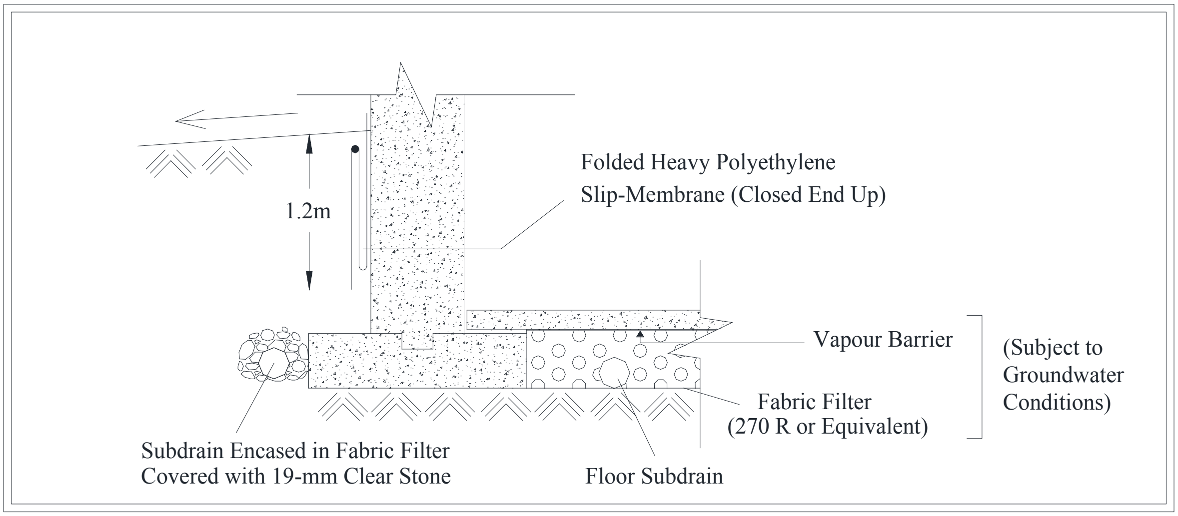
If excavation into the shale is to be carried out close to the foundation walls, the sides of excavation into sound shale should be shielded by compressible Styrofoam (or equivalent). This will provide a cushioning layer against movement of the shale that may damage the basement walls.

Perimeter subdrains and dampproofing of the foundation walls will be required. All the subdrains should be encased in a fabric filter to protect them against blockage by silting.

It should be noted that if groundwater seepage is encountered during the footing excavations, or where the subgrade of the normal foundations is found to be wet, the subgrade should be protected by a concrete mud-slab immediately after exposure. This will prevent construction disturbance and costly rectification.

Some of the in situ soils have high soil-adfreezing potential. Where these material are used to backfill against foundations, the foundation walls must be constructed of concrete and either backfilled with non-frost-susceptible pit-run granular, or should be properly shielded with a polyethylene slip-membrane extending below the frost depth to alleviate the risk of frost damage. If the proposed structures have a basement and groundwater seepage is detected at the time of foundation excavation, under-floor subdrains may be installed and they must be connected to sump-wells, or to the drains which have a positive outlet. Also, a vapour barrier should be installed to prevent upfiltration of soil moisture that may wet the floor. The recommended measures are schematically presented in Diagram 1.

Diagram 1 - Frost Protection Measures (Foundation)



The necessity to implement the above measures should be assessed at the time of construction.

The foundations should meet the requirements specified in the latest Ontario Building Code, and the structure should be designed to resist an earthquake force using Site Classification ‘C’ (very dense soil and soft rock).

6.2 **Engineered Fill**

The existing fill and weathered soils can be upgraded to or replaced with engineered fill, and where earth fill is required to raise the site or extended footings are required, it is generally more economical to place engineered fill for normal footing, underground services and pavement construction. The engineering requirements for a certifiable fill for pavement construction, municipal services, slab-on-grade, and footings designed with a Maximum Allowable Soil Pressure (SLS) of 150 kPa and a Factored Ultimate Soil Bearing Pressure (ULS) of 250 kPa are presented below:

1. All of the topsoil and organics must be removed, and the subgrade must be inspected and proof-rolled prior to any fill placement. The existing earth fill and badly weathered soils must be subexcavated, sorted free of topsoil inclusions and deleterious materials, if any, aerated and properly compacted. The subgrade should be inspected and proof-rolled prior to filling.
2. Existing ponds within the property should be properly decommissioned and all sediment and soft soils must be removed from the sides and bottom of the pond prior to placement of engineered fill.
3. Inorganic soils must be used, and they must be uniformly compacted in lifts of 20 cm thick to 98% or + of their maximum Standard Proctor dry density, up to the proposed finished grade and/or slab-on-grade subgrade. The soil moisture must be properly controlled on the wet side of the optimum. If the foundations are to be built soon after the fill placement, the densification process for the engineered fill must be increased to 100% of the maximum Standard Proctor compaction.
4. If imported fill is to be used, the hauler is responsible for its environmental quality and must provide a document to certify that the material is free of hazardous contaminants.
5. If the engineered fill is to be left over the winter months, adequate earth cover, or equivalent, must be provided for protection against frost action.
6. The engineered fill must extend over the entire graded area; the engineered fill envelope and finished elevations must be clearly and accurately defined in the field, and they must be precisely documented by qualified surveyors. Foundations partially on engineered fill must be reinforced by two 15-mm steel reinforcing bars in the footings and upper section of the foundation and basement walls, or be designed by a structural engineer, to properly distribute the stress induced by the abrupt differential settlement (estimated to be 15± mm) between the natural soils and engineered fill.

7. The engineered fill must not be placed during the period from late November to early April, when freezing ambient temperatures occur either persistently or intermittently. This is to ensure that the fill is free of frozen soils, ice and snow.
8. Where the ground is wet due to subsurface water seepage, an appropriate subdrain scheme must be implemented prior to the fill placement, particularly if it is to be carried out on sloping ground or a bank.
9. Where fill is to be placed on a bank steeper than 1 vertical:3 horizontal, the face of the bank must flattened to 3+ so that it is suitable for safe operation of the compactor and the required compaction can be obtained.
10. The fill operation must be inspected on a full-time basis by a technician under the direction of a geotechnical engineer.
11. The footing and underground services subgrade must be inspected by the geotechnical consulting firm that inspected the engineered fill placement. This is to ensure that the foundations are placed within the engineered fill envelope, and the integrity of the fill has not been compromised by interim construction, environmental degradation and/or disturbance by the footing excavation.
12. Any excavation carried out in certified engineered fill must be reported to the geotechnical consultant who inspected the fill placement in order to document the locations of the excavation and/or to inspect reinstatement of the excavated areas to engineered fill status. If construction on the engineered fill does not commence within a period of 2 years from the date of certification, the condition of the engineered fill must be assessed for re-certification.
13. Despite stringent control in the placement of the engineered fill, variations in soil type and density may occur in the engineered fill. Therefore, the strip footings and the upper section of the foundation walls constructed on the engineered fill may require continuous reinforcement with steel bars, depending on the uniformity of the soils in the engineered fill and the thickness

of the engineered fill underlying the foundations. Should the footings and/or walls require reinforcement, the required number and size of reinforcing bars must be assessed by considering the uniformity as well as the thickness of the engineered fill beneath the foundations. In sewer construction, the engineered fill is considered to have the same structural proficiency as a natural inorganic soil.

If the shale spoil is intended for use as structural fill, it must be piled thinly on the ground for optimum exposure to weathering. Any remaining hard limy or sandy slabs must be pulverized to sizes less than 15 cm or must not be used for structural backfill and/or construction of engineered fill. It should be noted that if the shale spoil is to be left on the ground surface for weathering, it will swell and result in a significant increase in soil volume. This phenomenon must be considered in the cut and fill calculations.

6.3 **Slab-On-Grade**

The subgrade for the slab-on-grade must consist of sound natural soils, shale bedrock or properly compacted inorganic fill. In preparation of the subgrade, it must be inspected and assessed by proof-rolling. The topsoil must be removed; the earth fill, badly weathered soils or any soft or loose soils should be subexcavated, sorted free of any deleterious material, aerated and uniformly compacted to 98% or + of its maximum Standard Proctor dry density. If the deleterious materials cannot be sorted, the soils should be replaced by properly compacted, organic-free earth fill.

Any new material for raising the grade should consist of organic-free soil compacted to at least 98% of its maximum Standard Proctor dry density.

If the subgrade has been loosened due to construction traffic, it must be proof-rolled before placement of the granular base.

The slab should be constructed on a granular base, 20 cm thick, consisting of 20-mm Crusher-Run Limestone, or equivalent, compacted to its maximum Standard Proctor dry density.

A Modulus of Subgrade Reaction of 25 MPa/m can be used for the design of the floor slab.

The slab-on-grade in open areas should be designed to tolerate frost heave, and the grading around the slab-on-grade and building structures must be such that it directs runoff away from the structures.

6.4 **Underground Services**

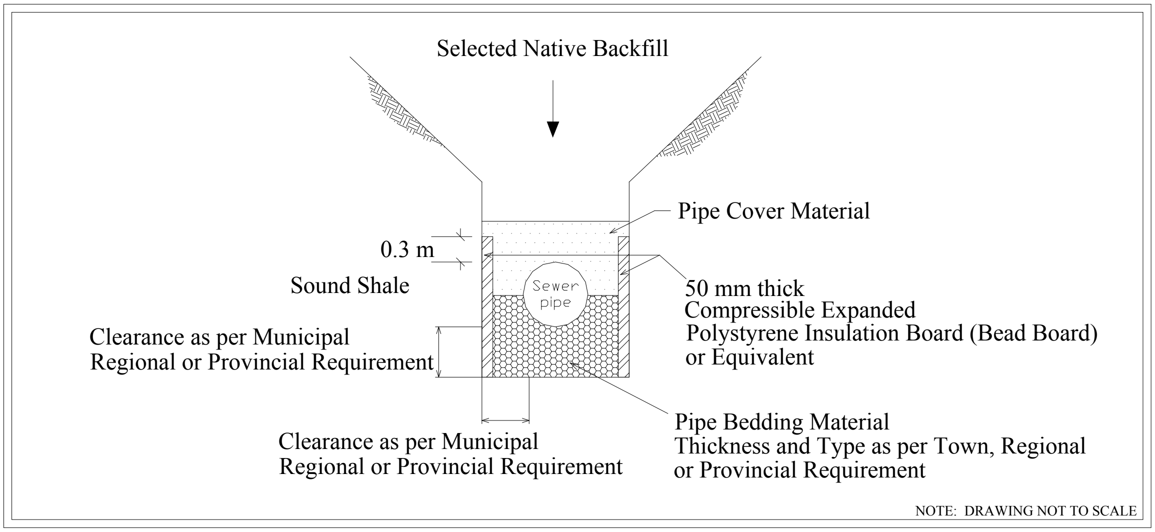
The subgrade for the underground services should consist of sound natural soils or properly compacted organic-free earth fill. Where topsoil, organic earth fill or badly weathered soils are encountered, it should be subexcavated and replaced with bedding material compacted to at least 95% or + of its Standard Proctor compaction.

A Class ‘B’ bedding is recommended for the underground services construction. The bedding material should consist of compacted 20-mm Crusher-Run Limestone, or equivalent, or as approved by a geotechnical engineer. The bedding material must meet the requirements prescribed by the Ontario Provincial Standards (OPS), Region of Halton and Town of Oakville. Pipe bedding consisting of HL-6 is acceptable provided the bedding is wrapped with filter cloth. In the areas where extensive dewatering is required, a Class ‘A’ bedding will be required.

Where wet or water-bearing silts or sands occur, the pipe joints should be leak-proof, or the joints should be wrapped with a waterproof membrane, to prevent subgrade upfiltration through the joints.

Where underground services are to be placed in sound shale, the trench sides should be sloped rather than vertical, due to the residual stress relief and the swelling characteristics of the shale. The side slopes should be no steeper than 2 vertical: 1 horizontal. The rock face can be lined with a cushioning layer such as Styrofoam, to reduce the residual stress exerted on the buried structure, and then backfilled with sand up to 0.3 m above the crown of the pipe and flooded. The recommended scheme is illustrated in Diagram 2.

Diagram 2 - Sewer Installation in Sound Shale



In order to prevent pipe floatation when the sewer trench is deluged with water, a soil cover at least equal in thickness to the diameter of the pipe should be in place at all times after completion of the pipe installation.

Openings to subdrains and catch basins should be shielded with a fabric filter to prevent blockage by silting.

Since the silty clay has moderately high corrosivity to buried metal, all metal fittings for the underground services should be protected against soil corrosion. In determining the mode of protection, an electrical resistivity of 2500 ohm·cm should be used. This, however, should be confirmed by testing the soil along the water main alignment at the time of services construction.

6.5 Backfilling in Trenches and Excavated Areas

The on-site inorganic soils are generally suitable for use as trench backfill. However, the soils should be sorted free of any topsoil inclusions and other deleterious materials prior to the backfilling. The soils should be sorted free of any large pieces (over 15 cm in size) of limestone bands and shale fragments, or the large pieces must be broken into sizes suitable for structural compaction.

The excavated shale can be pulverized to sizes less than 15 cm and thoroughly mixed with the overburden soils. The trench can then be backfilled by levelling the debris using a bulldozer with lifts no more than 20 cm (loose) in thickness. Compaction should be carried out by a vibratory sheepsfoot roller, with water constantly sprayed on each lift.

The backfill in trenches and excavated areas should be compacted to at least 95% of its maximum Standard Proctor dry density. In the zone within 1.0 m below the pavement subgrade, the materials should be compacted with the water content 2% to 3% drier than the optimum, and the compaction should be increased to at least 98% of the respective maximum Standard Proctor dry density. This is to provide the required stiffness for pavement construction. In the lower zone, the compaction should be carried out on the wet side of the optimum; this allows a wider latitude of lift thickness. Wetting of the sound till may be necessary to achieve this requirement. Backfill below any slab-on-grade which is sensitive to settlement must be compacted to at least 98% of its maximum Standard Proctor dry density.

In normal underground services construction practice, the problem areas of settlement largely occur adjacent to manholes, catch basins, services crossings, foundation walls and columns. The lumpy clays and broken shale are generally difficult to compact in these close quarters, and it is recommended that a sand backfill should be used. Imported sand backfill should also be used in areas which are inaccessible to a heavy compactor. Unless compaction of the backfill is carefully performed, the interface of the native soils and the sand backfill will have to be flooded for a period of several days.

The narrow trenches for services crossings should be cut at 1 vertical:
2 or + horizontal so that the backfill can be effectively compacted. Otherwise, soil arching will prevent the achievement of proper compaction. The lift of each backfill layer should either be limited to a thickness of 20 cm, or the thickness should be determined by test strips.

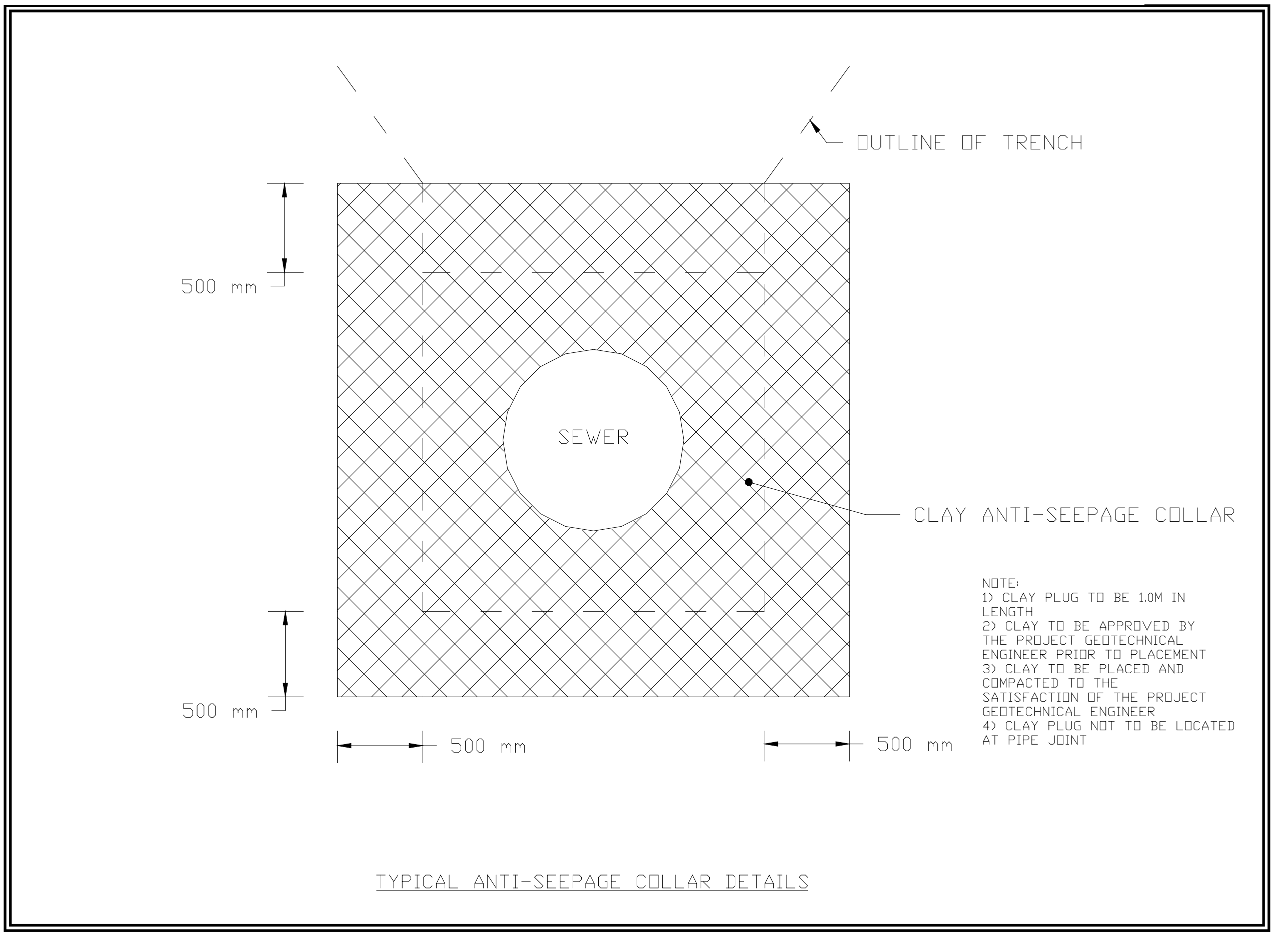
One must be aware of the possible consequences during trench backfilling and exercise caution as described below:

- When construction is carried out in freezing winter weather, allowance should be made for these following conditions. Despite stringent backfill monitoring, frozen soil layers may inadvertently be mixed with the structural trench backfill. Should the in situ soils have a water content on the dry side of the optimum, it would be impossible to wet the soils due to the freezing condition, rendering difficulties in obtaining uniform and proper compaction. Furthermore, the freezing condition will prevent flooding of the backfill when it is required, such as in a narrow vertical trench section, or when the trench box is removed, or when backfill consists of shale mixture. The above will invariably cause backfill settlement that may become evident within 1 to several years, depending on the depth of the trench which has been backfilled.

- In areas where the construction is carried out during the winter months, prolonged exposure of the trench walls will result in frost heave within the soil mantle of the walls. This may result in some settlement as the frost recedes, and repair costs will be incurred prior to final surfacing of the new pavement and the slab-on-grade construction.
- To backfill a deep trench, one must be aware that future settlement is to be expected, unless the side of the cut is flattened to at least 1 vertical: 1.5+ horizontal, and the lifts of the fill and its moisture content are stringently controlled; i.e., lifts should be no more than 20 cm (or less if the backfilling conditions dictate) and uniformly compacted to achieve at least 95% of the maximum Standard Proctor dry density, with the moisture content on the wet side of the optimum.
- It is often difficult to achieve uniform compaction of the backfill in the lower vertical section of a trench which is an open cut or is stabilized by a trench box, particularly in the sector close to the trench walls or the sides of the box. These sectors must be backfilled with sand. In a trench stabilized by a trench box, the void left after the removal of the box will be filled by the backfill. It is necessary to backfill this sector with sand, and the compacted backfill must be flooded for 1 day, prior to the placement of the backfill above this sector; i.e., in the upper sloped trench section. This measure is necessary in order to

prevent consolidation of inadvertent voids and loose backfill which will compromise the compaction of the backfill in the upper section. In areas where groundwater movement is expected in the sand fill mantle, anti-seepage collars should be provided. Typical anti-seepage collar details are illustrated in Diagram 3.

Diagram 3 - Typical Anti-Seepage Collar Details



NOTE:
1) CLAY PLUG TO BE 1.0M IN LENGTH
2) CLAY TO BE APPROVED BY THE PROJECT GEOTECHNICAL ENGINEER PRIOR TO PLACEMENT
3) CLAY TO BE PLACED AND COMPACTED TO THE SATISFACTION OF THE PROJECT GEOTECHNICAL ENGINEER
4) CLAY PLUG NOT TO BE LOCATED AT PIPE JOINT

TYPICAL ANTI-SEEPAGE COLLAR DETAILS

6.6 **Sidewalks, Interlocking Stone Pavement and Landscaping**

Interlocking stone pavement, sidewalks and landscaping structures in areas which are sensitive to frost-induced ground movement must be constructed on a free-draining, non-frost-susceptible granular material such as Granular ‘B’. The material must extend to 0.3 to 1.2 m below the sidewalk, slab or pavement surface, depending on the degree of tolerance for ground movement, and be provided with positive drainage, such as weeper subdrains connected to manholes or catch basins. Alternatively, the landscaping structures, sidewalks and interlocking stone pavement should be properly insulated with 50-mm Styrofoam, or equivalent.

6.7 Pavement Design

The recommended pavement design for various roads meeting the Town of Oakville standards is given in Table 4.

Table 4 - Pavement Design (Roads)

Course	Thickness (mm)	OPS Specifications
Asphalt Surface	40	HL-3
Asphalt Binder Residential Industrial, Collector and Bus Route	 50 80	HL-8
Granular Base	150	Granular 'A' or equivalent
Granular Sub-base Residential Industrial, Collector and Bus Route	 350 450	50-mm Crusher-Run Limestone or equivalent

For driveways and driveway aprons, the recommended pavement design meeting the Town of Oakville standards is given in Table 5.

Table 5 - Pavement Design (Driveways and Driveway Aprons)

Course	Thickness (mm)	OPS Specifications
Asphalt Surface	50	HL-3A
Granular Base	150	19-mm Crusher-Run Limestone

In preparation of the subgrade, the topsoil should be stripped and removed, and the subgrade surface must be proof-rolled. The earth fill, weathered soils and any soft/loose subgrade must be subexcavated, sorted free of any deleterious materials, aerated and properly compacted. If the deleterious materials cannot be sorted, the soils should be replaced by properly compacted, organic-free earth fill or granular materials. Earth fill used to raise the grade for pavement construction should consist of organic-free soil uniformly compacted to 95% or + of its maximum Standard Proctor dry density.

All the granular bases should be compacted to 100% of their maximum Standard Proctor dry density.

In the zone within 1.0 m below the road subgrade, the backfill should be compacted to at least 98% of its maximum Standard Proctor dry density, with the water content 2% to 3% drier than the optimum. In the lower zone, a 95% or + Standard Proctor compaction is considered adequate.

The pavement subgrade will suffer a strength regression if water is allowed to saturate the mantle. The following measures should, therefore, be incorporated into the construction procedures and pavement design:

- If the pavement construction does not immediately follow the trench backfilling, the subgrade should be properly crowned and smooth-rolled to allow interim precipitation to be properly drained.
- Areas adjacent to the pavement should be properly graded to prevent ponding of large amounts of water during the interim construction period.
- Curb subdrains will be required. The subdrains should consist of filter-sleeved weepers to prevent blockage by silting.

- If the pavement is to be constructed during wet seasons and extensively soft subgrade occurs, the granular sub-base should be thickened in order to compensate for the inadequate strength of the subgrade. This can be assessed during construction.

Along the perimeter where surface runoff may drain onto the pavement, a swale or an intercept subdrain system should be installed to prevent infiltrating precipitation from seeping into the granular bases (since this may inflict frost damage on the flexible pavement). The subdrains should consist of filter-wrapped weepers, and they should be connected to the catch basins and storm manholes in the paved areas. The subdrains should be backfilled with free-draining granular material.

6.8 **Stormwater Management Pond** (Boreholes S14 and S15, and Test Pit STP29)

The stormwater management (SWM) pond is located in the east portion of the site.

According to the SWM Pond detail drawing, dated January 2017, prepared by David Schaeffer Engineering Ltd., the side slopes of the pond range from 1.5± to 6.5± m in height; this includes the dividing slopes between the pond and forebays. The proposed elevation for the bottom of the pond is El. 118.40 m, with the top elevation ranging from approximately El. 123.75 m to El. 124.90 m. The designed permanent pool will be at El. 121.40 m.

Based on the borehole and test pit findings, the area of the proposed pond consists of silty clay till overlaying shale bedrock at a depth of 1.5± to 3.0± m below the prevailing ground surface, or El. 121.7± to 122.7± m. The boreholes and test pit were found to be dry upon their completion.

The silty clay till has an estimated coefficient of permeability of 10^{-7} cm/sec with an estimated percolation time of 80+ min/cm, while the shale bedrock is considered to be relatively impermeable. As such, the seepage of groundwater into the pond constructed will likely be equal to or less than the amount of water lost through evaporation. The impact on the storage volume of the pond will be minimal. The in situ silty clay till and shale bedrock are suitable for the pond construction. If necessary, a clay liner, at least 1.0 m thick, compacted to at least 98% of its maximum Standard Proctor dry density, should be installed on the sides or bottom of the pond if permeable sand or silt layers, or cracks within the shale bedrock are encountered within the pond envelope and should extend to 1.0 m (minimum) above the permanent pool level. The extent of the clay liner and its implementation can be assessed at the time of the pond construction. The in situ clay material is suitable for use as a clay liner material, if required.

The side slopes should be surface compacted. The side slopes are proposed with gradients of 1 vertical:3 to 7 horizontal, with the side slope below the designed permanent pool elevation being no steeper than 1 vertical:4 horizontal; this is considered to be geotechnically acceptable. Where the deep pool area is entirely within the shale bedrock, a side slope of 1 vertical:3 horizontal is acceptable. All the proposed slopes must be vegetated and/or sodded to prevent erosion.

One should be aware that minor maintenance may be required after rapid drawdown as the water recedes from a high level to a lower level.

For construction of the pond and earth berm around the pond, the topsoil and topsoil fill must be removed and the subgrade must be proof-rolled. The existing earth fill and weathered soils should be subexcavated, inspected, sorted free of any deleterious materials, aerated and properly compacted. Inorganic clay material compacted to at least 98% of its maximum Standard Proctor dry density in 20 cm lifts, must be used. The in situ silty clay is suitable for berm construction.

The footings for all control structures for the SWM pond and associated outfall will be placed onto the natural sound clay till, or likely shale bedrock. The Maximum Allowable Soil Pressures (SLS) and Factored Ultimate Soil Bearing Pressures (ULS), along with the suitable founding levels for the design footings are presented in Table 6.

Table 6 - Founding Levels for SWM Pond Control Structures

BH No.	Recommended Maximum Allowable Soil Pressure (SLS)/ Factored Ultimate Soil Bearing Pressure (ULS) and Suitable Founding Level			
	300 kPa (SLS) 500 kPa (ULS)		500 kPa (SLS) 800 kPa (ULS)	
	Depth (m)	El. (m)	Depth (m)	El. (m)
S14	1.0 or +	123.7 or -	2.4 or +	122.3 or -
S15	1.0 or +	123.2 or -	1.8 or +	122.4 or -
S16	-	-	1.0 or +	121.7 or -
S17	-	-	1.0 or +	120.0 or -

The footings must be placed below the frost depth of 1.2 m, or below the scouring depth, whichever is deeper. The footing subgrade must be inspected by a geotechnical engineer prior to concrete pouring to ensure its conformity to the design.

6.9 **Stormwater Management Pond Outfall System** (Boreholes S14, S15, S16 and S17, and Test Pit STP29)

The SWM Pond detail drawing indicates that the proposed storm sewer is to run in the north-south direction from the proposed SWM pond to the existing slope. The sewer is to be installed by trenchless technology where it is to cross under the existing 2400 mm diameter CPP sanitary sewer, and also at the outfall at the existing slope. The remainder of the sewer is to be installed by open-cut.

Based on drawings provided, the storm sewer is to be installed in the shale bedrock.

Storm Sewer Construction using Open-Cut Method

Where the concrete storm sewer is to be constructed using the open-cut method, the excavation must be carried out in accordance with Ontario Regulation 213/91. The sides should be 1 vertical:1 or + horizontal, or they should be stabilized by shoring or the use of a trench box. In shale bedrock, a cut steeper than 1 vertical: 1 horizontal may be allowed, provided that the bedding plane of the rock is horizontal and loose rocks protruding from the excavation are removed for safety.

Recommendations presented in Section 6.4 should be followed for underground services construction.

Trenchless Construction Method

Trenchless construction will be carried out through the shale; this will likely consist of micro tunnelling or horizontal directional drilling (HDD). The noted characteristics of the shale per 0.3 m wide strip are listed in Table 7.

Table 7 - Soil Characteristics for Tunnelling

Material	**Characteristics**
Shale	Soft Rock, slowly ravelling, stand-up time of over 60 min to 24 hours

Where a liner is required for the sewer construction, it should be designed with an overburden load per linear metre as given in the following:

$Q = W \times B^2$ + traffic load
$W = 24.0$ kN/m^3
B = diameter of liner in metres

The soil friction on the liner can be calculated by multiplying the overburden at the midpoint of the liner by the frictional coefficient of 0.35.

If HDD is proposed, it must be properly designed by a qualified HDD contractor. Appropriate measures such as earth cover and regulation of drilling pressure must be implemented by the HDD contractor in order to prevent frac-out; however, due to the presence of shale bedrock and cohesive soils along the alignment, the occurrence of frac-outs is unlikely.

The tunnelling must be carefully carried out, and if it is suspected that a cavity has occurred above or around the liner, trial grouting should be implemented.

In some instances, shale contains occasional pockets of groundwater trapped in the rock fissures, and the groundwater may be under moderate subterranean artesian pressure. Upon release through excavation, this water will likely drain readily with limited yield. Detailed discussion and planning must be carried out with the tunnelling contractor to assess the cost impact and time required to complete the tunnelling.

Due to the residual stress relief and swelling characteristics of the sound shale, a steel liner must be installed to prevent the services from suffering stress damage.

Pit Construction

The cuts for the access pits must be carried out in a manner in accordance with Ontario Regulation 213/91. The pit must be cut at 1 vertical:1 or + horizontal, and no steeper than 2 vertical:1 horizontal in the shale bedrock. Recommendations presented in Sections 6.4 and 6.12 should be followed for trenching within shale bedrock.

In order to prevent overstressing along the sides of the pits, the excavated spoil should be placed a distance away from the edge of the pits equal to 2 times the depth of the pits.

If groundwater is encountered at shallow depths, dewatering may be required for the pit construction.

Slope Concern

The installation of the sewer and the construction of the headwall and wingwalls will disturb the slope at the outfall. Where this is the case, the slope should be re-engineered, and the re-engineered slope should be graded at 1 vertical: 3 or + horizontal.

6.10 Bridge Foundation and Construction

For the proposed bridge, it is recommended that the normal spread and strip footings be placed below the topsoil, earth fill and weathered soils onto the sound natural soils, engineered fill or shale bedrock. As a general guide, Maximum Allowable Soil Pressures (SLS) of 300 kPa and 500 kPa, and Factored Ultimate Soil Bearing Pressures (ULS) of 500 kPa and 800 kPa, are recommended for design of the footings at founding depths of 1.0 m or + and 3.3 m or +, respectively, below the prevailing ground surface.

Bridge foundations, as well as wing walls and headwalls, should have at least 1.2 m of soil cover for frost protection, or should extend to a depth below the expected scouring depth, whichever is greater.

To backfill the wing walls, headwalls and abutments, the lateral earth pressure coefficients are given in Table 8.

Table 8 - Earth Pressure Coefficients for Wing Walls and Head Walls

	Active K_a	**Active K_a with Compacted Loads**	**At Rest K_0**	**Passive K_p**
Granular 'A'	0.30	0.50	0.45	3.00
Granular 'B'	0.35	0.60	0.55	2.80
Compacted Fill	0.45	0.70	0.60	2.20

The design of the walls and abutments should incorporate the lateral earth pressure due to compactive loads.

In order to prevent water from ponding against the structures and to avoid a build-up of ice pressure during cold weather, a drainage system must be provided behind the walls. Weep holes should also be provided against the back of the walls and the walls should be backfilled with free-draining granular material to facilitate the drainage of infiltrating water.

All of the backfill must consist of inorganic material and be uniformly compacted to 95% or + of its maximum Standard Proctor dry density.

6.11 Soil Parameters

The recommended soil parameters for the project design are given in Table 9.

Table 9 - Soil Parameters

Unit Weight and Bulk Factor

	Unit Weight (kN/m^3)		**Estimated Bulk Factor**	
	Bulk	**Submerged**	**Loose**	**Compacted**
Earth Fill	20.0	11.5	1.20	0.98
Silty Clay Till	22.0	12.5	1.33	1.05
Sandy Silt Till and Silty Sand Till	22.5	12.5	1.33	1.10
Sands	20.0	10.8	1.25	0.95
Silty Clay	20.5	11.5	1.30	1.00
Silt	21.0	10.5	1.20	1.00
Sandy Silt and Silty Fine Sand	20.5	10.5	1.20	0.98
Broken Shale	24.0	14.0	1.50	1.15

Table 9 - Soil Parameters (cont'd)

Lateral Earth Pressure Coefficients	**Active** K_a	**At Rest** K_0	**Passive** K_p
Earth Fill and Silty Clay	0.40	0.56	2.50
Silty Clay Till	0.33	0.50	3.00
Sandy Silt/Silty Sand Tills, Silts and Silty Fine Sand	0.32	0.48	3.12
Sands	0.29	0.46	3.39
Broken Shale	0.25	0.35	4.00
Coefficients of Friction			
Between Concrete and Granular Base		0.60	
Between Concrete and Sound Natural Soils		0.40	
Maximum Allowable Soil Pressure (SLS) For Thrust Block Design			
Engineered Fill		75 kPa	
Sound Natural Soils		100 kPa	

6.12 Excavation

Where the new services are to be cut close to any existing underground services, one must be aware that the backfill for the existing underground services is amorphous in structure and is susceptible to sloughing and sudden side collapse. Extreme caution must be exercised when excavating the existing backfilled services trenches; the sides of the cuts in the backfill will readily slough and may collapse suddenly. The existing services must be properly secured for the new/replacement services construction. The stability of the new trench and the existing services must be ensured by flattening the slope of the cut, by shoring or by the use of a trench box.

Excavation should be carried out in accordance with Ontario Regulation 213/91.

Excavations in excess of 1.2 m should be sloped at 1 vertical:1 horizontal for stability. In the earth fill, weathered soils, and/or where groundwater is encountered, the sides of excavations may need to be flattened to 1 vertical:1.5 or + horizontal for stability.

For excavation purposes, the types of soils are classified in Table 10.

Table 10 - Classification of Soils for Excavation

Material	Type
Sound Shale Bedrock	1
Sound Natural Soils and weathered Shale Bedrock	2
Earth Fill, weathered Soils, and dewatered Silts and Sands	3
Saturated Silts and Sands	4

Excavation into the weathered shale, or the tills containing boulders or large shale fragments, may require extra effort and the use of a heavy-duty backhoe. Boulders and shale fragments larger than 15 cm in size are not suitable for structural backfill and/or construction of engineered fill.

If groundwater is encountered from the silty clay till and silty clay, the yield is expected to be small and limited, due to the low permeability of the soils, and the yield of groundwater from the silty sand till and sandy silt till may be some to moderate, while the yield of groundwater from the silts and sands will be moderate to appreciable, and likely persistent, depending on their extent and continuity.

In shale bedrock, a cut steeper than 1 vertical:1 horizontal may be allowed, provided that the bedding plane of the rock is horizontal and loose rocks protruding from the excavation are removed for safety. The weathered shale or the hard clay till containing shale fragments will require extra effort for excavation using heavy-duty mechanical equipment, and a rock-ripper will be required to facilitate the excavation. This method can generally be employed to excavate the weathered shale to a depth of 3.0± m below the bedrock surface. Excavation into the sound shale may require the aid of pneumatic hammering.

Where excavation is to be carried out in the wet or water-bearing silts and/or sands, the possibility of flowing sides and bottom boiling dictates that the ground be predrained by pumping from closely spaced sump-wells or, if necessary, the use of a well-point dewatering system. This should be assessed by test pumping prior to the project construction when the intended bottom of excavation is determined. In order to provide a stable subgrade for the services or foundation construction, the groundwater should be depressed at least 1.0 m below the subgrade level.

Alternatively, sheeting structures can be installed around the excavation. The sheeting structure should be driven to a depth below the bottom of the excavation at least equal to the height of water above the bed of excavation. The sheeting structure must be properly designed to sustain the earth pressure, hydrostatic pressure and applicable surcharge loads.

Prospective contractors must be asked to assess the in situ subsurface conditions for soil cuts by digging test pits to at least 0.5 m below the intended bottom of excavation. These test pits should be allowed to remain open for a period of at least 4 hours to assess the trenching conditions.

7.0 LIMITATIONS OF REPORT

This report was prepared by Soil Engineers Ltd. for the account of Bronte Green Corporation and for review by its designated consultants and government agencies. Use of the report is subject to the conditions and limitations of the contractual agreement. The material in it reflects the judgement of Mumta Mistry, B.A.Sc., and Bernard Lee, P.Eng., in light of the information available to it at the time of preparation. Any use which a Third Party makes of this report, or any reliance on decisions to be made based on it, are the responsibility of such Third Parties. Soil Engineers Ltd. accepts no responsibility for damages, if any, suffered by any Third Party as a result of decisions made or actions based on this report.

SOIL ENGINEERS LTD.

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PROVINCE OF ONTARIO

LIST OF ABBREVIATIONS AND DESCRIPTION OF TERMS

The abbreviations and terms commonly employed on the borehole logs and figures, and in the text of the report, are as follows:

SAMPLE TYPES

AS	Auger sample
CS	Chunk sample
DO	Drive open (split spoon)
DS	Denison type sample
FS	Foil sample
RC	Rock core (with size and percentage recovery)
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

PENETRATION RESISTANCE

Dynamic Cone Penetration Resistance:

A continuous profile showing the number of blows for each foot of penetration of a 2-inch diameter, 90° point cone driven by a 140-pound hammer falling 30 inches.

Plotted as '—●—'

Standard Penetration Resistance or 'N' Value:

The number of blows of a 140-pound hammer falling 30 inches required to advance a 2-inch O.D. drive open sampler one foot into undisturbed soil.

Plotted as '○'

WH	Sampler advanced by static weight
PH	Sampler advanced by hydraulic pressure
PM	Sampler advanced by manual pressure
NP	No penetration

SOIL DESCRIPTION

Cohesionless Soils:

'N' (blows/ft)	Relative Density
0 to 4	very loose
4 to 10	loose
10 to 30	compact
30 to 50	dense
over 50	very dense

Cohesive Soils:

Undrained Shear Strength (ksf)	'N' (blows/ft)	Consistency
less than 0.25	0 to 2	very soft
0.25 to 0.50	2 to 4	soft
0.50 to 1.0	4 to 8	firm
1.0 to 2.0	8 to 16	stiff
2.0 to 4.0	16 to 32	very stiff
over 4.0	over 32	hard

Method of Determination of Undrained Shear Strength of Cohesive Soils:

x 0.0	Field vane test in borehole; the number denotes the sensitivity to remoulding
△	Laboratory vane test
☐	Compression test in laboratory

For a saturated cohesive soil, the undrained shear strength is taken as one half of the undrained compressive strength

METRIC CONVERSION FACTORS

1 ft = 0.3048 metres

1lb = 0.454 kg

1 inch = 25.4 mm

1ksf = 47.88 kPa

JOB NO.: 1611-S034

LOG OF BOREHOLE NO.: RJMW1d

FIGURE NO.: 1A

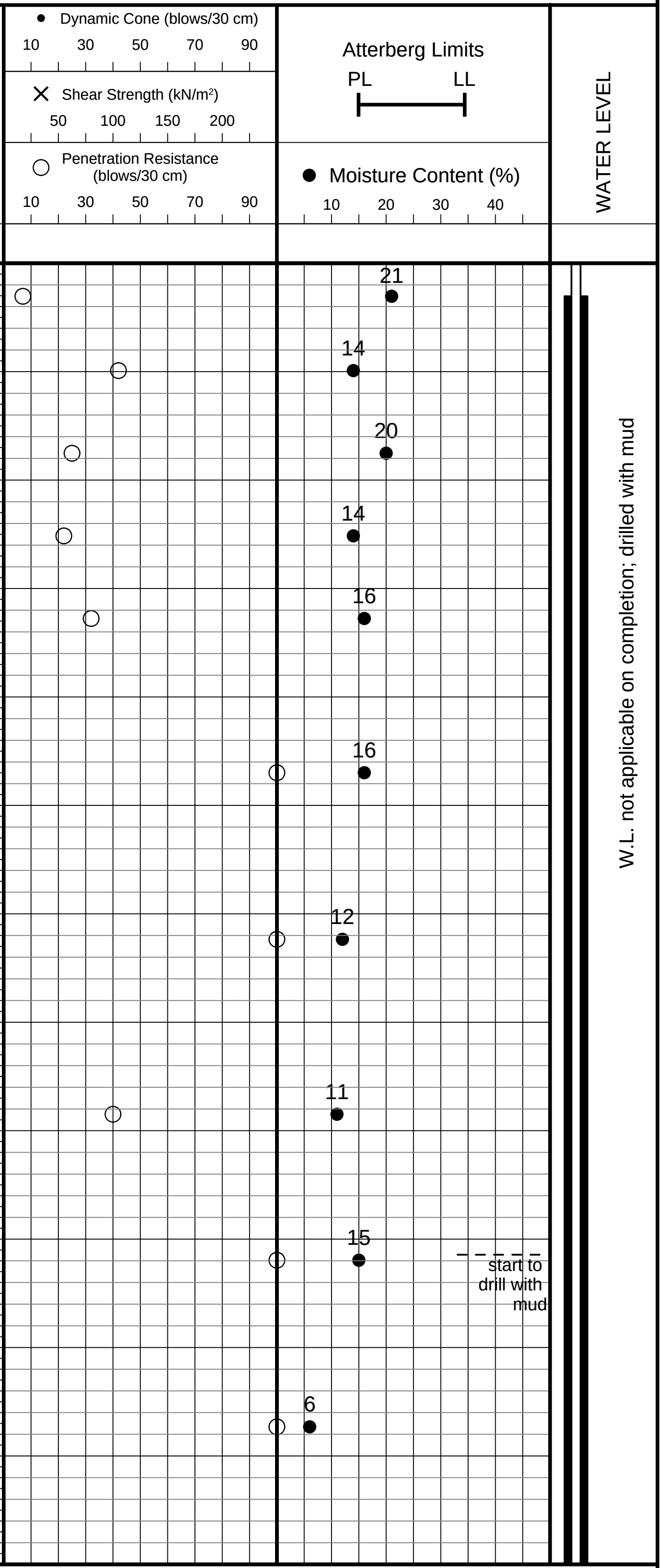
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight-Auger (Hollow-Stem) and Tri-cone

PROJECT LOCATION: Bronte Green - 1401 Bronte Road
Southeast Corner of Bronte Road and Upper Middle Road
Town of Oakville

DRILLING DATE: November 18 and 21, 2016

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value	Depth Scale (m)
127.5	Ground Surface				
0.0	**23 cm TOPSOIL**				0
	Brown, firm to hard	1	DO	7	
	SILTY CLAY — weathered	2	DO	42	1
	a trace of sand occ. wet sand and silt seams and layers	3	DO	25	2
125.2 2.3	Brown, very stiff	4	DO	22	
	SILTY CLAY TILL	5	DO	32	3
	traces of sand and gravel occ. wet sand and silt seams and layers, cobbles and boulders				4
122.9 4.6	Brown, very dense	6	DO	50/10	
	SILT a trace to some clay, a trace of sand occ. sand layers				5
121.4 6.1	Brown, very dense — sand layers **SANDY SILT TILL** traces of clay and gravel occ. wet sand and silt seams and layers, cobbles and boulders	7	DO	50/13	6 7
119.9 7.6	Dense to very dense	8	DO	40	8
	GRAVELLY SAND				
	a trace to some silt — coarse sand	9	DO	50/10	9 10
	red grey	10	DO	50/13	11 12



Soil Engineers Ltd.

JOB NO.: 1611-S034

LOG OF BOREHOLE NO.: RJMW1d

FIGURE NO.: 1A

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight-Auger (Hollow-Stem) and Tri-cone

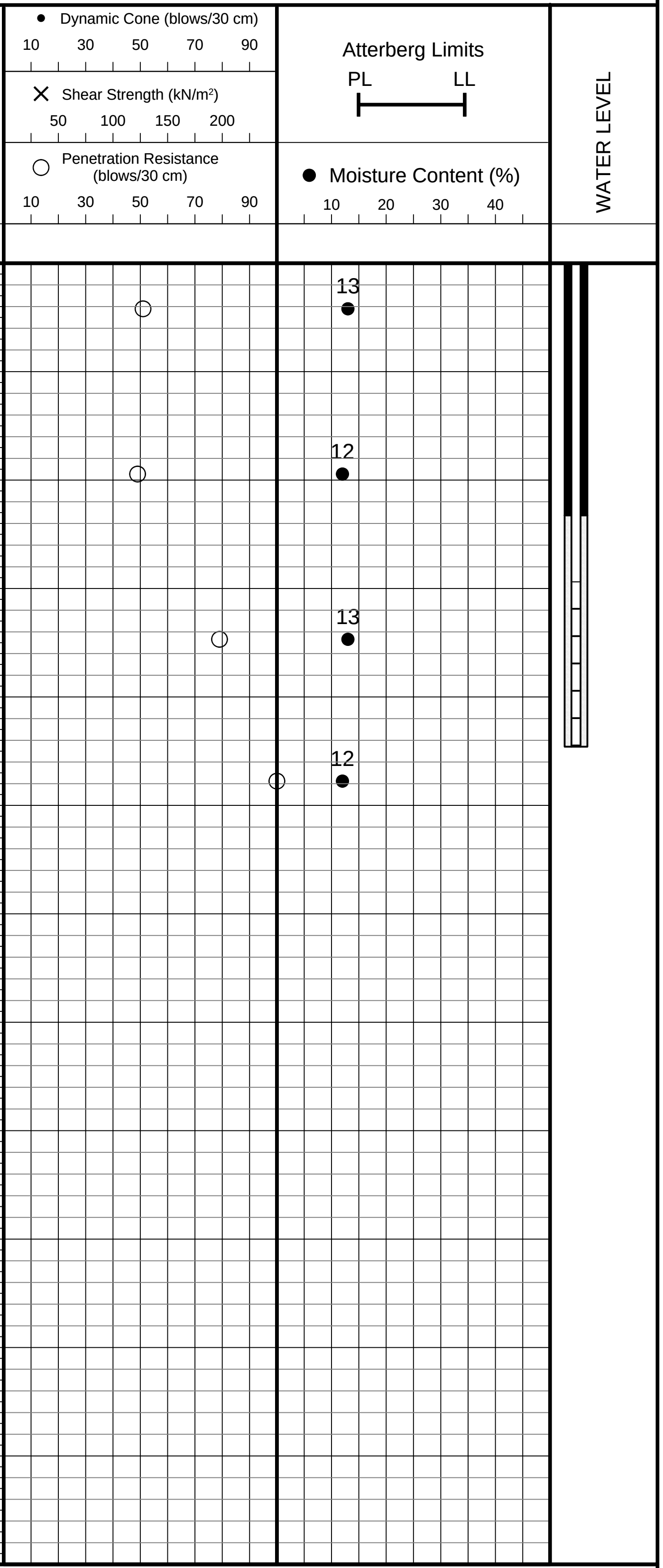
PROJECT LOCATION: Bronte Green - 1401 Bronte Road
Southeast Corner of Bronte Road and Upper Middle Road
Town of Oakville

DRILLING DATE: November 18 and 21, 2016

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value	Depth Scale (m)
115.3 12.2	Dense to very dense **SAND** medium to coarse grained a trace to some silt traces of clay and gravel	11	DO	51	12
		12	DO	49	13 14
	brown grey	13	DO	79	15
110.7 110.7 16.8	Red, very dense **SILTY SAND TILL** some clay and gravel occ. wet sand and silt seams and layers, cobbles and boulders	14	DO	50/3	16 17

END OF BOREHOLE

Installed 50 mm Ø PVC monitoring well to 16.5 m (1.5 m screen)
Sand backfill from 14.3 to 16.5 m
Bentonite holeplug from 0.3 to 14.3 m
Provided with a 4x4 steel monument casing with top and bottom caps, and lock



Depth Scale (m): 12 13 14 15 16 17 18 19 20 21 22 23 24

Soil Engineers Ltd.

JOB NO.: 1611-S034

LOG OF BOREHOLE NO.: RJMW1s

FIGURE NO.: **1B**

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight-Auger
(Hollow-Stem)

PROJECT LOCATION: Bronte Green - 1401 Bronte Road
Southeast Corner of Bronte Road and Upper Middle Road
Town of Oakville

DRILLING DATE: November 21, 2016

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
127.5	Ground Surface			
0.0	**50-mm PVC NESTED WELL**			
122.0 5.5	**END OF BOREHOLE** Installed 50 mm Ø PVC monitoring well to 5.5 m (1.5 m screen) Sand backfill from 3.4 to 5.5 m Bentonite holeplug from 0.3 to 3.4 m Provided with a 4x4 steel monument casing with top and bottom caps, and lock			

● Dynamic Cone (blows/30 cm) 10 30 50 70 90

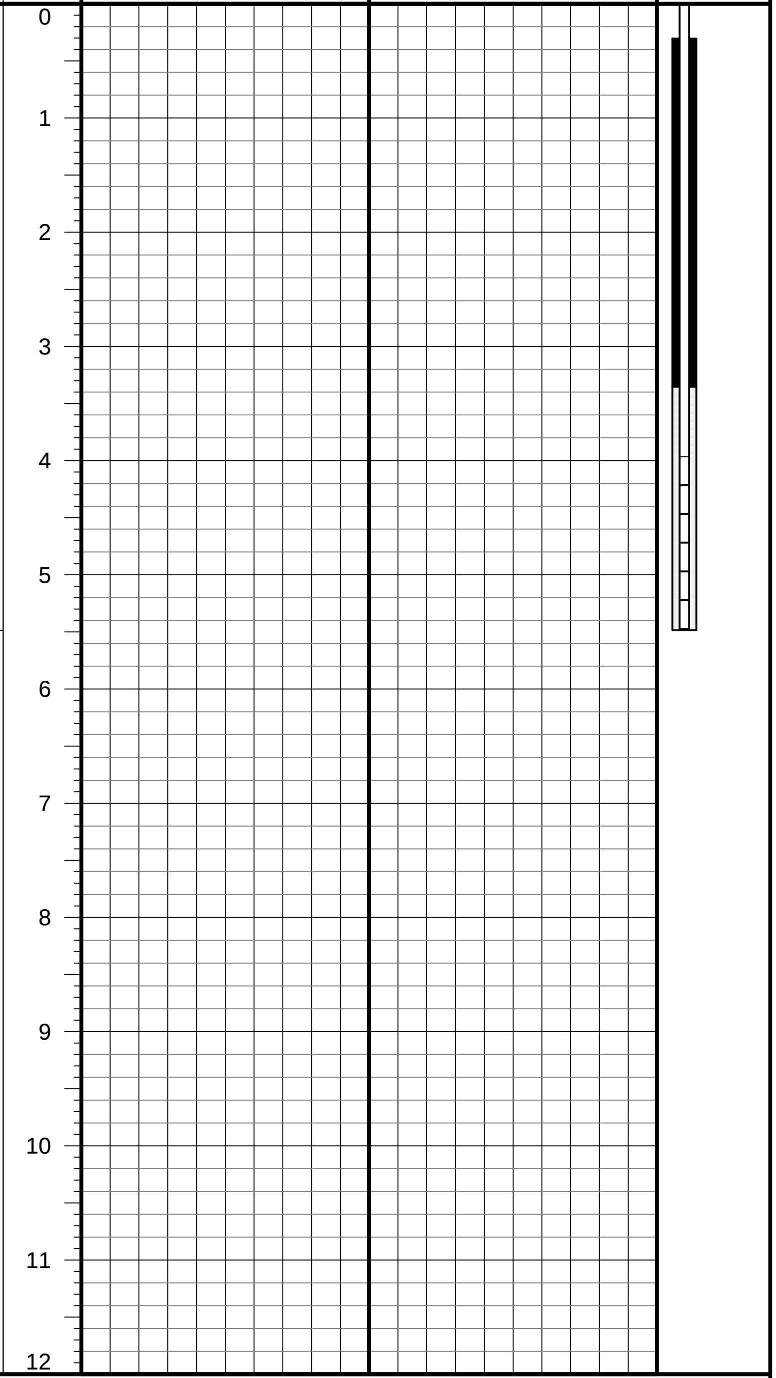
× Shear Strength (kN/m²) 50 100 150 200

○ Penetration Resistance (blows/30 cm) 10 30 50 70 90

Atterberg Limits PL LL

● Moisture Content (%) 10 20 30 40

WATER LEVEL



Soil Engineers Ltd.

JOB NO.: 1611-S034

LOG OF BOREHOLE NO.: RJMW2d

FIGURE NO.: 2A

PROJECT DESCRIPTION: Proposed Residential Development

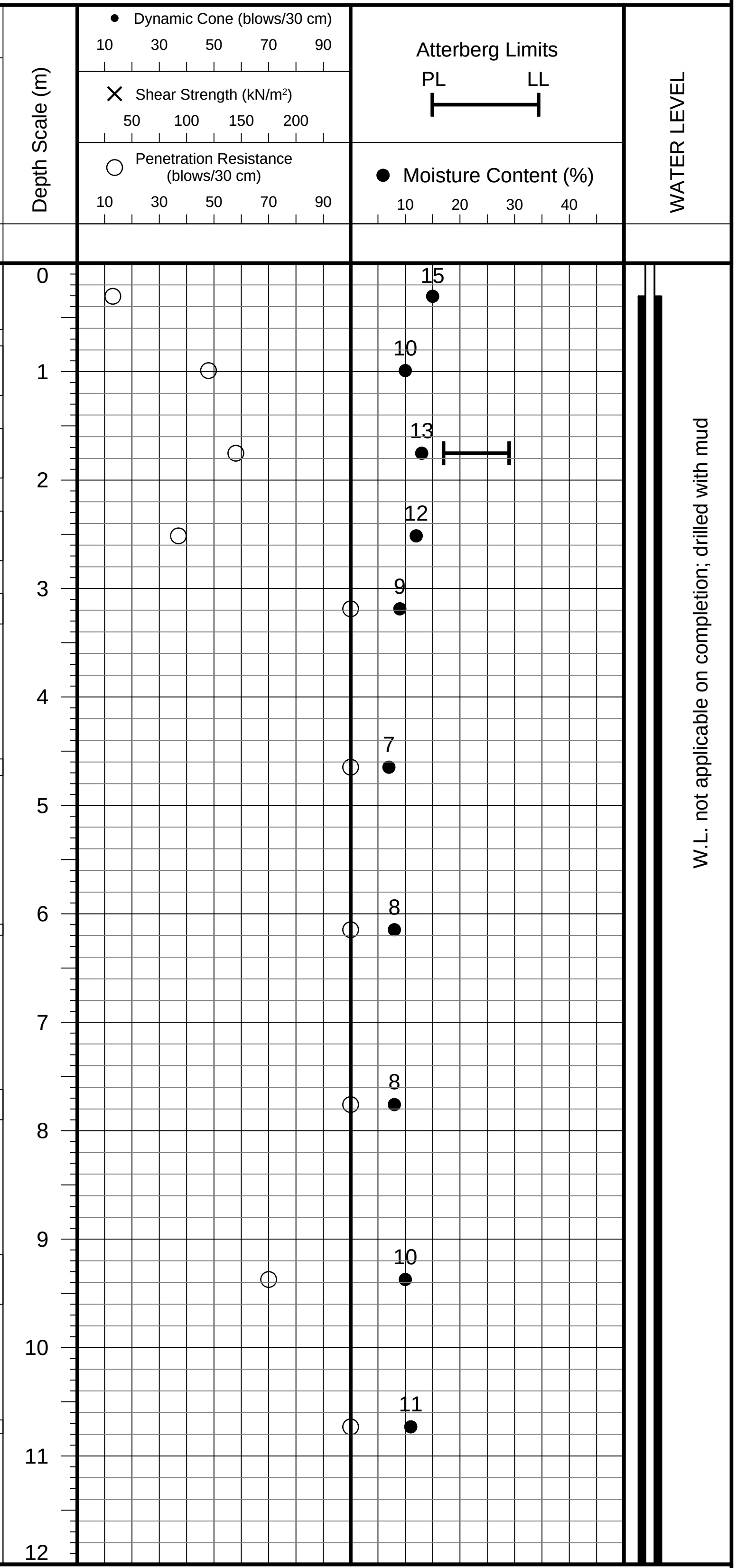
METHOD OF BORING: Flight-Auger (Hollow-Stem) and Tri-cone

PROJECT LOCATION: Bronte Green - 1401 Bronte Road
Southeast Corner of Bronte Road and Upper Middle Road
Town of Oakville

DRILLING DATE: November 16 and 17, 2016

El. (m) Depth (m)	SOIL DESCRIPTION
125.6	Ground Surface
0.0	**23 cm TOPSOIL** clayey Stiff to hard weathered/ brown red **SILTY CLAY TILL** a trace of sand to sandy a trace of gravel occ. wet sand and silt seams and layers, cobbles and boulders
121.0 4.6	Brown, very dense **SILTY SAND TILL** traces of clay and gravel occ. wet sand and silt seams and layers, cobbles and boulders
119.5 6.1	Red, very dense **SANDY SILT TILL** traces of clay and gravel occ. wet sand and silt seams and layers, cobbles, boulders and shale fragments
118.0 7.6	Red, very dense **GRAVELLY SAND** a trace to some silt
113.6	

SAMPLES		
Number	Type	N-Value
1	DO	13
2	DO	48
3	DO	58
4	DO	37
5	DO	50/13
6	DO	50/15
7	DO	50/10
8	DO	50/13
9	DO	70
10	DO	50/13



Soil Engineers Ltd.

JOB NO.: 1611-S034

LOG OF BOREHOLE NO.: RJMW2d

FIGURE NO.: 2A

PROJECT DESCRIPTION: Proposed Residential Development

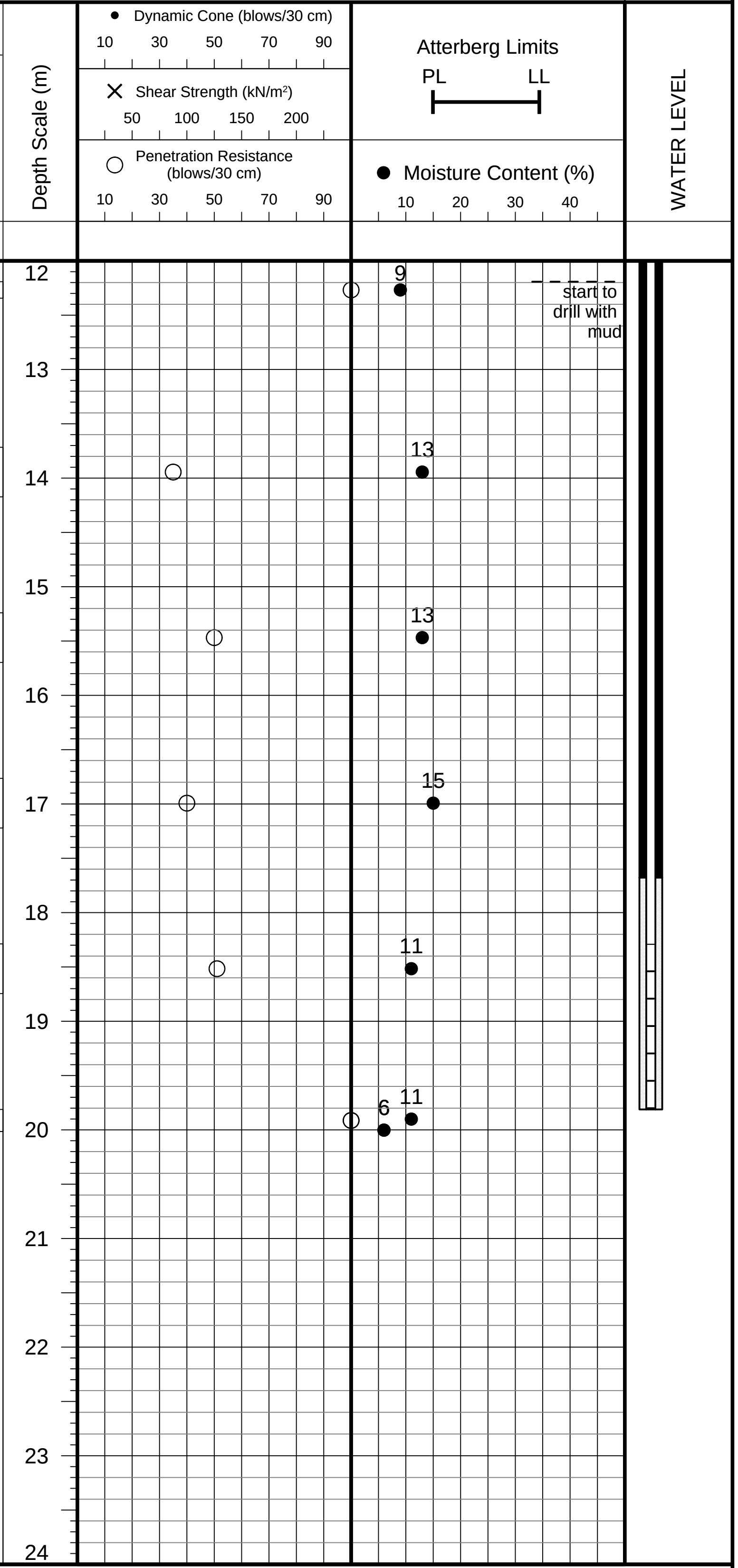
METHOD OF BORING: Flight-Auger (Hollow-Stem) and Tri-cone

PROJECT LOCATION: Bronte Green - 1401 Bronte Road
Southeast Corner of Bronte Road and Upper Middle Road
Town of Oakville

DRILLING DATE: November 16 and 17, 2016

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
12.0	Very dense red / grey **GRAVELLY SAND** a trace of silt	11	DO	50/15
111.9 13.7	Grey, dense to very dense **SAND** medium to coarse grained a trace to some silt traces of clay and gravel	12	DO	35
		13	DO	50
		14	DO	40
		15	DO	51
105.6 20.0	rock fragments	16A 16B	DO	50/5
	END OF BOREHOLE			

Installed 50 mm Ø PVC monitoring well to 19.8 m (1.5 m screen with sock)
Sand backfill from 17.7 to 19.8 m
Bentonite holeplug from 0.3 to 17.7 m
Provided with a 4x4 steel monument casing with top and bottom caps, and lock



Soil Engineers Ltd.

JOB NO.: 1611-S034

LOG OF BOREHOLE NO.: RJMW2s

FIGURE NO.: 2B

PROJECT DESCRIPTION: Proposed Residential Development

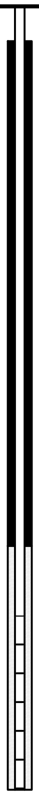
METHOD OF BORING: Flight-Auger (Hollow-Stem)

PROJECT LOCATION: Bronte Green - 1401 Bronte Road
Southeast Corner of Bronte Road and Upper Middle Road
Town of Oakville

DRILLING DATE: November 17, 2016

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value	Depth Scale (m)	● Dynamic Cone (blows/30 cm) 10 30 50 70 90 × Shear Strength (kN/m²) 50 100 150 200 ○ Penetration Resistance (blows/30 cm) 10 30 50 70 90	Atterberg Limits PL LL ● Moisture Content (%) 10 20 30 40	WATER LEVEL
125.7	Ground Surface							
0.0	**50-mm PVC NESTED WELL**				0			
118.8 6.9	**END OF BOREHOLE** Installed 50 mm Ø PVC monitoring well to 6.9 m (1.5 m screen) Sand backfill from 4.7 to 6.9 m Bentonite holeplug from 0.3 to 4.7 m Provided with a 4x4 steel monument casing with top and bottom caps, and lock				7			

Depth Scale (m): 0 1 2 3 4 5 6 7 8 9 10 11 12



Soil Engineers Ltd.

Page: 1 of 1

JOB NO.: 1611-S034

LOG OF BOREHOLE NO.: RJMW3

FIGURE NO.: 3

PROJECT DESCRIPTION: Proposed Residential Development

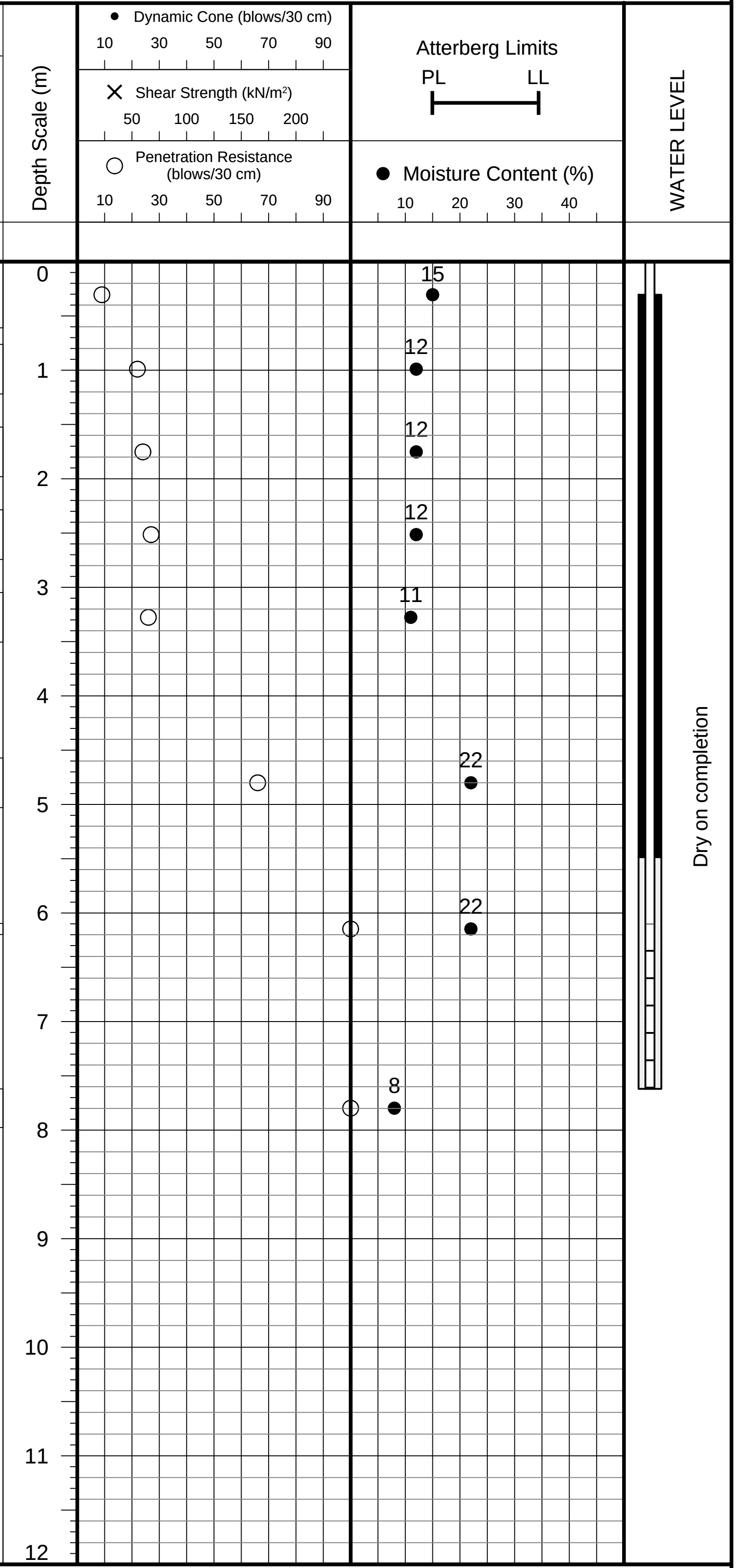
METHOD OF BORING: Flight-Auger (Hollow-Stem)

PROJECT LOCATION: Bronte Green - 1401 Bronte Road
Southeast Corner of Bronte Road and Upper Middle Road
Town of Oakville

DRILLING DATE: November 22, 24 and 25, 2016

El. (m) Depth (m)	SOIL DESCRIPTION
125.8	Ground Surface
0.0	**18 cm TOPSOIL** clayey
	Brown **EARTH FILL** **(Silty Clay)** traces of sand and gravel with topsoil inclusions
125.0 0.8	Very stiff to hard **SILTY CLAY TILL** a trace of sand to sandy a trace of gravel occ. wet sand and silt seams and layers, cobbles and boulders brown red shale reversion
117.3 8.5	Red **SHALE BEDROCK**
113.8	

SAMPLES Number	Type	N-Value
1	DO	9
2	DO	22
3	DO	24
4	DO	27
5	DO	26
6	DO	66
7	DO	50/10
8	DO	88/20
9	RC RQD	
10	RC RQD	
11	RC RQD	



Soil Engineers Ltd.

JOB NO.: 1611-S034

LOG OF BOREHOLE NO.: RJMW3

FIGURE NO.: 3

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight-Auger (Hollow-Stem)

PROJECT LOCATION: Bronte Green - 1401 Bronte Road
Southeast Corner of Bronte Road and Upper Middle Road
Town of Oakville

DRILLING DATE: November 22, 24 and 25, 2016

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value	Depth Scale (m)	● Dynamic Cone (blows/30 cm) 10 30 50 70 90 ✕ Shear Strength (kN/m²) 50 100 150 200 ○ Penetration Resistance (blows/30 cm) 10 30 50 70 90	Atterberg Limits PL LL ● Moisture Content (%) 10 20 30 40	WATER LEVEL
12.0	Red **SHALE BEDROCK**	12	RC RQD		12			
112.7 13.1	**END OF BOREHOLE** Installed 50 mm Ø PVC monitoring well to 7.6 m (1.5 m screen) Sand backfill from 5.5 to 7.6 m Bentonite holeplug from 0.3 to 5.5 m Provided with a 4x4 steel monument casing with top and bottom caps, and lock				13			
					14			
					15			
					16			
					17			
					18			
					19			
					20			
					21			
					22			
					23			
					24			

Soil Engineers Ltd.

JOB NO.: 1611-S034

LOG OF BOREHOLE NO.: RJMW5

FIGURE NO.: 4

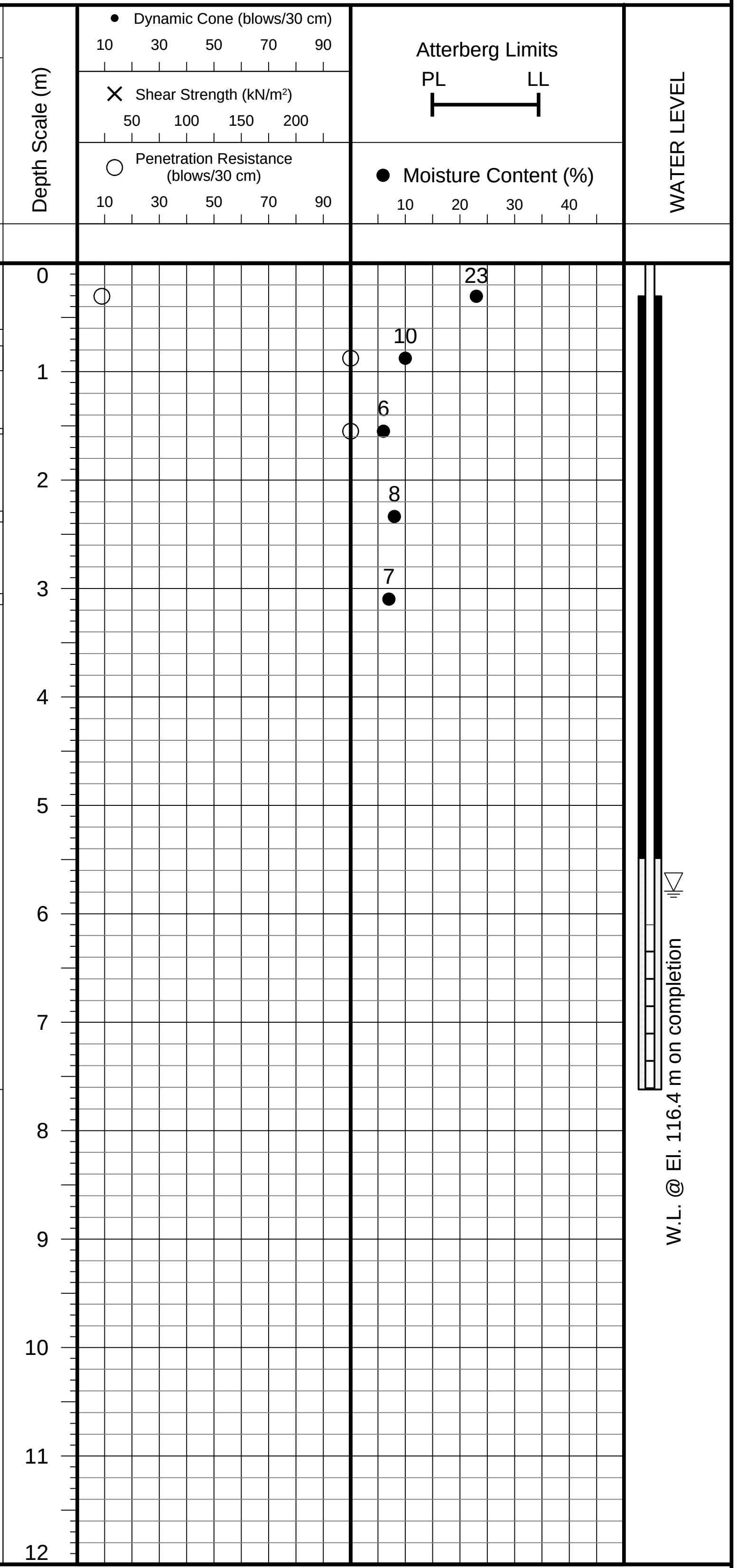
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight-Auger (Solid-Stem)

PROJECT LOCATION: Bronte Green - 1401 Bronte Road
Southeast Corner of Bronte Road and Upper Middle Road
Town of Oakville

DRILLING DATE: November 29, 2016

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
122.2	Ground Surface			
0.0	**23 cm TOPSOIL**			
	Brown, stiff to hard **SILTY CLAY TILL** trace of sand and gravel occ. wet sand and silt seams and layers, cobbles and boulders and shale fragments weathered	1	DO	9
		2	DO	50/8
120.7 1.5	Red weathered **SHALE BEDROCK** with limestone layers	3	DO	50/5
		4	AS	-
		5	AS	-
114.6 7.6	**END OF BOREHOLE** Installed 50 mm Ø PVC monitoring well to 7.6 m (1.5 m screen) Sand backfill from 5.5 to 7.6 m Bentonite holeplug from 0.3 to 5.5 m Provided with a 4x4 steel monument casing with top and bottom caps, and lock			



Soil Engineers Ltd.

JOB NO.: 1611-S034

LOG OF BOREHOLE NO.: RJMW6

FIGURE NO.: 5

PROJECT DESCRIPTION: Proposed Residential Development

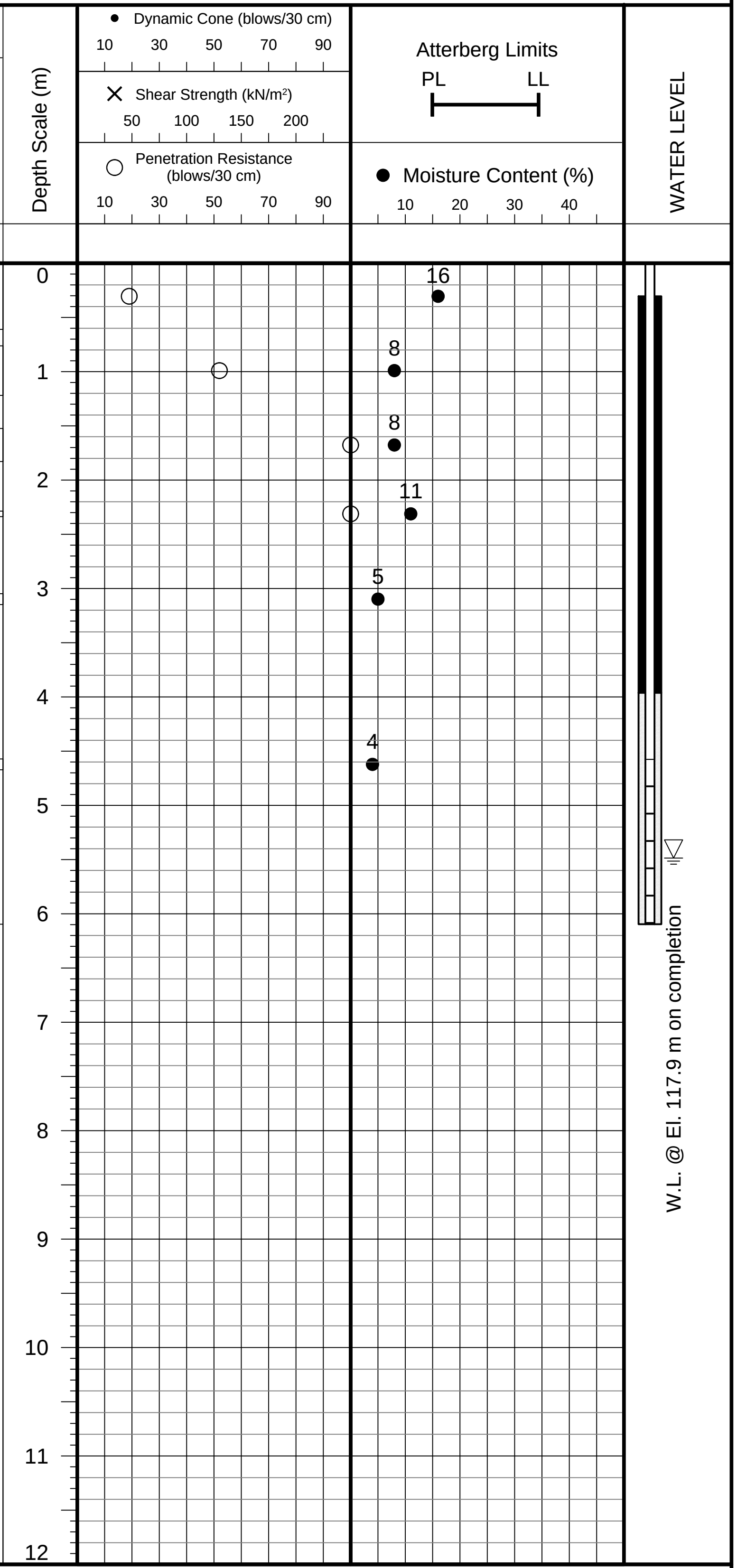
METHOD OF BORING: Flight-Auger (Solid-Stem)

PROJECT LOCATION: Bronte Green - 1401 Bronte Road
Southeast Corner of Bronte Road and Upper Middle Road
Town of Oakville

DRILLING DATE: November 29, 2016

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
123.4	Ground Surface			
0.0	**18 cm TOPSOIL**			
	Very stiff **SILTY CLAY TILL** traces of sand and gravel occ. wet sand and silt seams and layers, cobbles and boulders (weathered/brown, red)	1	DO	19
122.6 0.8	Red **SHALE BEDROCK** (weathered)	2	DO	52
		3	DO	50/15
		4	DO	50/5
	with limestone layers	5	AS	-
		6	AS	-
117.3 6.1	**END OF BOREHOLE**			

Installed 50 mm Ø PVC monitoring well to 6.1 m (1.5 m screen)
Sand backfill from 4.0 to 6.1 m
Bentonite holeplug from 0.3 to 4.0 m
Provided with a 4x4 steel monument casing with top and bottom caps, and lock



W.L. @ El. 117.9 m on completion

Soil Engineers Ltd.

JOB NO.: 1611-S034

LOG OF BOREHOLE NO.: RJTW1

FIGURE NO.: 6

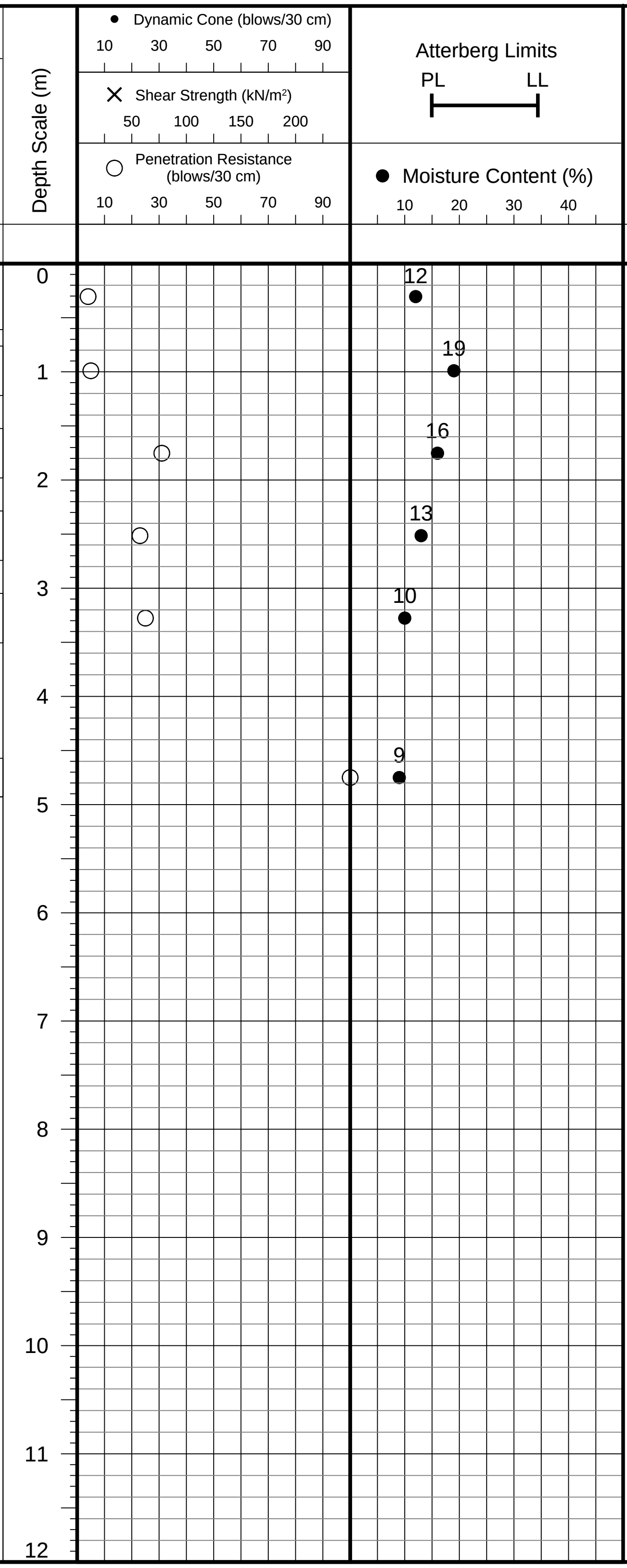
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight-Auger (Solid-Stem)

PROJECT LOCATION: Bronte Green - 1401 Bronte Road
Southeast Corner of Bronte Road and Upper Middle Road
Town of Oakville

DRILLING DATE: November 22, 2016

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value	WATER LEVEL
129.8	Ground Surface				
0.0	**15 cm TOPSOIL** sandy with roots	1	DO	4	
	Brown **EARTH FILL (Silty Sand and Clay)** with organic inclusions	2	DO	5	
128.3 1.5	Brown, dense **SILT** a trace of clay, some sand	3	DO	31	
127.5 2.3	Grey, very stiff to hard **SILTY CLAY TILL** traces of sand and gravel occ. wet sand and silt seams and layers, cobbles and boulders	4	DO	23	
		5	DO	25	
		6	DO	67/20	Dry on completion
124.9 4.9	**END OF BOREHOLE**				



Soil Engineers Ltd.

JOB NO.: 1611-S034

LOG OF BOREHOLE NO.: RJBH1

FIGURE NO.: 7

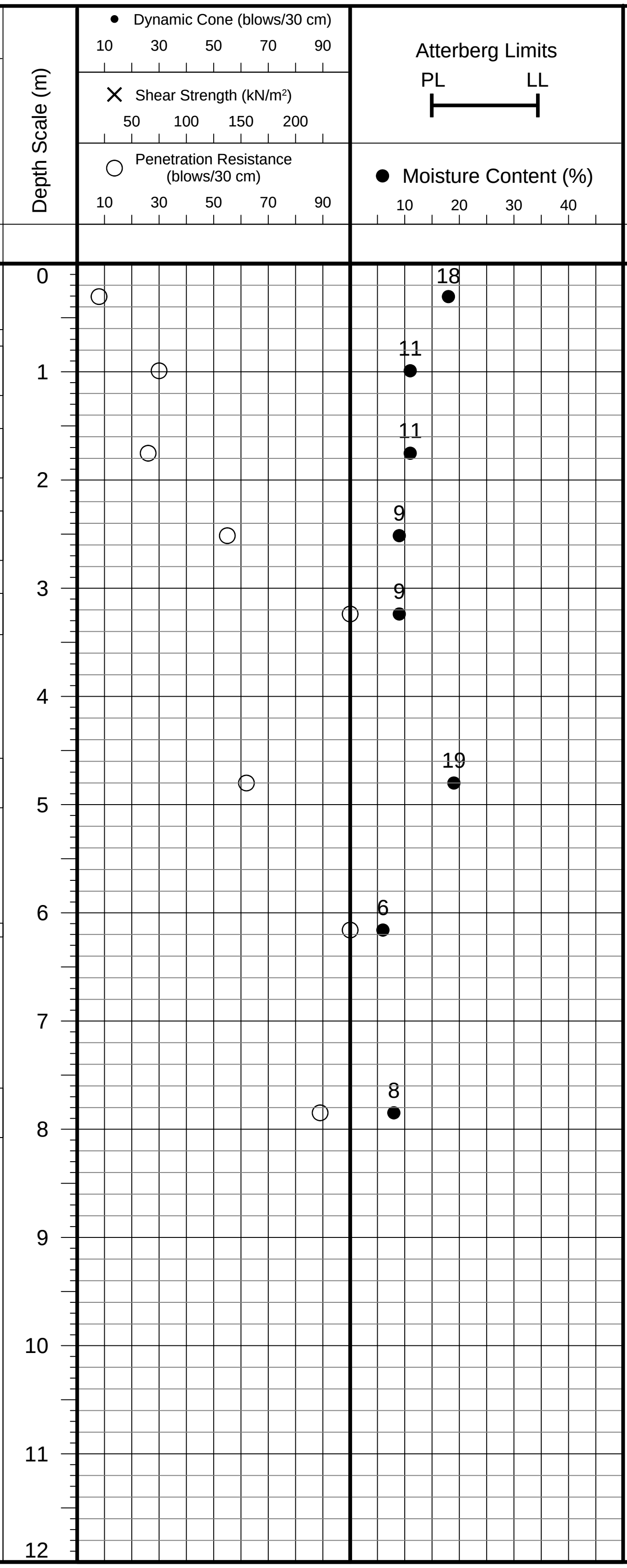
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight-Auger (Solid-Stem)

PROJECT LOCATION: Bronte Green - 1401 Bronte Road
Southeast Corner of Bronte Road and Upper Middle Road
Town of Oakville

DRILLING DATE: November 16, 2016

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
127.5	Ground Surface			
0.0	**25 cm TOPSOIL** clayey with roots	1	DO	8
	Firm to hard weathered	2	DO	30
	SILTY CLAY TILL	3	DO	26
	a trace of sand to sandy a trace of gravel occ. wet sand and silt seams and layers, cobbles and boulders	4	DO	55
	brown red	5	DO	86/23
122.9 4.6	Grey, very dense **SILT** traces of clay and sand	6	DO	62
121.4 6.1	Red, very dense **SILTY SAND TILL** traces of clay and gravel occ. wet sand and silt seams and layers, cobbles and boulders	7	DO	50/13
		8	DO	89
119.4 8.1	**END OF BOREHOLE**			



WATER LEVEL

∇ W.L. @ El. 120.2 m on completion

JOB NO.: 1611-S034

LOG OF BOREHOLE NO.: RJBH2

FIGURE NO.: 8

PROJECT DESCRIPTION: Proposed Residential Development

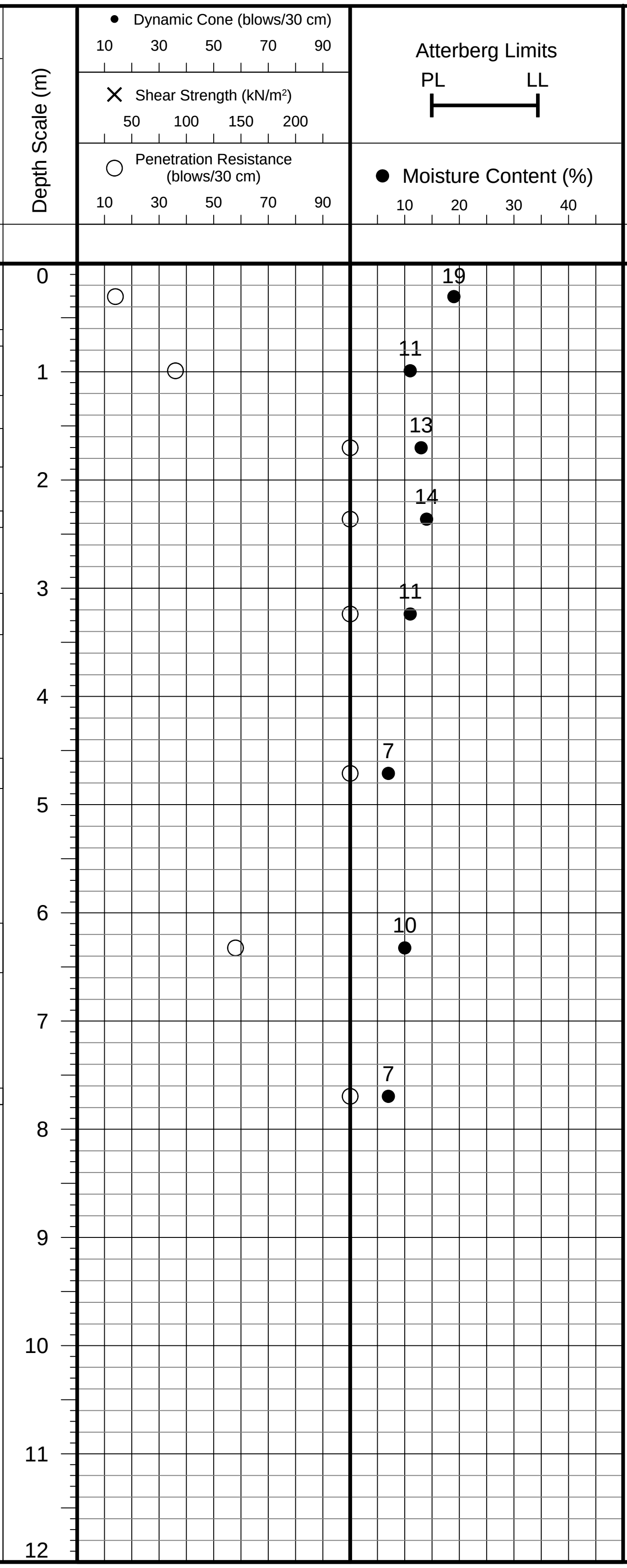
METHOD OF BORING: Flight-Auger (Solid-Stem)

PROJECT LOCATION:
Bronte Green - 1401 Bronte Road
Southeast Corner of Bronte Road and Upper Middle Road
Town of Oakville

DRILLING DATE: November 20, 2016

El. (m) Depth (m)	SOIL DESCRIPTION
125.8	Ground Surface
0.0	**25 cm TOPSOIL**
	Brown, stiff to hard weathered **SILTY CLAY TILL** a trace of sand to sandy a trace of gravel occ. wet sand and silt seams and layers, cobbles and boulders
122.8 3.0	Very dense **SILTY SAND TILL** brown red a trace to some clay a trace of gravel occ. wet sand and silt seams and layers, cobbles and boulders
119.7 6.1	Red, very dense **SAND** fine to coarse grained some silt to silty, a trace of gravel
118.2 118.0 7.8	Red, very dense **SILTY SAND TILL** traces of clay and gravel occ. wet sand and silt seams and layers, cobbles and boulders
	END OF BOREHOLE

Number	Type	N-Value	Moisture Content (%)
1	DO	14	19
2	DO	36	11
3	DO	66/20	13
4	DO	50/15	14
5	DO	50/8	11
6	DO	50/13	7
7	DO	58	10
8	DO	50/15	7



WATER LEVEL

W.L. @ El. 120.6 m on completion

Cave-in @ El. 118.5 m on completion

Soil Engineers Ltd.

JOB NO.: 1611-S034

LOG OF BOREHOLE NO.: RJBH3

FIGURE NO.: 9

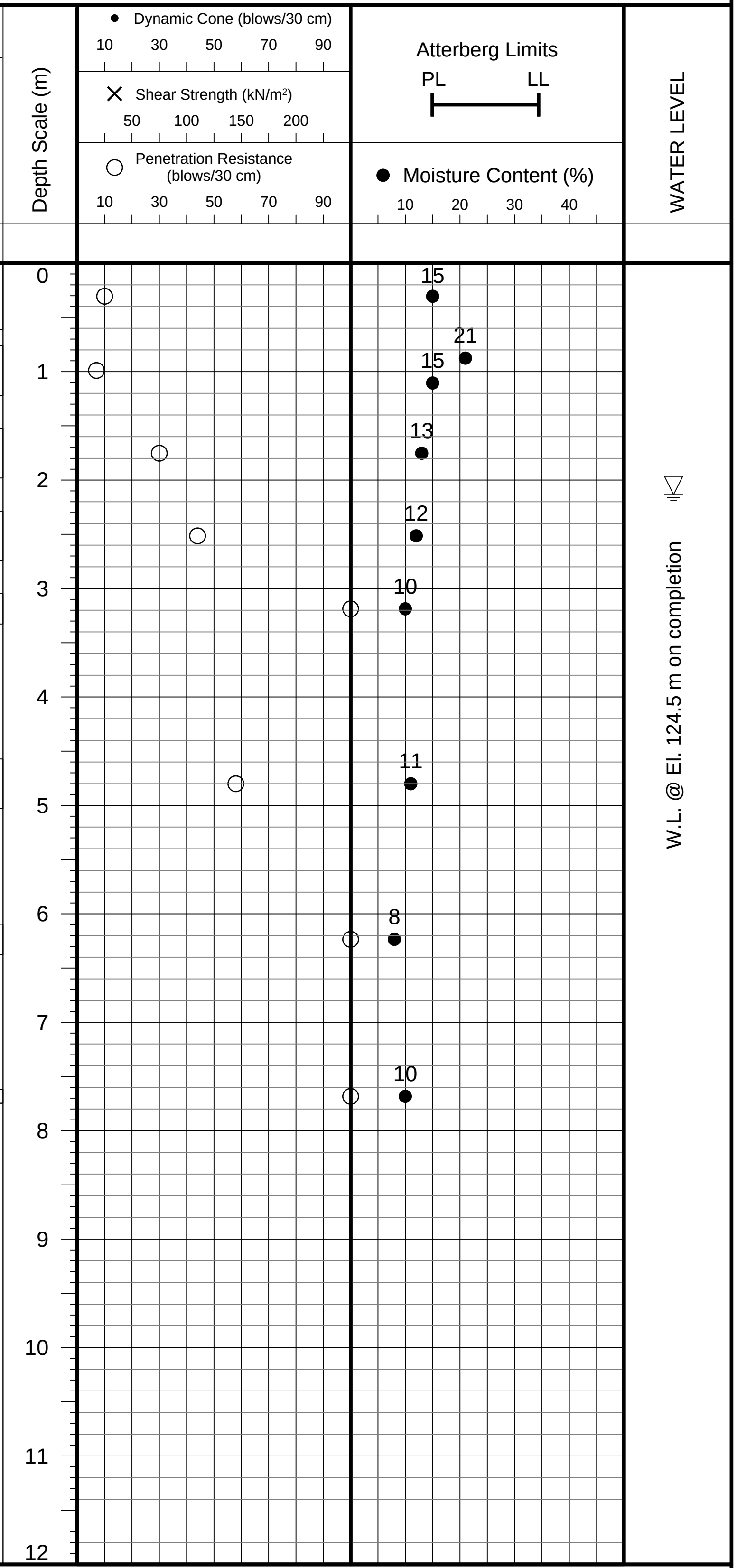
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight-Auger
(Solid-Stem)

PROJECT LOCATION: Bronte Green - 1401 Bronte Road
Southeast Corner of Bronte Road and Upper Middle Road
Town of Oakville

DRILLING DATE: November 20, 2016

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
126.6	Ground Surface			
0.0	Brown **EARTH FILL** **(Silty Clay)** traces of sand and gravel with organic inclusions	1	DO	10
		2A 2B	DO	7
125.6 1.0	Brown, firm to hard weathered **SILTY CLAY TILL** a trace of sand to sandy a trace of gravel occ. wet sand and silt seams and layers, cobbles and boulders	3	DO	30
		4	DO	44
		5	DO	50/13
		6	DO	58
120.5 6.1	Red, very dense **SILTY SAND TILL** some clay, gravelly occ. wet sand and silt seams and layers, cobbles and boulders	7	DO	50/13
119.0	Red, very dense **GRAVELLY SAND** a trace of clay, silty	8	DO	50/13
118.9 7.7	**END OF BOREHOLE**			



Soil Engineers Ltd.

JOB NO.: 1611-S034

LOG OF BOREHOLE NO.: S1

FIGURE NO.: 10

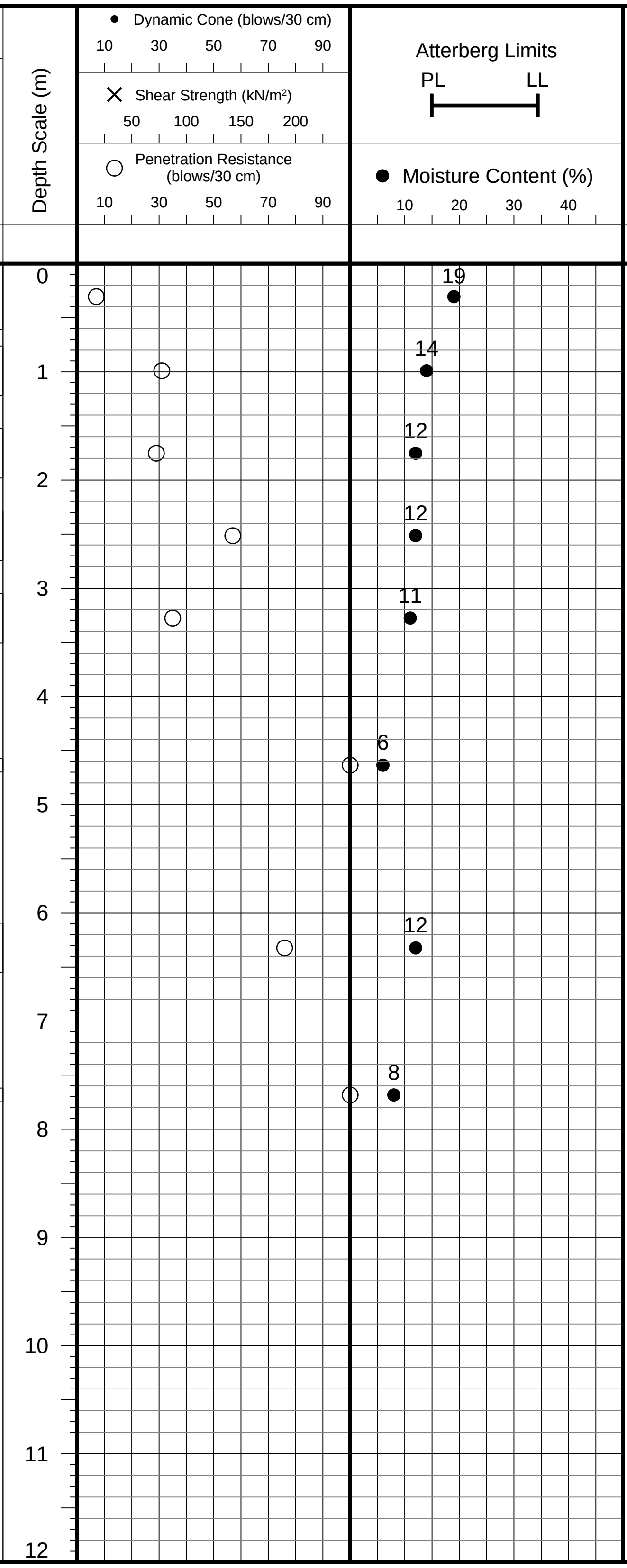
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight-Auger
(Solid-Stem)

PROJECT LOCATION: Bronte Green - 1401 Bronte Road
Southeast Corner of Bronte Road and Upper Middle Road
Town of Oakville

DRILLING DATE: November 16, 2016

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES		
		Number	Type	N-Value
129.3 0.0	Ground Surface **25 cm TOPSOIL** Brown, firm to hard weathered **SILTY CLAY TILL** traces of sand and gravel occ. wet sand and silt seams and layers, cobbles and boulders	1	DO	7
		2	DO	31
		3	DO	29
		4	DO	57
		5	DO	35
124.7 4.6	Red, very dense **SILTY SAND TILL** traces of clay and gravel occ. wet sand and silt seams and layers, cobbles and boulders	6	DO	50/13
123.2 6.1	Red, very dense **SANDY SILT TILL** traces of clay and gravel occ. wet sand and silt seams and layers, cobbles and boulders	7	DO	76
121.7 121.6 7.7	Red, very dense **SILTY SAND TILL** a trace of clay some gravel to gravelly occ. wet sand and silt seams and layers, cobbles and boulders **END OF BOREHOLE**	8	DO	50/13



WATER LEVEL

W.L. @ El. 122.0 m on completion

Soil Engineers Ltd.

JOB NO.: 1611-S034

LOG OF BOREHOLE NO.: S2

FIGURE NO.: 11

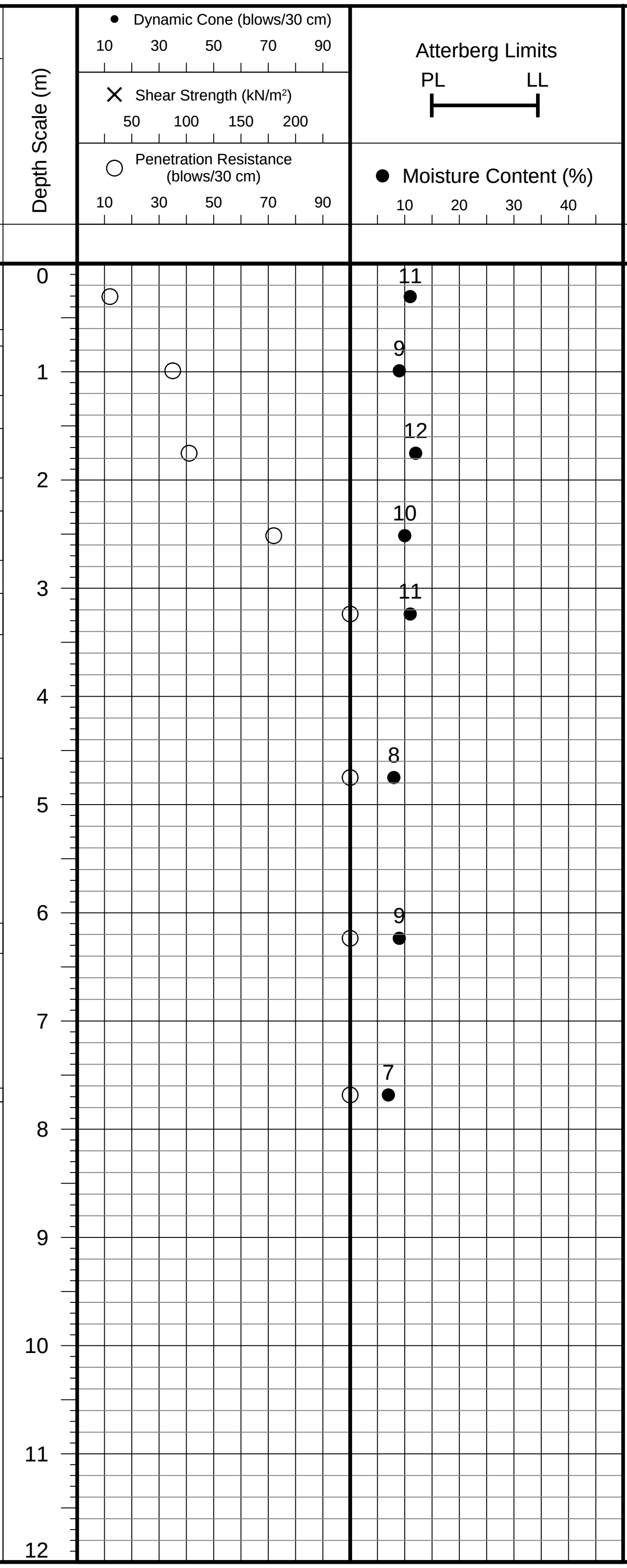
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight-Auger (Solid-Stem)

PROJECT LOCATION: Bronte Green - 1401 Bronte Road
Southeast Corner of Bronte Road and Upper Middle Road
Town of Oakville

DRILLING DATE: November 15, 2016

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
129.3	Ground Surface			
0.0	**18 cm TOPSOIL** with roots	1	DO	12
	weathered Stiff to hard			
	SILTY CLAY TILL	2	DO	35
		3	DO	41
	a trace to some sand a trace of gravel occ. wet sand and silt seams and layers, cobbles and boulders	4	DO	72
		5	DO	73/23
	brown red	6	DO	85/20
123.2 6.1	Red, very dense **SILTY SAND TILL** a trace of clay a trace to some gravel occ. wet sand and silt seams and layers, cobbles and boulders	7	DO	50/13
		8	DO	50/13
121.6 7.7	**END OF BOREHOLE**			



WATER LEVEL

W.L. @ El. 122.0 m on completion

Soil Engineers Ltd.

JOB NO.: 1611-S034

LOG OF BOREHOLE NO.: S3

FIGURE NO.: 12

PROJECT DESCRIPTION: Proposed Residential Development

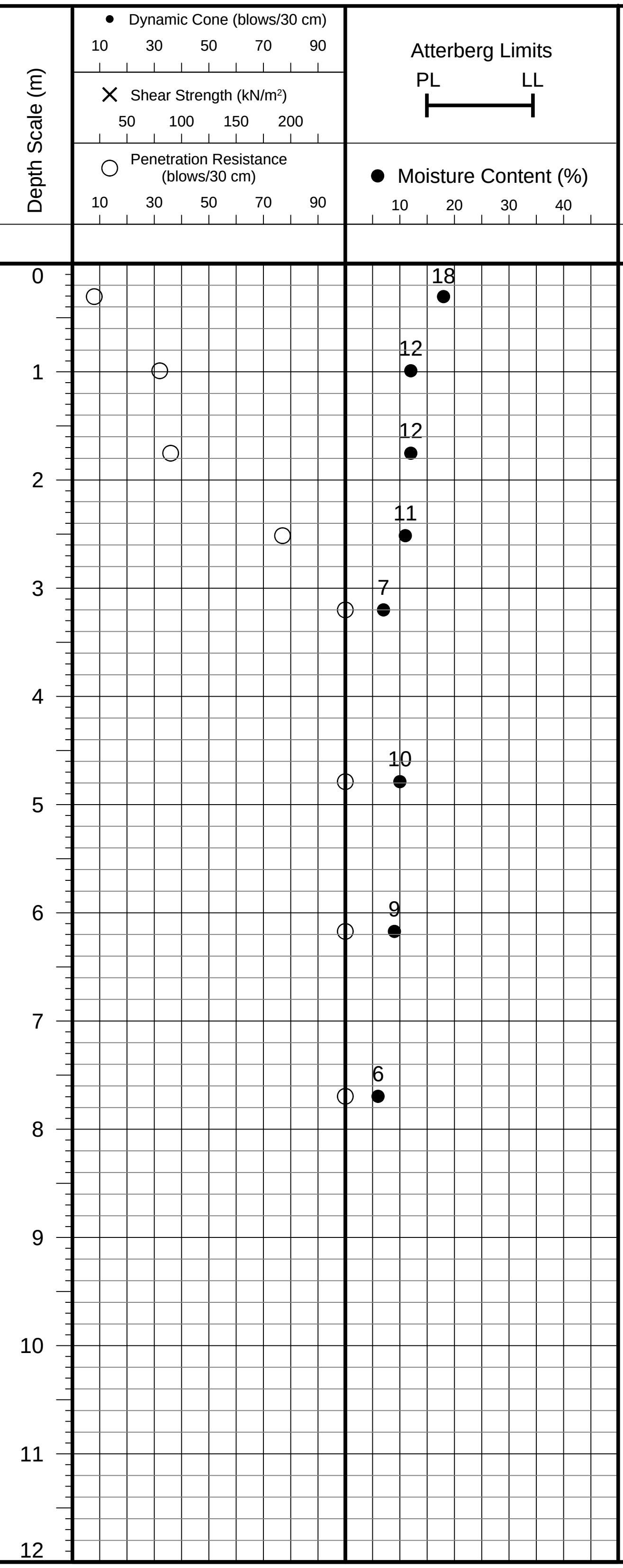
METHOD OF BORING: Flight-Auger (Solid-Stem)

PROJECT LOCATION: Bronte Green - 1401 Bronte Road
Southeast Corner of Bronte Road and Upper Middle Road
Town of Oakville

DRILLING DATE: November 15, 2016

El. (m) Depth (m)	SOIL DESCRIPTION
128.5	Ground Surface
0.0	**15 cm TOPSOIL**
	Brown, clayey **EARTH FILL (Silty Clay)** traces of sand and gravel with topsoil inclusions
127.7 0.8	Very stiff to hard **SILTY CLAY TILL** traces of sand and gravel occ. wet sand and silt seams and layers, cobbles and boulders brown red
122.4 6.1	Red, very dense **SANDY SILT TILL** a trace of clay a trace to some gravel occ. wet sand and silt seams and layers, cobbles and boulders
120.7 7.8	**END OF BOREHOLE**

SAMPLES Number	Type	N-Value	Moisture Content (%)
1	DO	8	18
2	DO	32	12
3	DO	36	12
4	DO	77	11
5	DO	50/15	7
6	DO	84/28	10
7	DO	50/15	9
8	DO	50/15	6



WATER LEVEL: Dry on completion

Soil Engineers Ltd.

JOB NO.: 1611-S034

LOG OF BOREHOLE NO.: S4

FIGURE NO.: 13

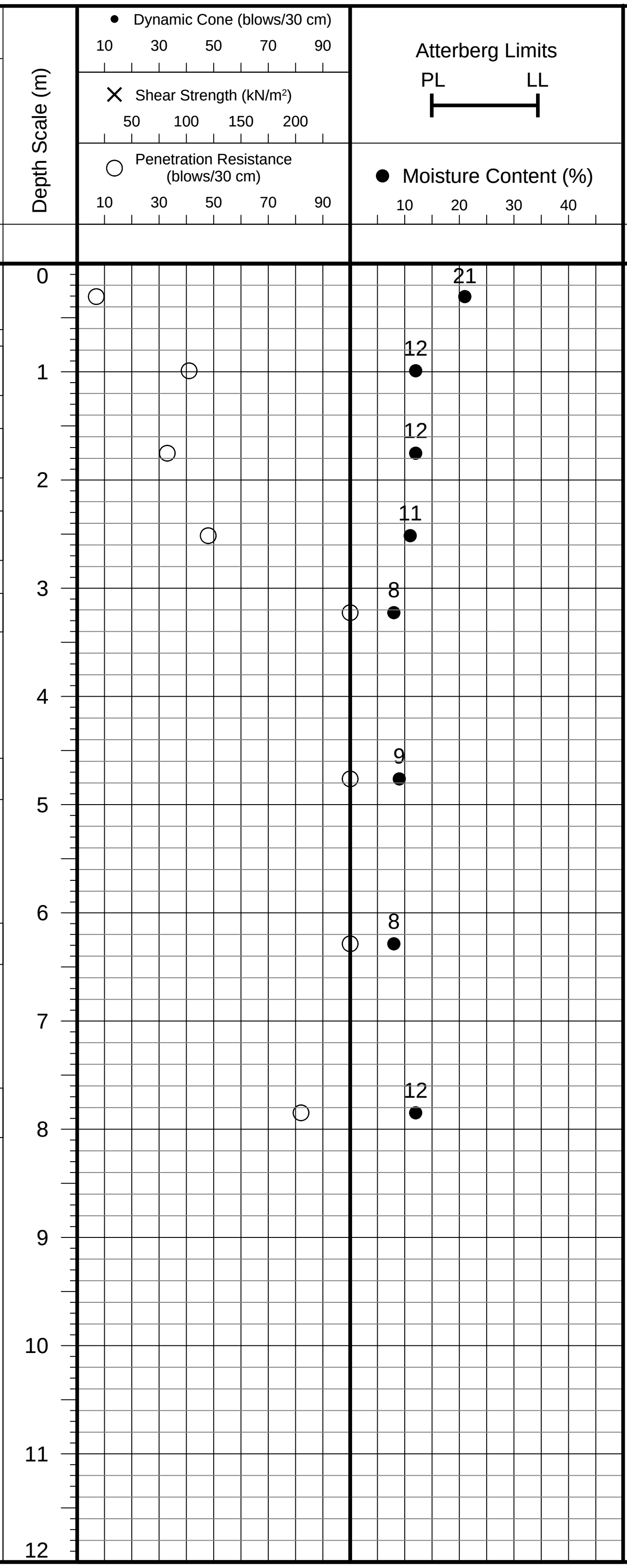
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight-Auger
(Solid-Stem)

PROJECT LOCATION: Bronte Green - 1401 Bronte Road
Southeast Corner of Bronte Road and Upper Middle Road
Town of Oakville

DRILLING DATE: November 15, 2016

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
128.9	Ground Surface			
0.0	**30 cm TOPSOIL** clayey	1	DO	7
	Firm to hard weathered	2	DO	41
	SILTY CLAY TILL	3	DO	33
	a trace to some sand a trace of gravel occ. wet sand and silt seams and layers, cobbles and boulders	4	DO	48
		5	DO	85/20
	brown red	6	DO	76/23
122.8 6.1	Red, very dense **SANDY SILT TILL** traces of clay and gravel occ. wet sand and silt seams and layers, cobbles and boulders	7	DO	84/23
121.3 7.6	Red, very dense **SILTY SAND TILL** traces of clay and gravel occ. wet sand and silt seams and layers, cobbles and boulders	8	DO	82
120.8 8.1	**END OF BOREHOLE**			



WATER LEVEL

Cave-in @ El. 121.6 m on completion

Soil Engineers Ltd.

JOB NO.: 1611-S034

LOG OF BOREHOLE NO.: S5

FIGURE NO.: 14

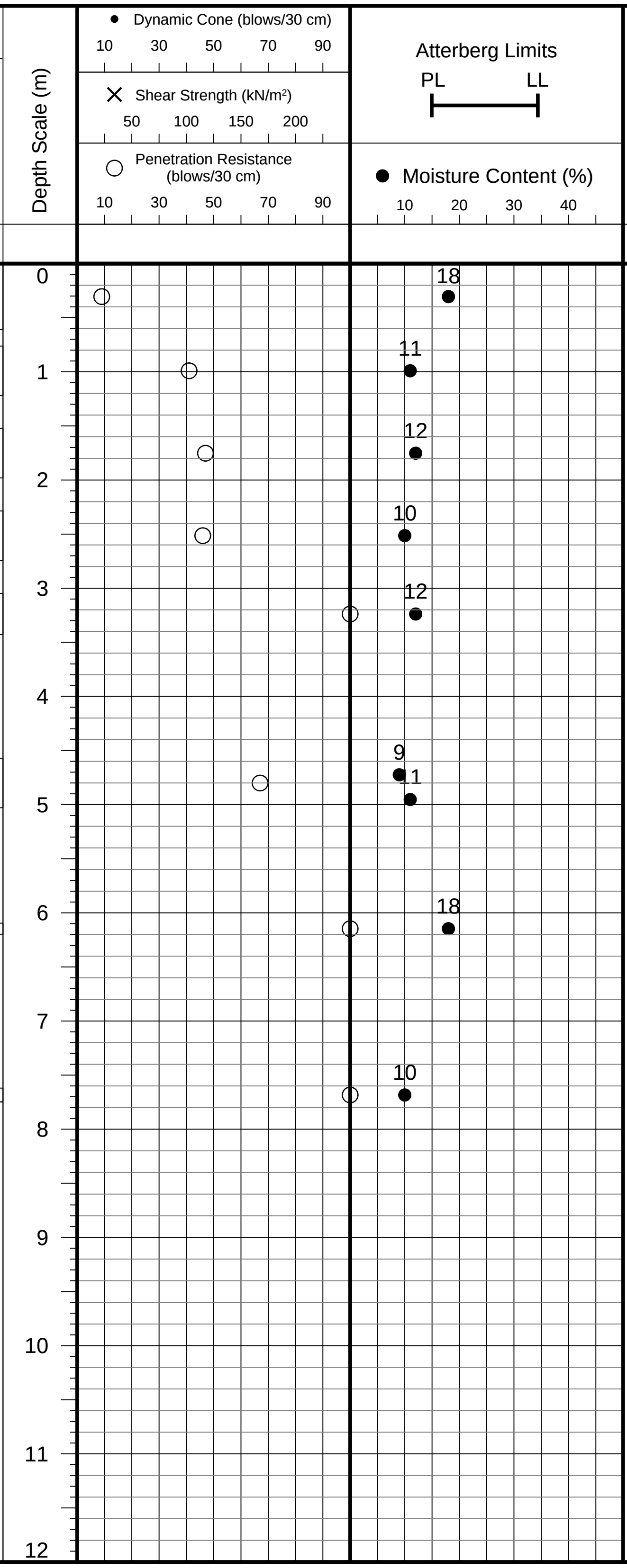
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight-Auger
(Solid-Stem)

PROJECT LOCATION: Bronte Green - 1401 Bronte Road
Southeast Corner of Bronte Road and Upper Middle Road
Town of Oakville

DRILLING DATE: November 15, 2016

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Moisture Content (%)
129.6	Ground Surface				
0.0	**23 cm TOPSOIL**				
	Stiff to hard	1	DO	9	18
	weathered **SILTY CLAY TILL**	2	DO	41	11
		3	DO	47	12
	a trace to some sand a trace of gravel occ. wet sand and silt seams and layers, cobbles and boulders	4	DO	46	10
		5	DO	83/23	12
	brown red	6A	DO	67	9
124.7 4.9	Red, very dense	6B			11
	SANDY SILT TILL traces of clay and gravel occ. wet sand and silt seams and layers, cobbles and boulders grey silt	7	DO	50/10	18
		8	DO	50/13	10
121.9 7.7	**END OF BOREHOLE**				



WATER LEVEL

Cave-in @ El. 122.3 m on completion

Soil Engineers Ltd.

JOB NO.: 1611-S034

LOG OF BOREHOLE NO.: S6

FIGURE NO.: 15

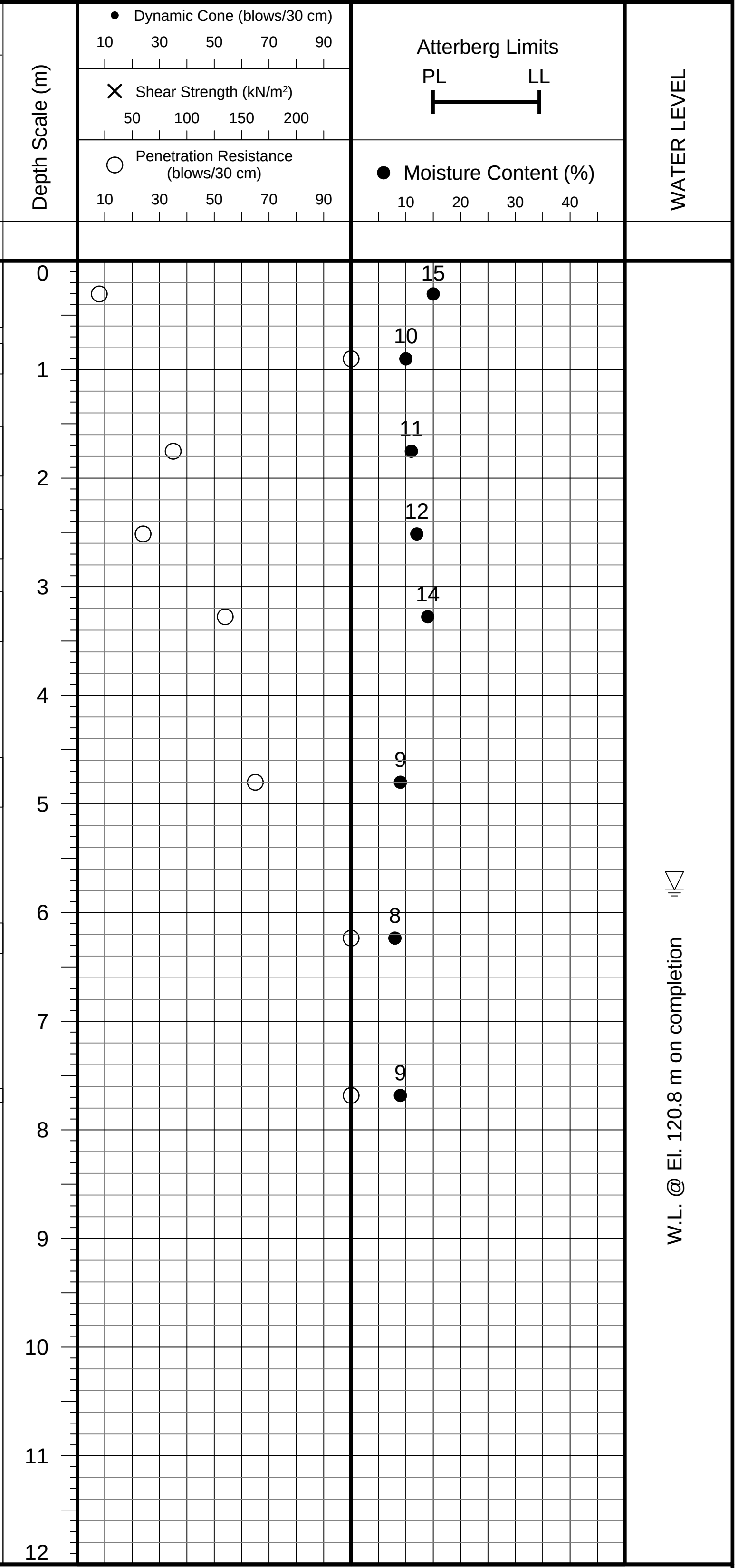
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight-Auger (Solid-Stem)

PROJECT LOCATION: Bronte Green - 1401 Bronte Road
Southeast Corner of Bronte Road and Upper Middle Road
Town of Oakville

DRILLING DATE: November 15, 2016

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
126.6	Ground Surface			
0.0	**15 cm TOPSOIL** Firm to hard	1	DO	8
	weathered	2	DO	50/13
	SILTY CLAY TILL brown red	3	DO	35
	traces of sand and gravel occ. wet sand and silt seams and layers, cobbles and boulders sand layer	4	DO	24
		5	DO	54
122.0 4.6	Red, very dense **SANDY SILT TILL** traces of clay and gravel occ. wet sand and silt seams and layers, cobbles and boulders	6	DO	65
120.5 6.1	Red, very dense **SILTY SAND TILL** a trace of clay a trace to some gravel occ. wet sand and silt seams and layers, cobbles and boulders	7	DO	50/13
119.0				
118.9 7.7	Red, very dense **GRAVELLY SAND** a trace to some silt	8	DO	50/13
	END OF BOREHOLE			



JOB NO.: 1611-S034

LOG OF BOREHOLE NO.: S7

FIGURE NO.: 16

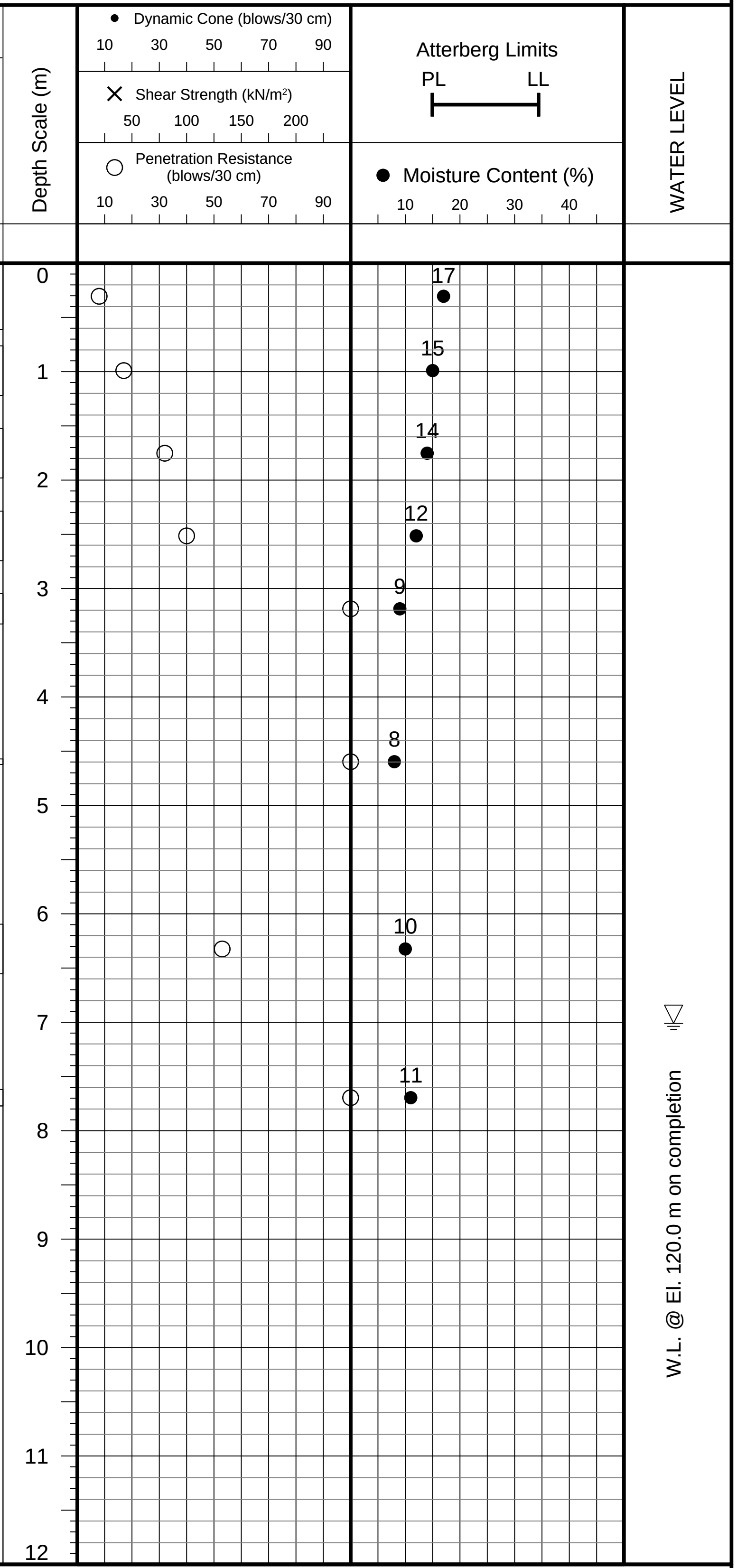
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight-Auger (Solid-Stem)

PROJECT LOCATION: Bronte Green - 1401 Bronte Road
Southeast Corner of Bronte Road and Upper Middle Road
Town of Oakville

DRILLING DATE: November 23, 2016

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
127.0	Ground Surface			
0.0	**20 cm TOPSOIL**			
	Firm to hard	1	DO	8
	weathered			
	SILTY CLAY TILL	2	DO	17
	brown red			
	silt seams	3	DO	32
	traces of sand and gravel occ. wet sand and silt seams and layers, cobbles and boulders	4	DO	40
		5	DO	50/13
122.4 4.6	Red, very dense **SILTY SAND TILL** traces of clay and gravel occ. wet sand and silt seams and layers, cobbles and boulders	6	DO	50/5
120.9 6.1	Red, very dense **GRAVELLY SAND** a trace to some silt	7	DO	53
		8	DO	50/15
119.2 7.8	**END OF BOREHOLE**			



W.L. @ El. 120.0 m on completion

Soil Engineers Ltd.

JOB NO.: 1611-S034

LOG OF BOREHOLE NO.: S8

FIGURE NO.: 17

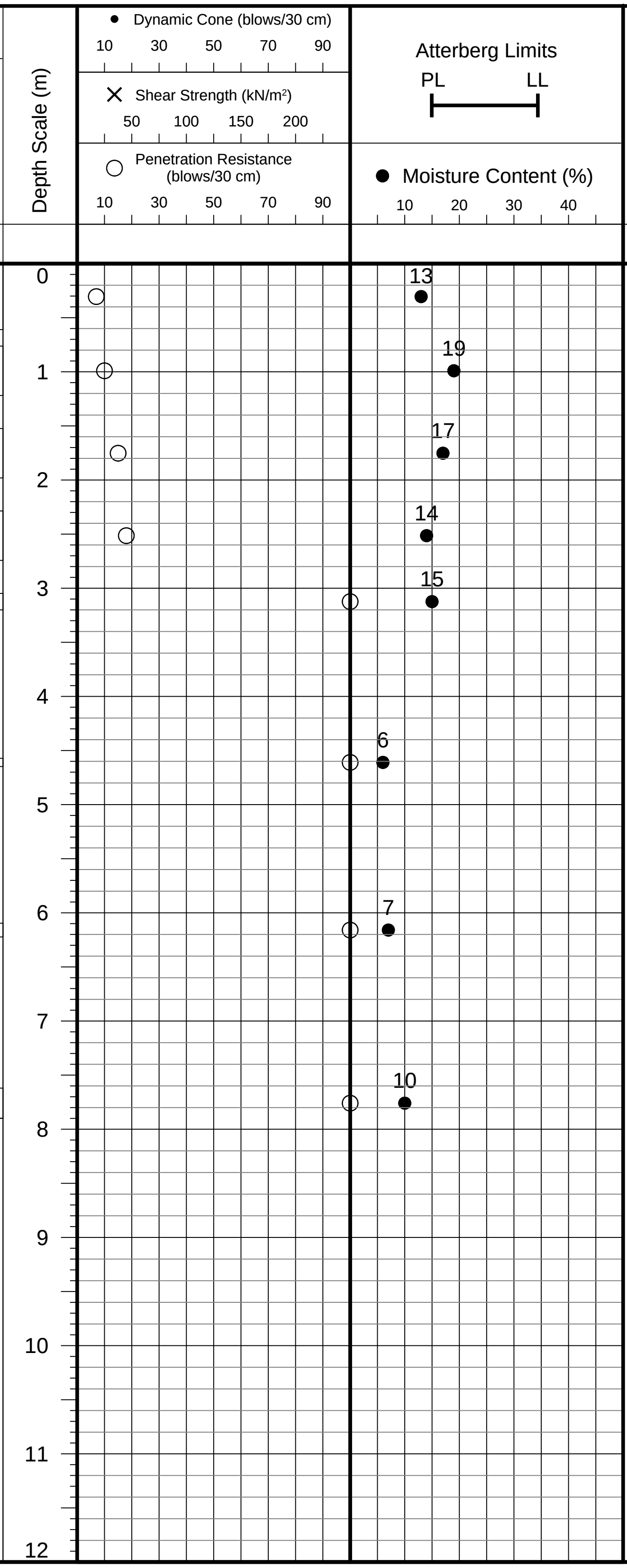
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight-Auger (Solid-Stem)

PROJECT LOCATION: Bronte Green - 1401 Bronte Road
Southeast Corner of Bronte Road and Upper Middle Road
Town of Oakville

DRILLING DATE: November 28, 2016

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
128.5	Ground Surface			
0.0	**8 cm TOPSOIL** with roots Brown **EARTH FILL (Sandy Silt)** a trace of clay with topsoil inclusions	1	DO	7
127.7 0.8	Brown, stiff **SILTY CLAY** a trace to some sand occ. wet sand and silt seams and layers	2	DO	10
127.0 1.5	Compact **SILT** traces to some clay and sand brown / grey	3 4	DO DO	15 18
125.5 3.0	Hard **SILTY CLAY TILL** grey / red traces to some sand and gravel occ. wet sand and silt seams and layers, cobbles and boulders	5 6	DO DO	50/15 50/8
122.4 6.1	Red, very dense **GRAVELLY SAND** a trace to some silt occ. cobbles	7 8	DO DO	50/13 50/13
120.6 7.9	**END OF BOREHOLE**			



WATER LEVEL

Cave-in @ El. 122.4 m on completion

Soil Engineers Ltd.

JOB NO.: 1611-S034

LOG OF BOREHOLE NO.: S9

FIGURE NO.: 18

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight-Auger (Solid-Stem)

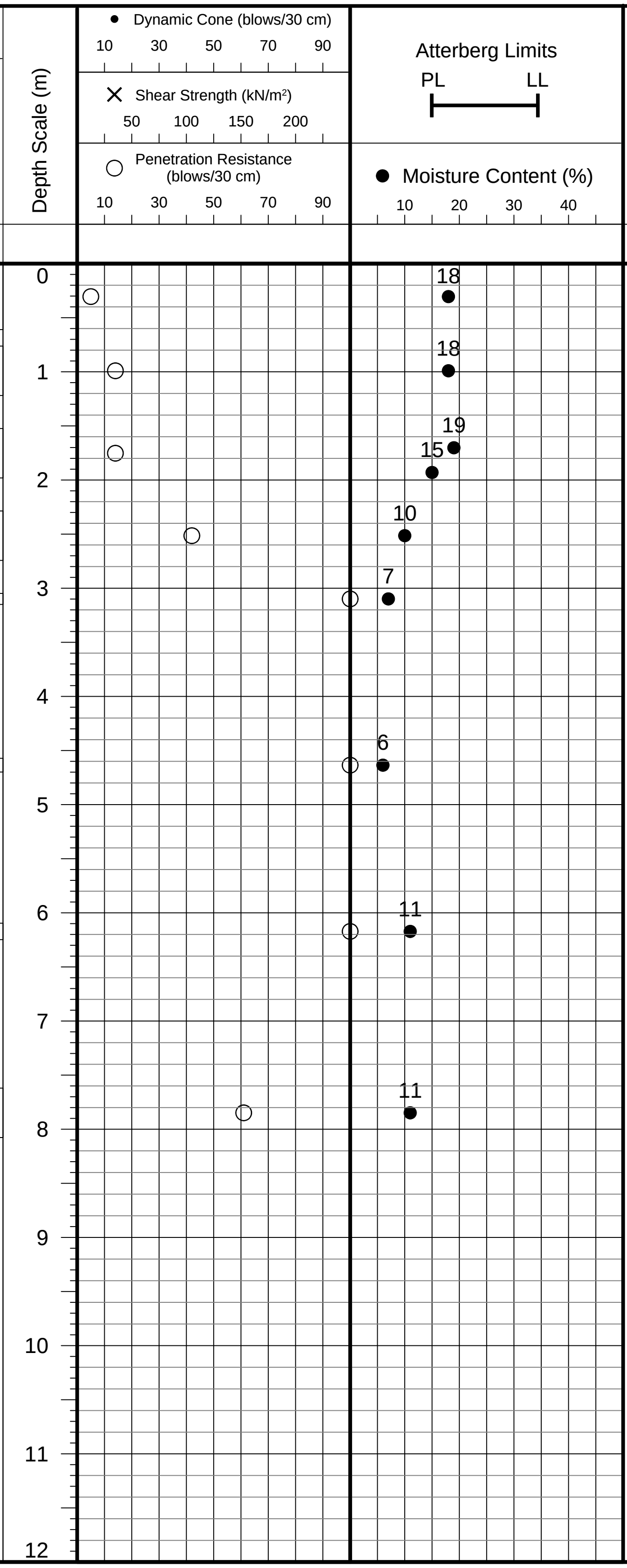
PROJECT LOCATION: Bronte Green - 1401 Bronte Road
Southeast Corner of Bronte Road and Upper Middle Road
Town of Oakville

DRILLING DATE: November 23, 2016

El. (m) Depth (m)	SOIL DESCRIPTION
127.9	Ground Surface
0.0	**10 cm TOPSOIL** sandy with roots
	Brown **EARTH FILL (Silt)** a trace of clay with topsoil inclusions
127.1 0.8	Brown, compact **SILT** a trace of clay to clayey a trace to some sand
126.0 1.9	Dense to very dense **SILTY SAND TILL** traces to some clay and gravel occ. wet sand and silt seams and layers, cobbles and boulders (grey / red)
121.8 6.1	Red, very dense **GRAVELLY SAND** a trace of silt
119.8 8.1	**END OF BOREHOLE**

SAMPLES

Number	Type	N-Value	Moisture Content (%)
1	DO	5	18
2	DO	14	18
3A	DO	14	19
3B			15
4	DO	42	10
5	DO	50/10	7
6	DO	50/13	6
7	DO	50/15	11
8	DO	61	11



WATER LEVEL

W.L. @ El. 122.7 m on completion

Cave-in @ El. 120.9 m on completion

JOB NO.: 1611-S034

LOG OF BOREHOLE NO.: S10

FIGURE NO.: 19

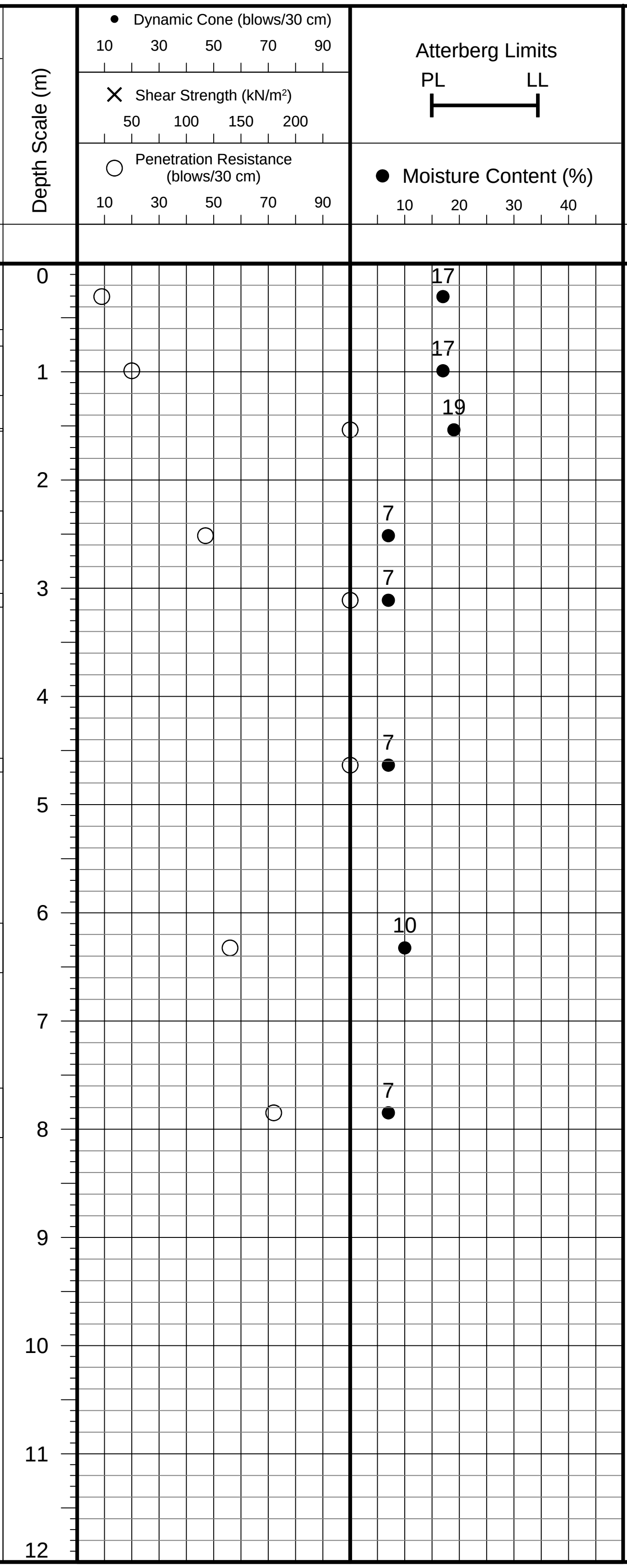
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight-Auger
(Solid-Stem)

PROJECT LOCATION: Bronte Green - 1401 Bronte Road
Southeast Corner of Bronte Road and Upper Middle Road
Town of Oakville

DRILLING DATE: November 23, 2016

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
127.6	Ground Surface			
0.0	**15 cm TOPSOIL** sandy with roots			
	Brown, loose, weathered **SANDY SILT**	1	DO	9
126.8 0.8	a trace of clay with topsoil inclusions	2	DO	20
	Brown, compact **SILT**	3	DO	50/3
126.1 1.5	a trace to some clay a trace of sand			
	Brown, hard **SILTY CLAY TILL**			
125.3 2.3	traces of sand and gravel occ. wet sand and silt seams and layers, cobbles and boulders	4	DO	47
	Red, very dense	5	DO	50/13
	SILTY SAND TILL			
	traces to some clay and gravel occ. wet sand and silt seams and layers, cobbles and boulders	6	DO	50/13
121.5 6.1	Red, very dense	7	DO	56
	GRAVELLY SAND			
	a trace to some silt	8	DO	72
119.5 8.1	**END OF BOREHOLE**			



WATER LEVEL

W.L. @ El. 121.8 m on completion

Soil Engineers Ltd.

JOB NO.: 1611-S034

LOG OF BOREHOLE NO.: S11

FIGURE NO.: 20

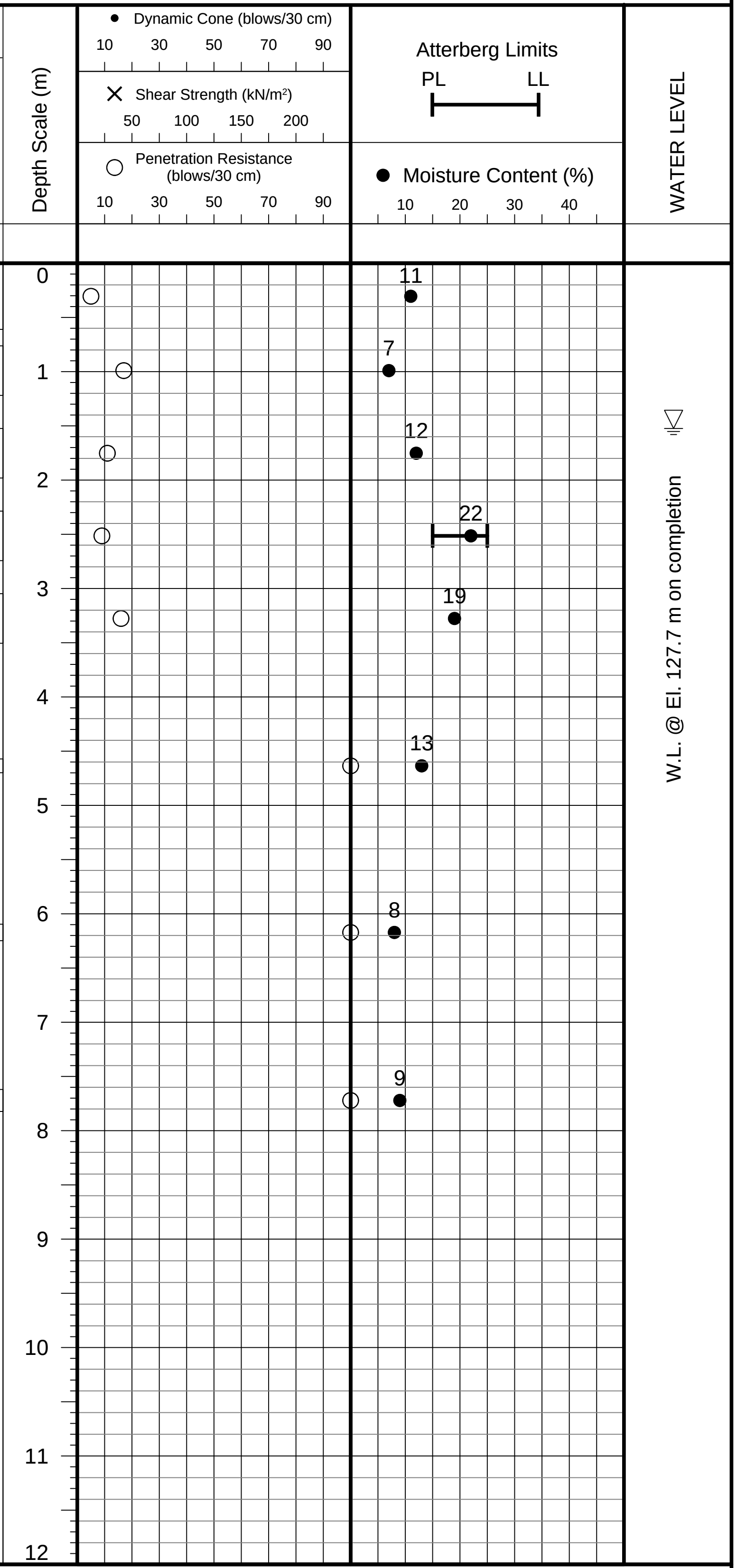
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight-Auger (Solid-Stem)

PROJECT LOCATION: Bronte Green - 1401 Bronte Road
Southeast Corner of Bronte Road and Upper Middle Road
Town of Oakville

DRILLING DATE: November 23, 2016

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
129.2	Ground Surface			
0.0	**15 cm TOPSOIL** sandy with roots — weathered/ organic inclusions/	1	DO	5
	Loose to compact **SILTY SAND TILL** traces of clay and gravel occ. wet sand and silt seams and layers, cobbles and boulders — brown / red	2	DO	17
127.7 1.5	Red, compact **SAND** fine to coarse grained some silt	3	DO	11
126.9 2.3	Grey, stiff **SILTY CLAY** a trace of sand occ. wet sand and silt seams and layers — silt layers	4	DO	9
126.2 3.0	Stiff to hard **SILTY CLAY TILL** traces of sand and gravel occ. wet sand and silt seams and layers, cobbles and boulders	5	DO	16
	— grey / red	6	DO	50/13
124.5 4.7	Red, very dense **GRAVELLY SAND** a trace to some silt	7	DO	50/15
		8	DO	50/5
121.4 7.8	**END OF BOREHOLE**			



Soil Engineers Ltd.

JOB NO.: 1611-S034

LOG OF BOREHOLE NO.: S12

FIGURE NO.: 21

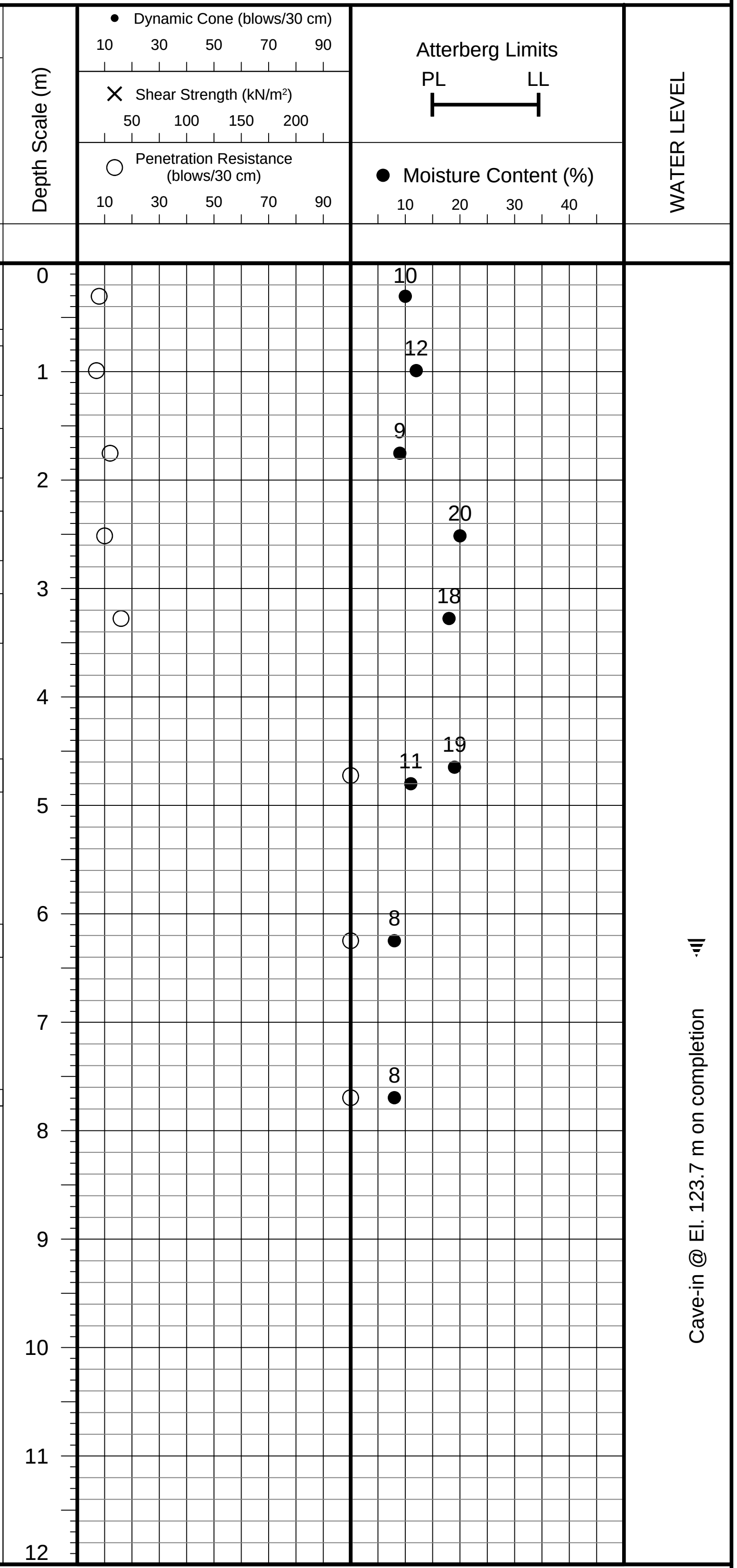
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight-Auger (Solid-Stem)

PROJECT LOCATION: Bronte Green - 1401 Bronte Road
Southeast Corner of Bronte Road and Upper Middle Road
Town of Oakville

DRILLING DATE: November 22, 2016

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
130.1	Ground Surface			
0.0	**15 cm TOPSOIL** sandy	1	DO	8
	Brown/red **EARTH FILL (Silty Sand)** brown/red, traces of clay and gravel	2	DO	7
		3	DO	12
127.8 2.3	Loose to compact **SILT** sandy silt, brown/grey, some clay to clayey, a trace to some sand	4	DO	10
		5	DO	16
125.5 125.4 4.7	Brown, very dense **SILTY FINE SAND** a trace of clay	6A 6B	DO	50/15
	Red, hard **SILTY CLAY TILL** a trace of sand, a trace to some gravel, occ. wet sand and silt seams and layers, cobbles and boulders			
124.0 6.1	Red, very dense **SILTY SAND TILL** traces to some clay and gravel, occ. wet sand and silt seams and layers, cobbles and boulders	7	DO	50/15
122.5 122.3 7.8	Red, very dense **GRAVELLY SAND** a trace to some silt	8	DO	50/15
	END OF BOREHOLE			



Soil Engineers Ltd.

JOB NO.: 1611-S034

LOG OF BOREHOLE NO.: S13

FIGURE NO.: 22

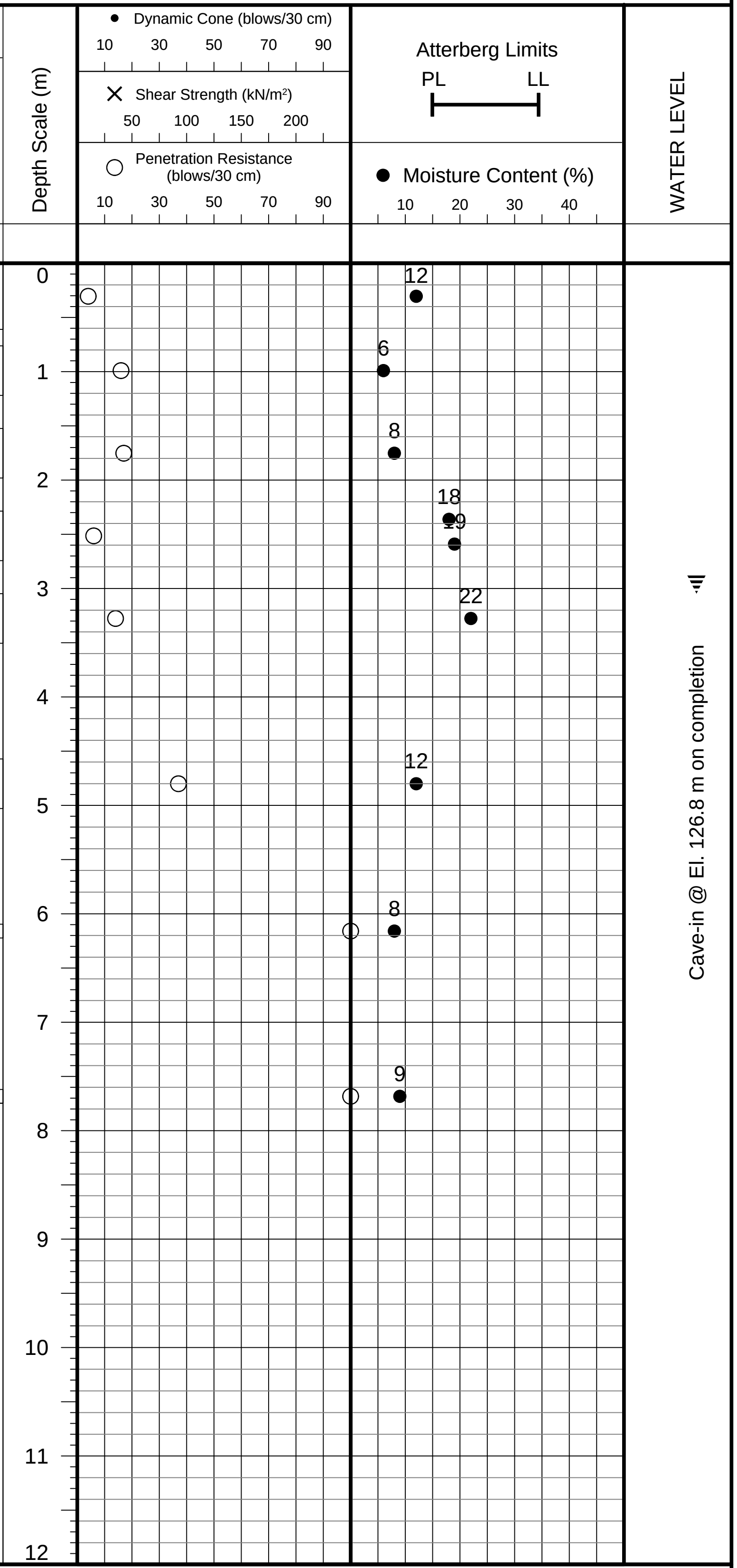
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight-Auger (Solid-Stem)

PROJECT LOCATION: Bronte Green - 1401 Bronte Road
Southeast Corner of Bronte Road and Upper Middle Road
Town of Oakville

DRILLING DATE: November 22, 2016

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
129.8	Ground Surface			
0.0	**8 cm TOPSOIL** sandy with roots Brown **EARTH FILL (Sandy Silt)** traces of clay and gravel with topsoil inclusions	1	DO	4
129.0 0.8	Brown, compact **SAND** fine to coarse grained some silt and gravel	2 3	DO DO	16 17
127.4 2.4	Loose to compact **SILT** brown / grey clay layer some clay to clayey a trace to some sand a trace of gravel	4A 4B 5	DO DO	6 14
125.2 4.6	Hard **SILTY CLAY TILL** traces of sand and gravel occ. wet sand and silt seams and layers, cobbles and boulders grey / red	6	DO	37
123.6 6.2	Red, very dense **GRAVELLY SAND** a trace to some silt	7 8	DO DO	50/13 50/13
122.1 7.7	**END OF BOREHOLE**			



Soil Engineers Ltd.

JOB NO.: 1611-S034

LOG OF BOREHOLE NO.: S14

FIGURE NO.: 23

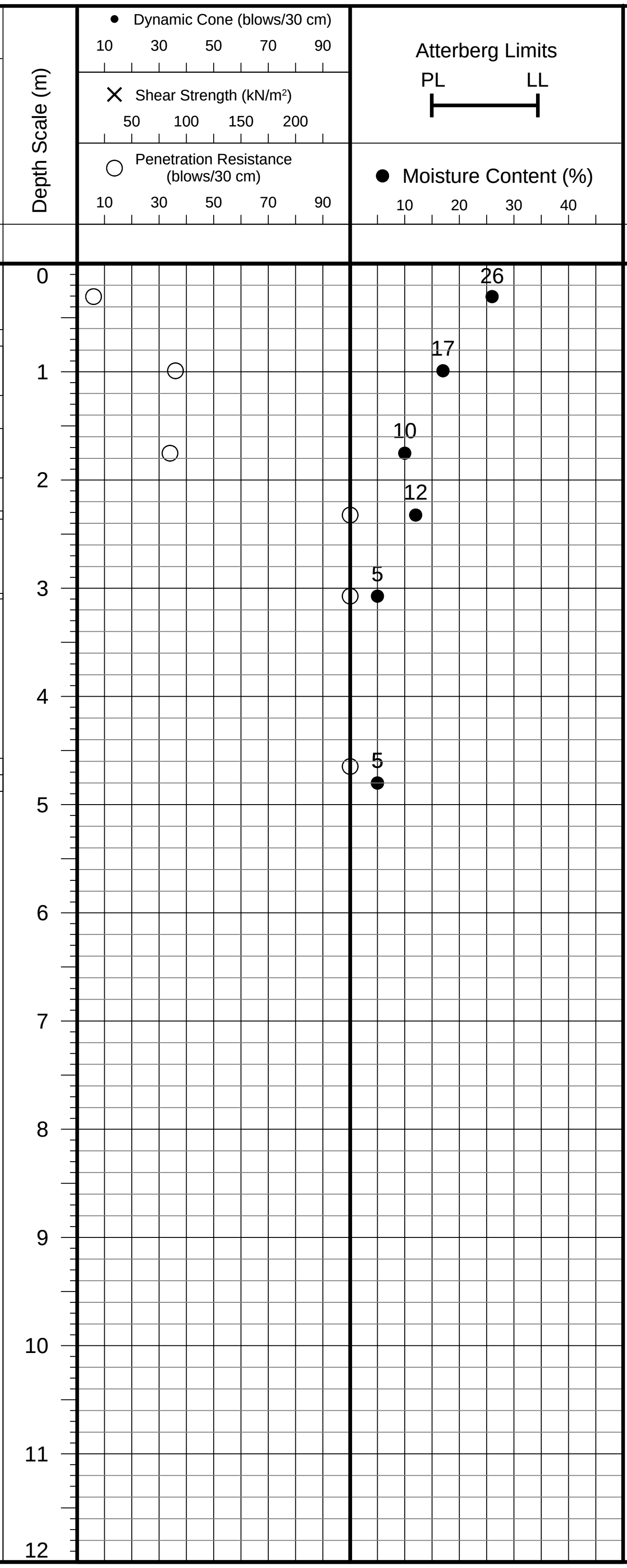
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight-Auger
(Solid-Stem)

PROJECT LOCATION: Bronte Green - 1401 Bronte Road
Southeast Corner of Bronte Road and Upper Middle Road
Town of Oakville

DRILLING DATE: November 25, 2016

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
124.7	Ground Surface			
0.0	**15 cm TOPSOIL**			
	Firm to hard	1	DO	6
	weathered			
	SILTY CLAY TILL	2	DO	36
	brown red			
	traces of sand and gravel occ. wet sand and silt seams and layers, cobbles and boulders	3	DO	34
		4	DO	50/8
	shale reversion			
121.7 3.0	Red	5	DO	50/5
	SHALE BEDROCK			
	weathered	6	DO AS	50/15 -
119.8 4.9	**END OF BOREHOLE**			
	Refusal to augering			



WATER LEVEL

Dry on completion

Soil Engineers Ltd.

JOB NO.: 1611-S034

LOG OF BOREHOLE NO.: S15

FIGURE NO.: 24

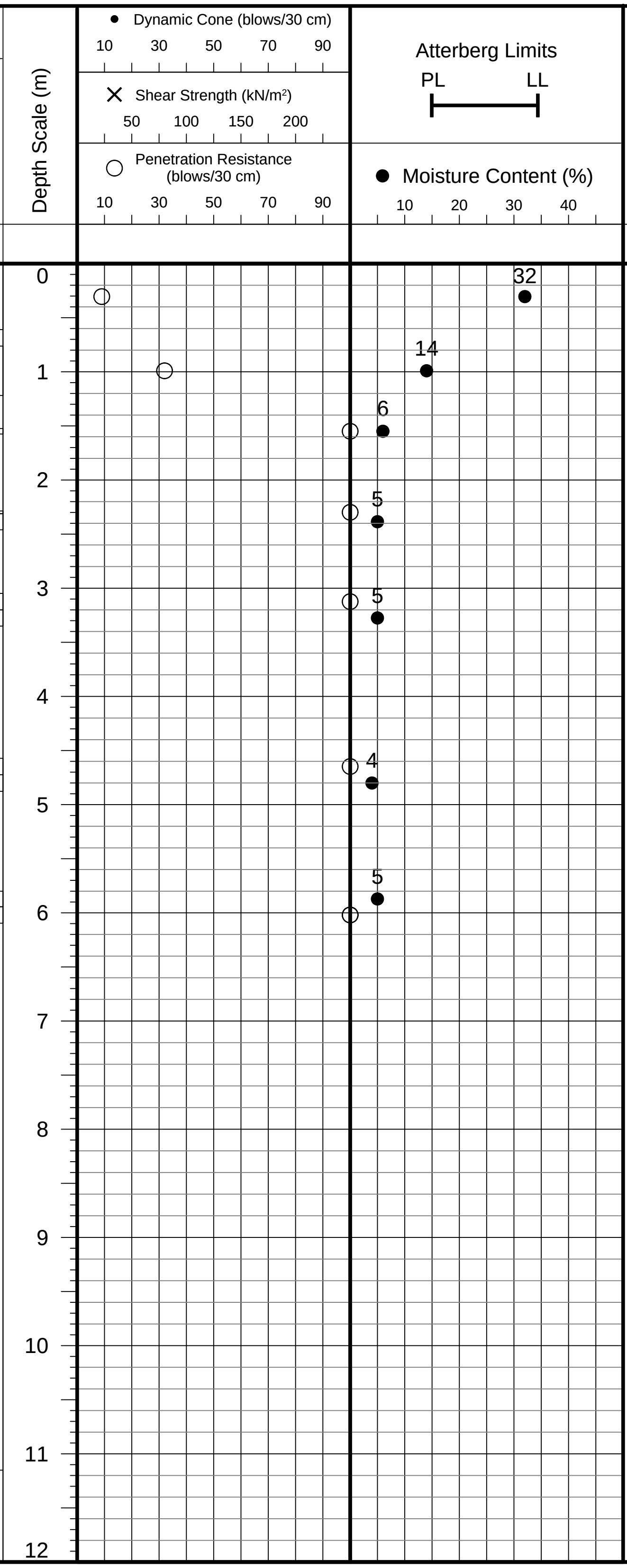
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight-Auger
(Solid-Stem)

PROJECT LOCATION: Bronte Green - 1401 Bronte Road
Southeast Corner of Bronte Road and Upper Middle Road
Town of Oakville

DRILLING DATE: November 25 and 28, 2016

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	WATER LEVEL
124.2	Ground Surface				
0.0	**15 cm TOPSOIL**				Dry on completion
	Brown, stiff to very stiff **SILTY CLAY TILL** traces of sand and gravel occ. wet sand and silt seams and layers, cobbles and boulders weathered	1	DO	9	
		2	DO	32	
122.7 1.5	Red weathered **SHALE BEDROCK**	3	DO	50/5	
		4	DO AS	50/3 -	
		5	DO AS	50/15 -	
		6	DO AS	50/15 -	
		7	AS DO	- 50/15	
		8	RC RQD		
		9	RC RQD		
		10	RC RQD		
		11	RC RQD		
		12	RC RQD		
113.0 11.2	**END OF BOREHOLE**				



Soil Engineers Ltd.

Page: 1 of 1

JOB NO.: 1611-S034

LOG OF BOREHOLE NO.: S16

FIGURE NO.: 25

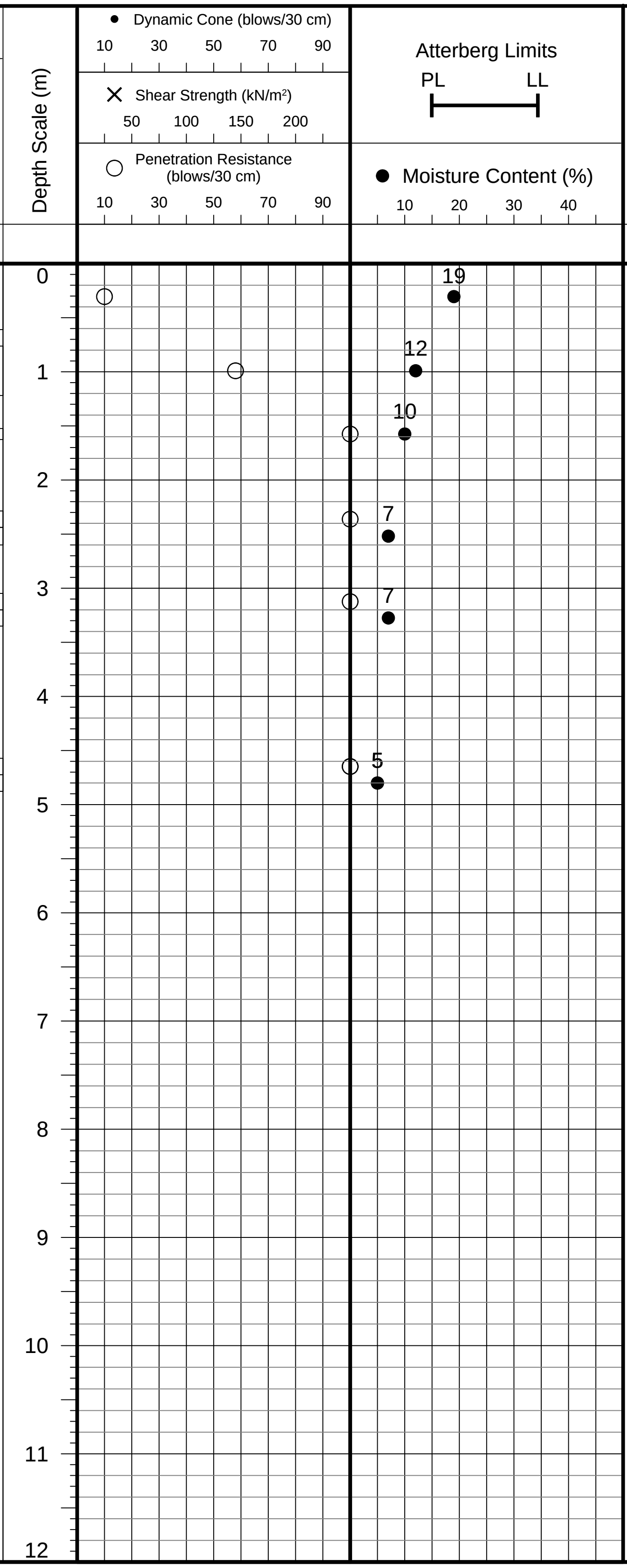
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight-Auger (Solid-Stem)

PROJECT LOCATION: Bronte Green - 1401 Bronte Road
Southeast Corner of Bronte Road and Upper Middle Road
Town of Oakville

DRILLING DATE: November 25, 2016

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value	WATER LEVEL
122.7	Ground Surface				
0.0	**20 cm TOPSOIL**				
	Stiff to hard **SILTY CLAY TILL** a trace to some sand a trace of gravel occ. wet sand and silt seams and layers, cobbles and boulders weathered brown red	1	DO	10	
		2	DO	58	
121.2 1.5	Red weathered **SHALE BEDROCK**	3	DO	50/10	
		4	DO AS	50/15 -	
		5	DO AS	50/15 -	Dry on completion
		6	DO AS	50/15 -	
117.8 4.9	**END OF BOREHOLE** Refusal to augering				



Soil Engineers Ltd.

JOB NO.: 1611-S034

LOG OF BOREHOLE NO.: S17

FIGURE NO.: 26

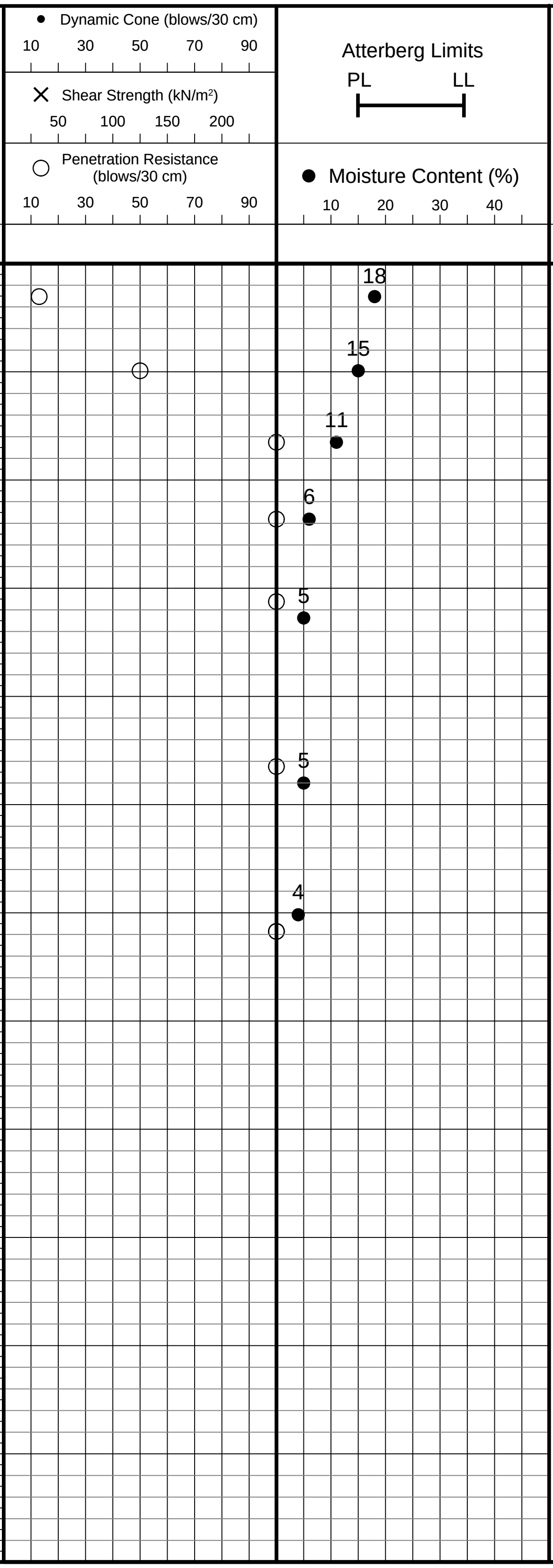
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight-Auger (Solid-Stem)

PROJECT LOCATION: Bronte Green - 1401 Bronte Road
Southeast Corner of Bronte Road and Upper Middle Road
Town of Oakville

DRILLING DATE: November 25, 2016

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value	Depth Scale (m)
121.0	Ground Surface				
0.0	**15 cm TOPSOIL**				0
	Red, stiff to hard organic inclusions/ weathered	1	DO	13	
	SILTY CLAY	2	DO	50	1
	a trace of sand occ. wet sand and silt seams and layers shale reversion	3	DO	50/10	
118.7 2.3	Red	4	DO	50/15	2
	weathered **SHALE BEDROCK**	5	DO AS	50/15 -	3
		6	DO AS	50/15 -	4 5
114.8 6.2		7	AS DO	- 50/15	6
	END OF BOREHOLE				7 8 9 10 11 12

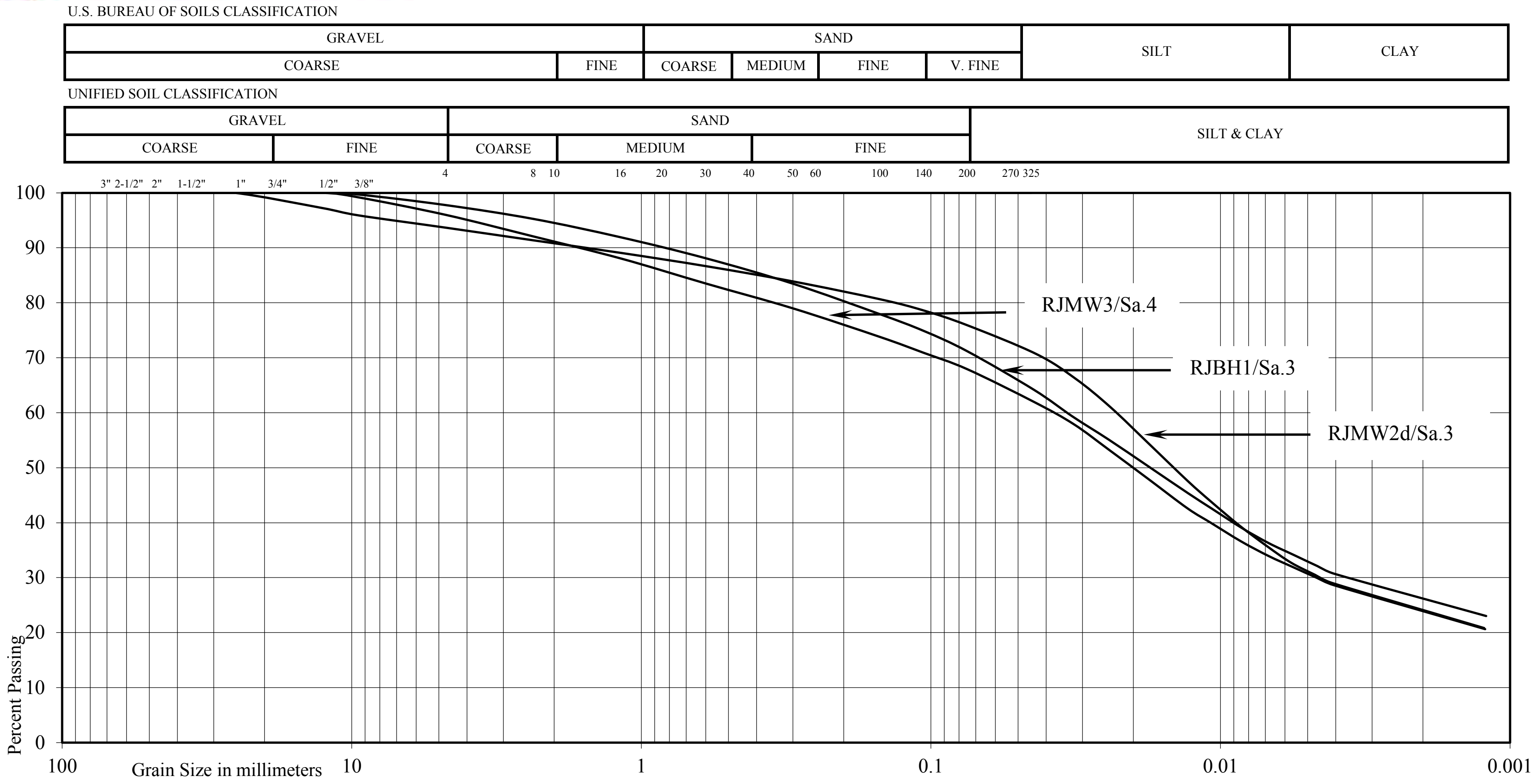


WATER LEVEL: Dry on completion

Soil Engineers Ltd.

GRAIN SIZE DISTRIBUTION

Reference No: 1611-S034



Project: Proposed Residential Development

Location: Bronte Green - 1401 Bronte Road

Southeast Corner of Bronte Road and Upper Middle Road, Town of Oakville

Borehole No:	RJMW2d	RJMW3	RJBH1
Sample No:	3	4	3
Depth (m):	1.8	2.5	1.8
Elevation (m):	123.8	123.3	125.7

BH./Sa.	RJMW2d/3	RJMW3/4	RJBH1/3
Liquid Limit (%) =	29	-	-
Plastic Limit (%) =	17	-	-
Plasticity Index (%) =	12	-	-
Moisture Content (%) =	13	12	11
Estimated Permeability (cm./sec.) =	10^{-7}	10^{-7}	10^{-7}

Classification of Sample [& Group Symbol]: SILTY CLAY TILL

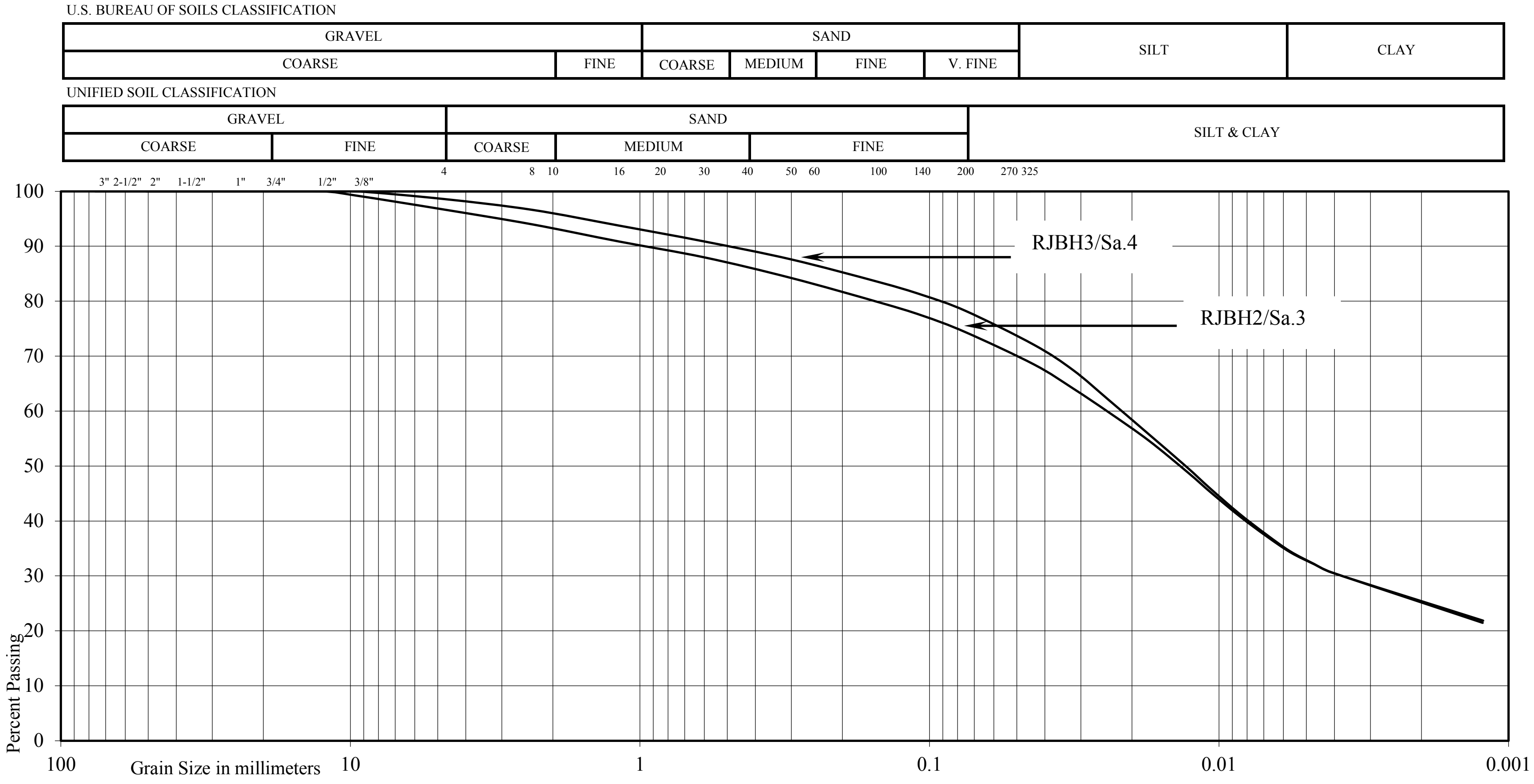
some sand to sandy, a tr. of gravel

Figure: 27

Soil Engineers Ltd.

GRAIN SIZE DISTRIBUTION

Reference No: 1611-S034



Project: Proposed Residential Development

Location: Bronte Green - 1401 Bronte Road

Southeast Corner of Bronte Road and Upper Middle Road, Town of Oakville

Borehole No: RJBH2 RJBH3

Sample No: 3 4

Depth (m): 1.7 2.5

Elevation (m): 124.1 124.1

BH./Sa.	RJBH2/3	RJBH3/4
Liquid Limit (%) =	-	-
Plastic Limit (%) =	-	-
Plasticity Index (%) =	-	-
Moisture Content (%) =	13	12
Estimated Permeability (cm./sec.) =	10^{-7}	10^{-7}

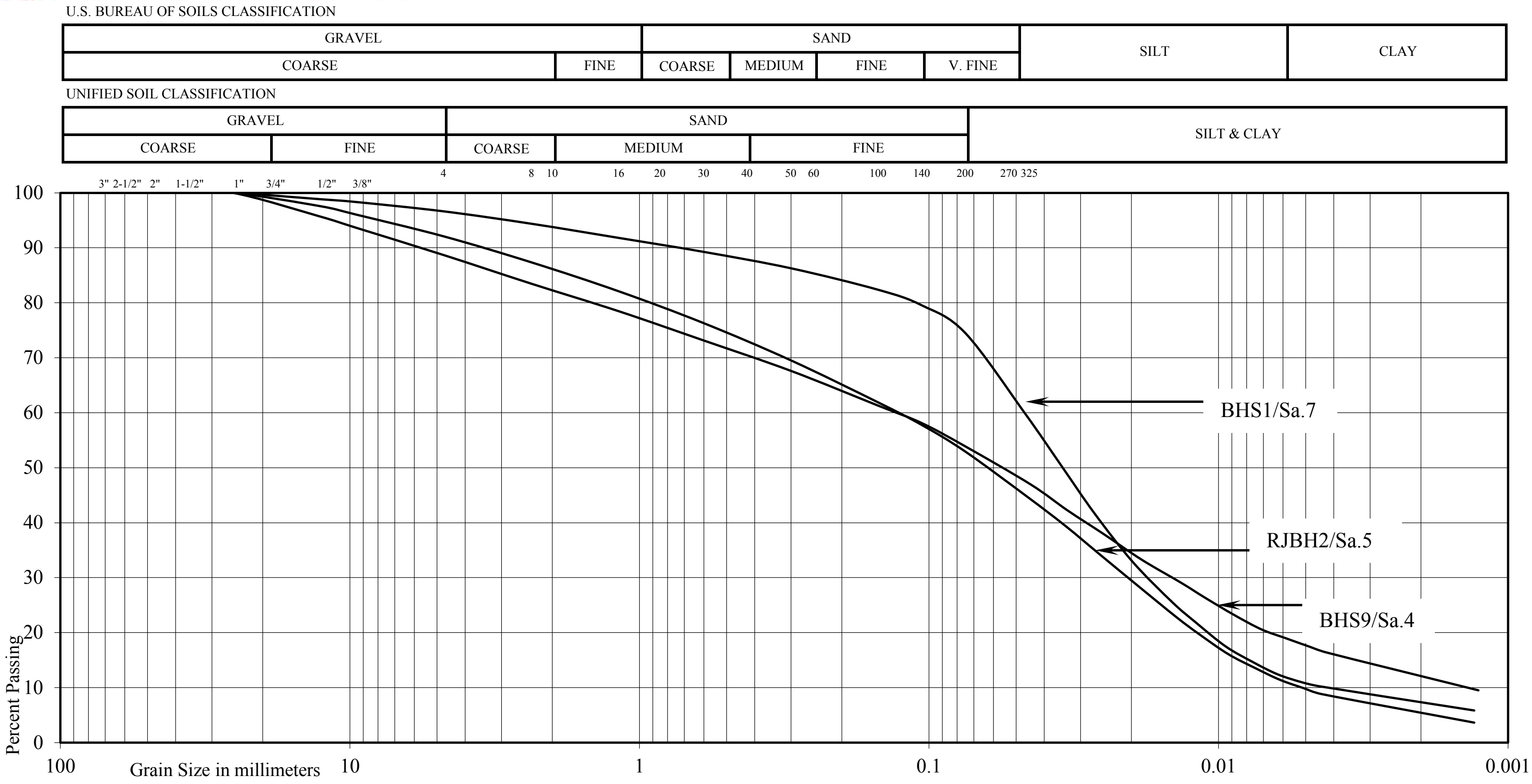
Classification of Sample [& Group Symbol]: SILTY CLAY TILL
sandy, a tr. of gravel

Figure: 28

Soil Engineers Ltd.

GRAIN SIZE DISTRIBUTION

Reference No: 1611-S034



Project: Proposed Residential Development

Location: Bronte Green - 1401 Bronte Road

Southeast Corner of Bronte Road and Upper Middle Road, Town of Oakville

Borehole No:	RJBH2	S1	S9
Sample No:	5	7	4
Depth (m):	3.2	6.3	2.5
Elevation (m):	122.6	123.0	125.4

BH./Sa.	RJBH2/5	S1/7	S9/4
Liquid Limit (%) =	-	-	-
Plastic Limit (%) =	-	-	-
Plasticity Index (%) =	-	-	-
Moisture Content (%) =	11	12	10
Estimated Permeability (cm./sec.) =	10^{-5}	10^{-5}	10^{-6}

Classification of Sample [& Group Symbol]: RJBH2/Sa.5 and BHS9/Sa.4 - SILTY SAND TILL, trs. to some clay and gravel

BHS1/Sa.7 - SANDY SILT TILL, trs. of clay and gravel

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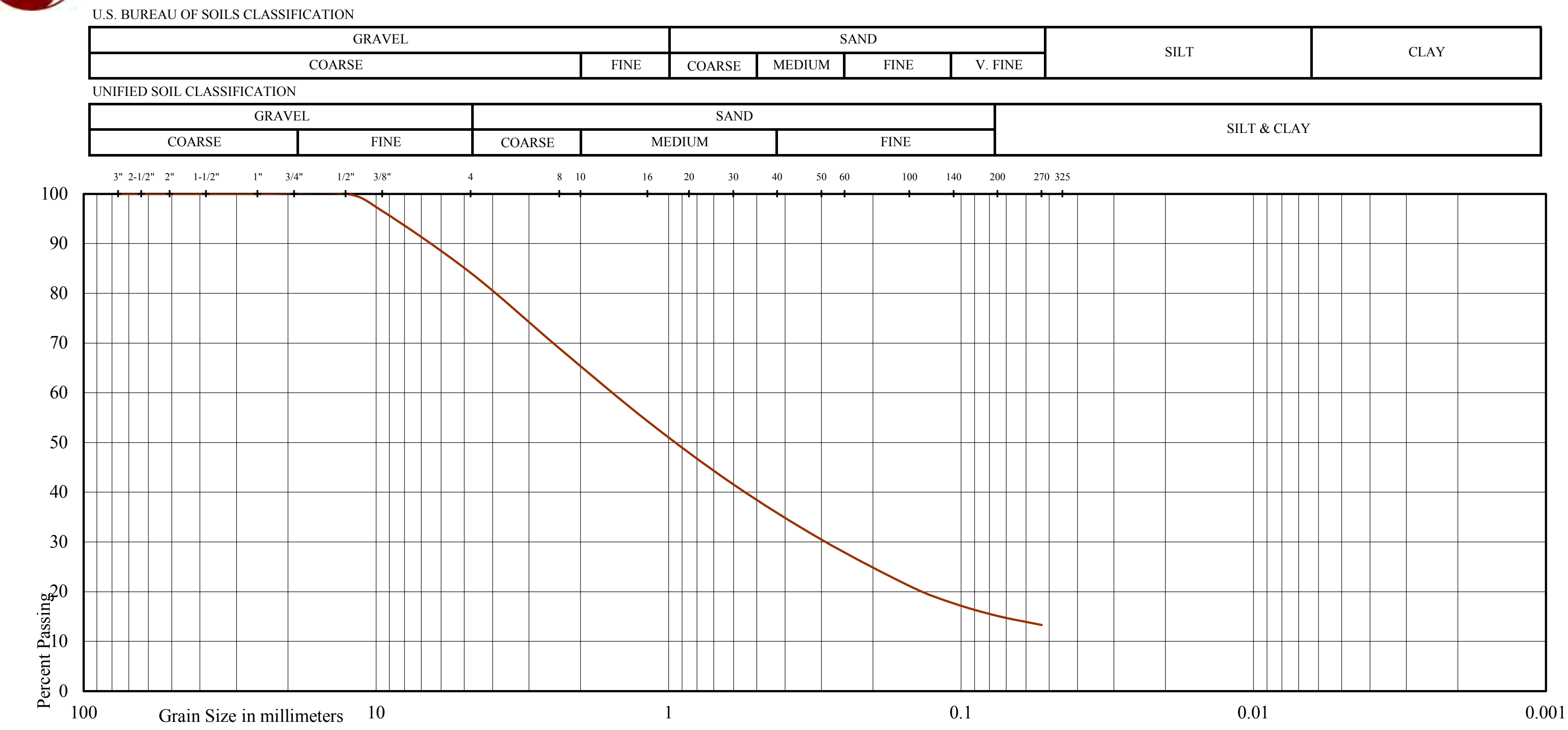
GRAIN SIZE DISTRIBUTION

Reference No: 1611-S034



Project: Proposed Residential Development

Location: Bronte Green - 1401 Bronte Road

Southeast Corner of Bronte Road and Upper Middle Road, Town of Oakville

Borehole No: S13

Sample No: 2

Depth (m): 1.0

Elevation (m): 128.8

Liquid Limit (%) = -

Plastic Limit (%) = -

Plasticity Index (%) = -

Moisture Content (%) = 6

Estimated Permeability

(cm./sec.) = 10^{-3}

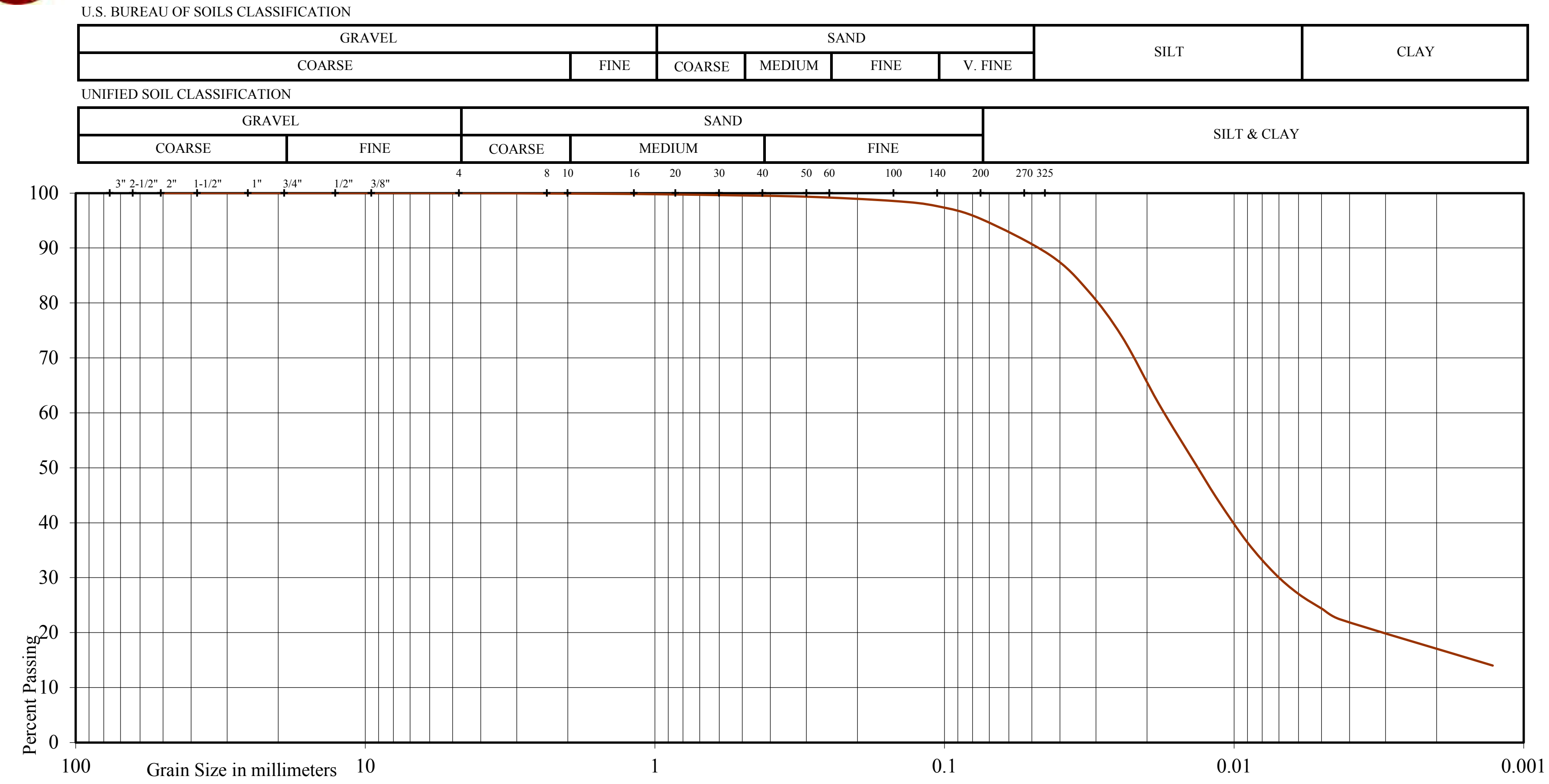
Classification of Sample [& Group Symbol]: SAND, fine to coarse grained, some silt and gravel

Figure: 30

Soil Engineers Ltd.

GRAIN SIZE DISTRIBUTION

Reference No: 1611-S034



Project:	Proposed Residential Development		
Location:	Bronte Green - 1401 Bronte Road	Liquid Limit (%) =	25
	Southeast Corner of Bronte Road and Upper Middle Road, Town of Oakville	Plastic Limit (%) =	15
Borehole No:	S11	Plasticity Index (%) =	10
Sample No:	4	Moisture Content (%) =	22
Depth (m):	2.5	Estimated Permeability	
Elevation (m):	126.7	(cm./sec.) =	10^{-7}

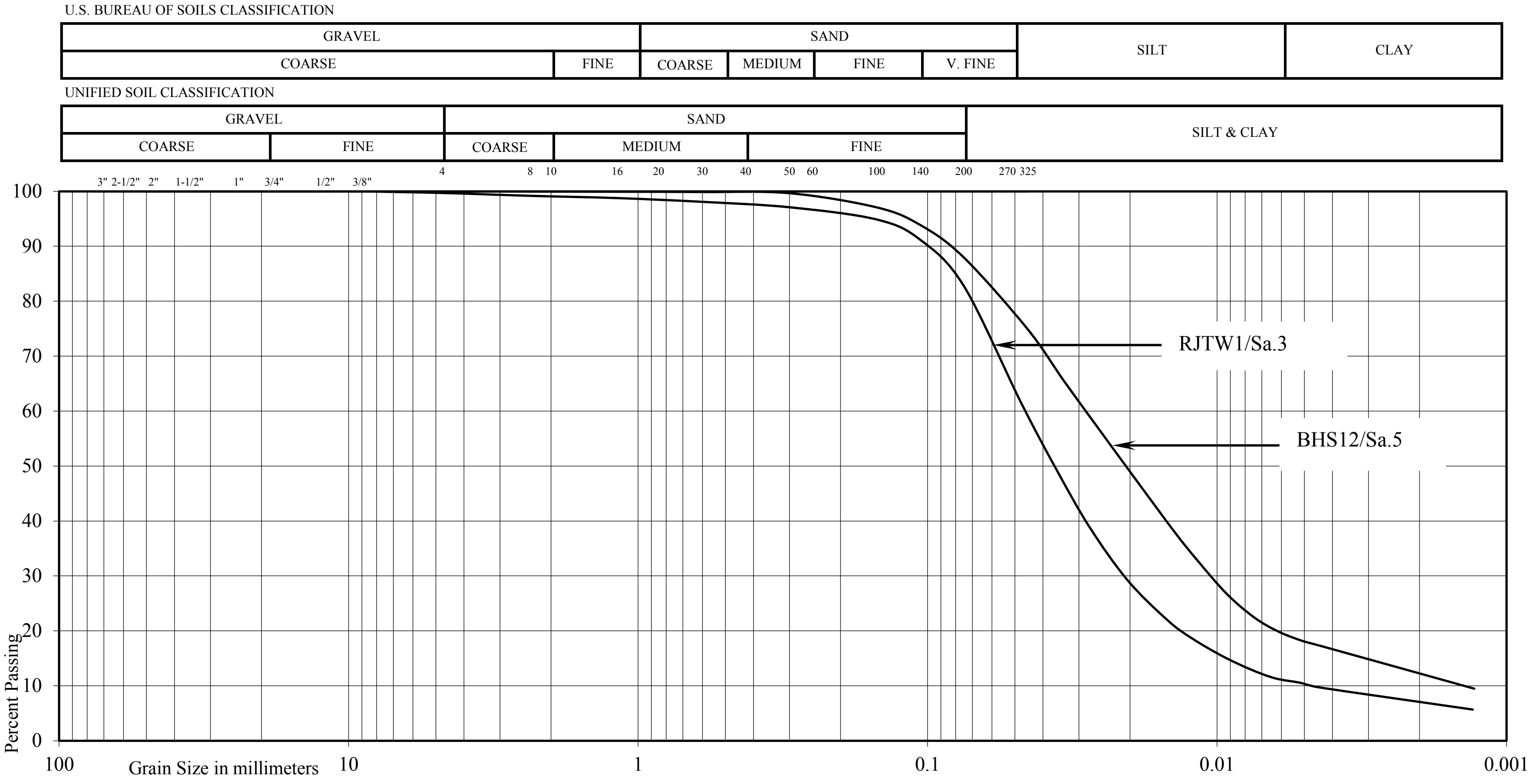
Classification of Sample [& Group Symbol]: SILTY CLAY, a tr. of sand

Figure: 31

Soil Engineers Ltd.

GRAIN SIZE DISTRIBUTION

Reference No: 1611-S034



Project: Proposed Residential Development

Location: Bronte Green - 1401 Bronte Road

Southeast Corner of Bronte Road and Upper Middle Road, Town of Oakville

Borehole No: RJTW1 S12

Sample No: 3 5

Depth (m): 1.8 3.3

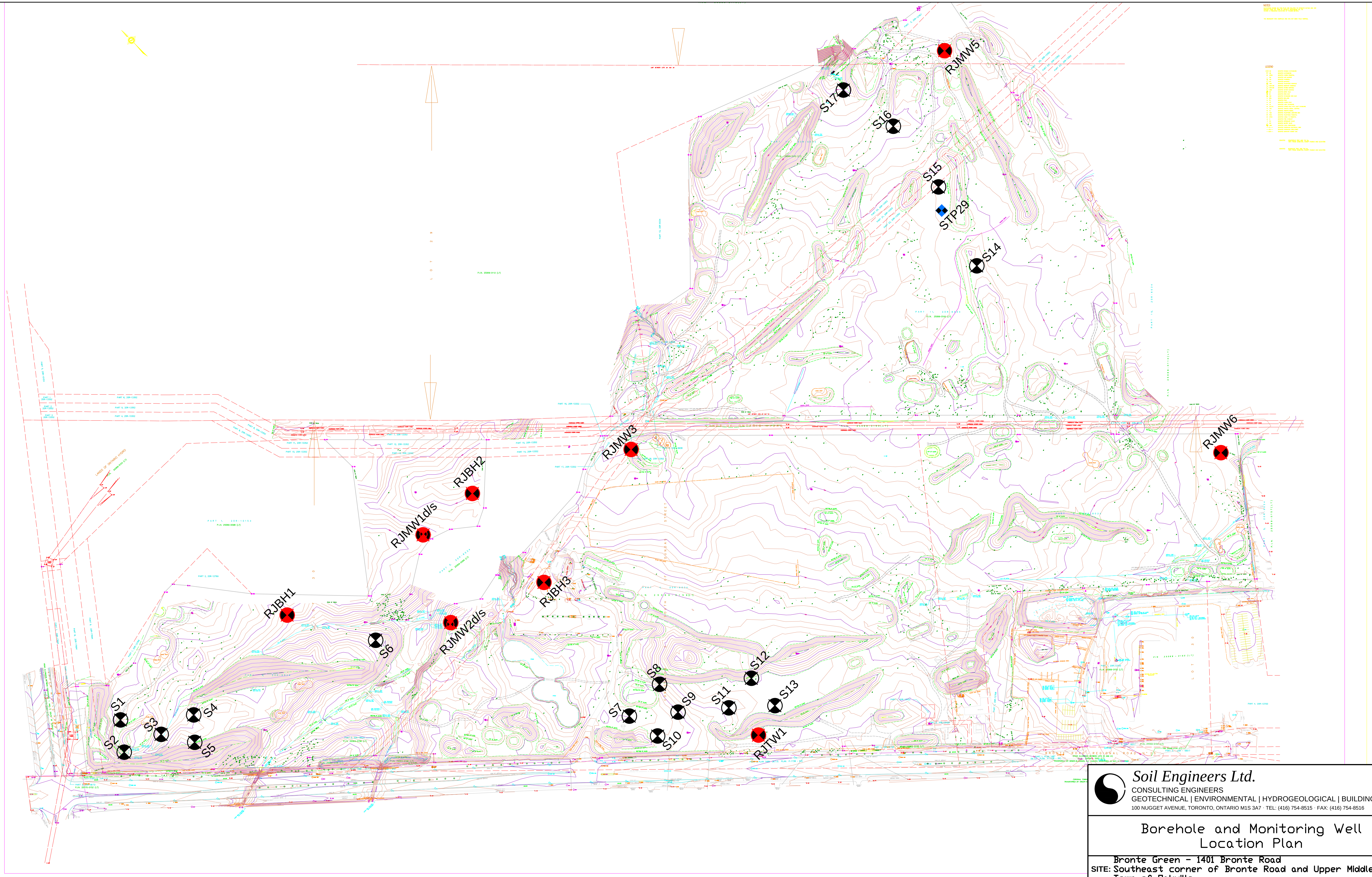
Elevation (m): 128.0 126.8

BH./Sa.	RJTW1/3	S12/5
Liquid Limit (%) =	-	-
Plastic Limit (%) =	-	-
Plasticity Index (%) =	-	-
Moisture Content (%) =	16	18
Estimated Permeability (cm./sec.) =	10^{-5}	10^{-6}

Classification of Sample [& Group Symbol]: SILT

a tr. to some clay, some sand

Figure: 32



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Borehole and Monitoring Well Location Plan

SITE: Bronte Green - 1401 Bronte Road
Southeast corner of Bronte Road and Upper Middle Road
Town of Oakville

DESIGNED BY:	CHECKED BY:	DWG NO.: 1

SCALE: 1:4000	REF. NO.: 1611-S034	DATE: April 2017	REV A

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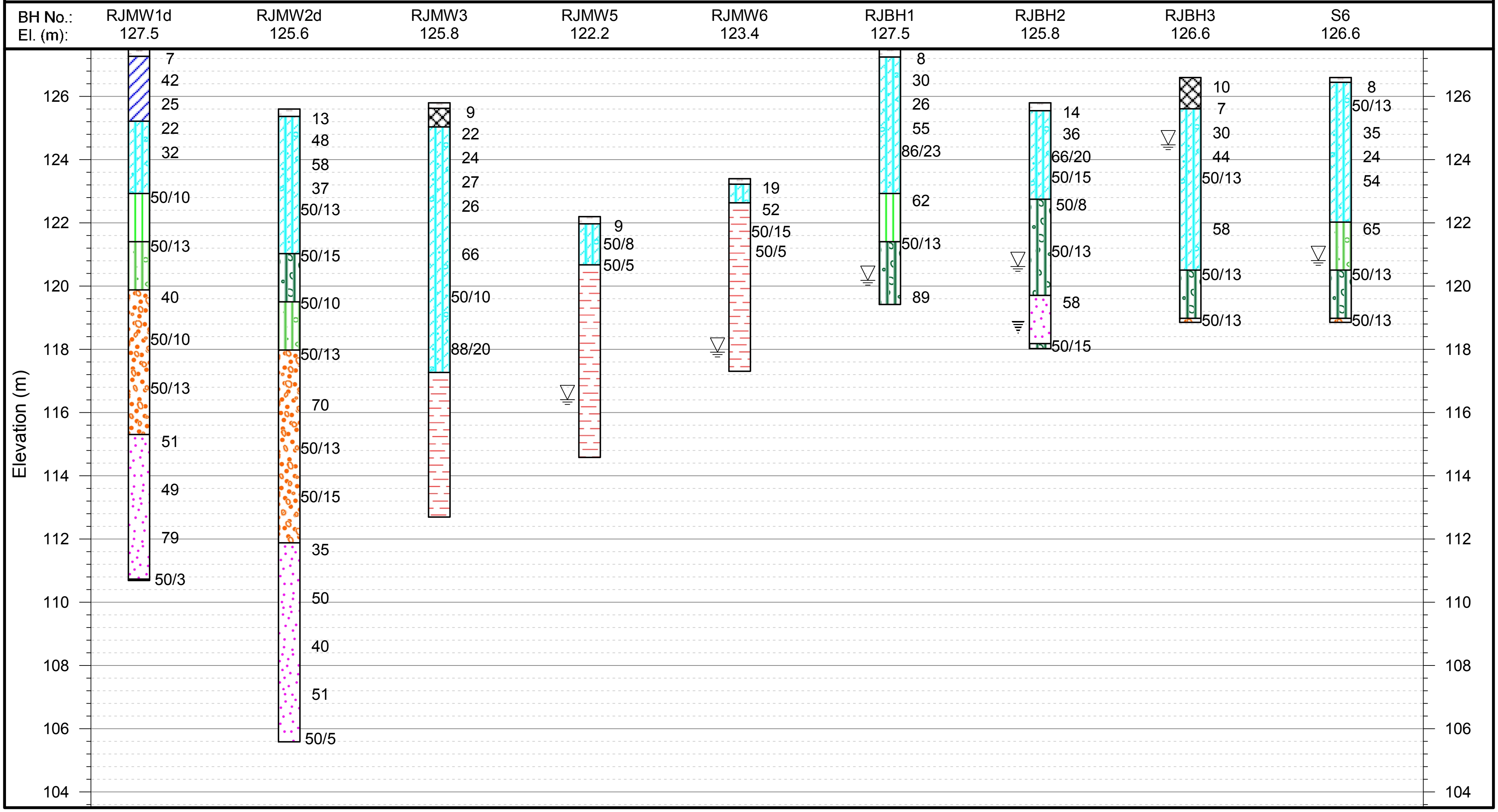
SUBSURFACE PROFILE
DRAWING NO. 2
SCALE: AS SHOWN

JOB NO.: 1611-S034
REPORT DATE: April 2017
PROJECT DESCRIPTION: Proposed Residential Development
PROJECT LOCATION: Bronte Green - 1401 Bronte Road
Southeast Corner of Bronte Road and Upper Middle Road
Town of Oakville

LEGEND

▨	TOPSOIL	▨	SILTY SAND TILL	▨	SILTY CLAY	▨	SHALE
▨	FILL	▨	SANDY SILT TILL	▨	SILTY CLAY TILL	▨	GRAVELLY SAND
▨	SAND	▨	SILT				

▽ WATER LEVEL (END OF DRILLING) ≡ CAVE-IN



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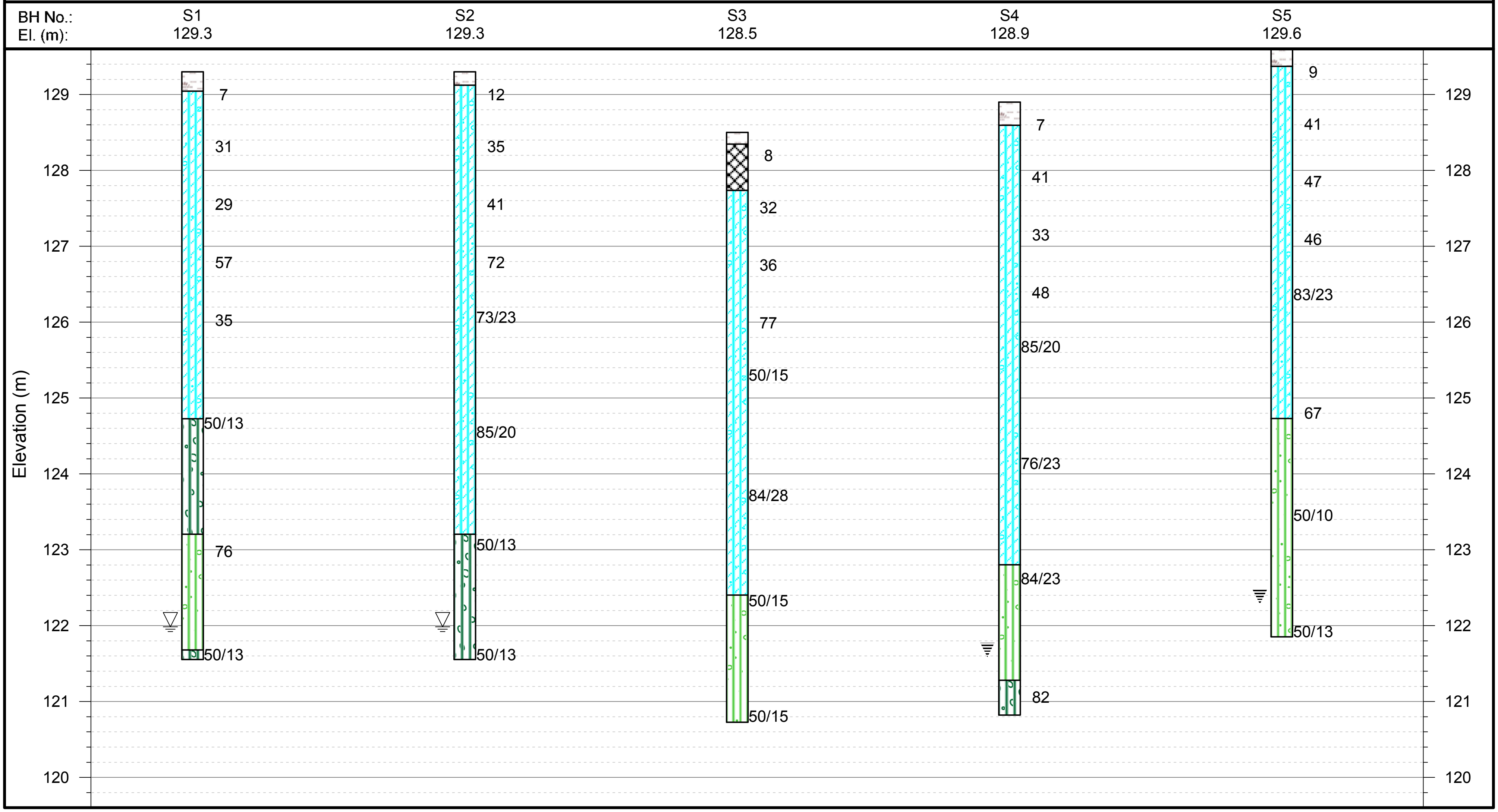
SUBSURFACE PROFILE
DRAWING NO. 3
SCALE: AS SHOWN

JOB NO.: 1611-S034
REPORT DATE: April 2017
PROJECT DESCRIPTION: Proposed Residential Development

PROJECT LOCATION: Bronte Green - 1401 Bronte Road
Southeast Corner of Bronte Road and Upper Middle Road
Town of Oakville

LEGEND

- ▨ TOPSOIL
- ▨ SILTY SAND TILL
- 🟩 SANDY SILT TILL
- ▨ SILTY CLAY TILL
- ▩ FILL
- ▽ WATER LEVEL (END OF DRILLING)
- ≡ CAVE-IN



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SUBSURFACE PROFILE
DRAWING NO. 4
SCALE: AS SHOWN

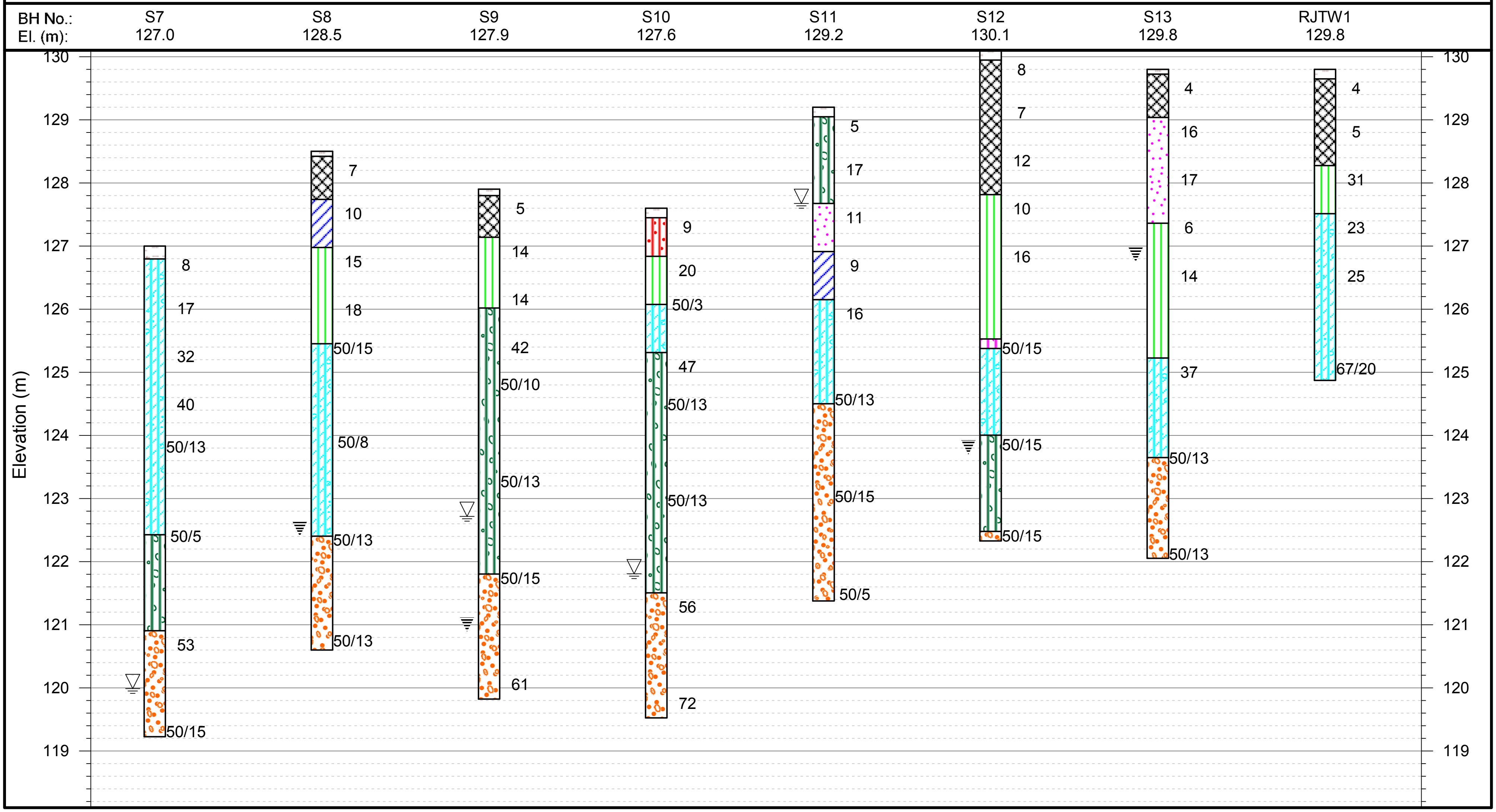
JOB NO.: 1611-S034
REPORT DATE: April 2017
PROJECT DESCRIPTION: Proposed Residential Development

PROJECT LOCATION: Bronte Green - 1401 Bronte Road
Southeast Corner of Bronte Road and Upper Middle Road
Town of Oakville

LEGEND

▨	TOPSOIL	▨	SILTY FINE SAND	▨	SILT	▨	SILTY CLAY TILL
▨	FILL	▨	SILTY SAND TILL	▨	SILTY CLAY	▨	GRAVELLY SAND
▨	SAND	▨	SANDY SILT				

∇ WATER LEVEL (END OF DRILLING)   ≡ CAVE-IN



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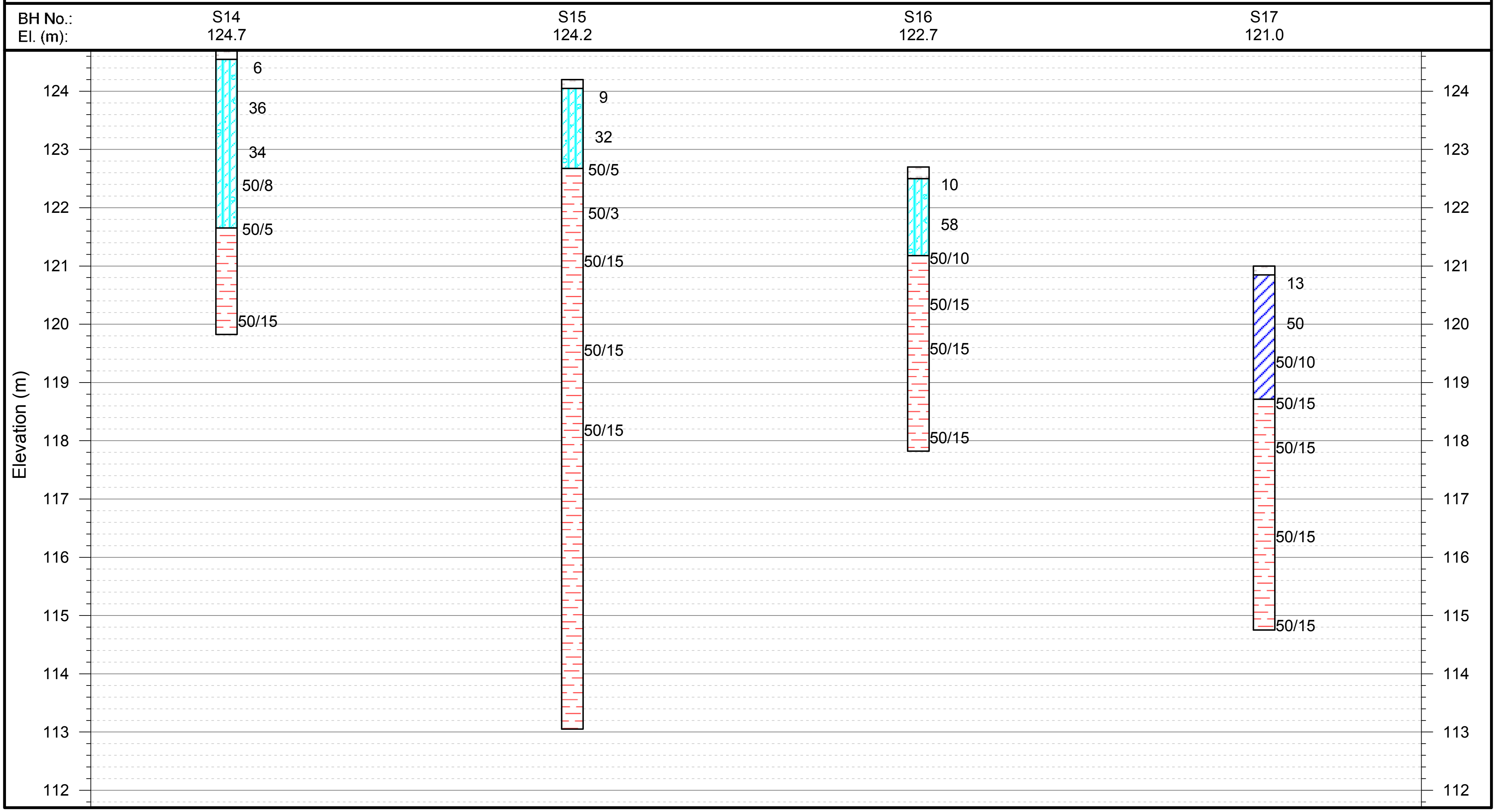
SUBSURFACE PROFILE
DRAWING NO. 5
SCALE: AS SHOWN

JOB NO.: 1611-S034
REPORT DATE: April 2017
PROJECT DESCRIPTION: Proposed Residential Development

PROJECT LOCATION: Bronte Green - 1401 Bronte Road
Southeast Corner of Bronte Road and Upper Middle Road
Town of Oakville

LEGEND

▨	TOPSOIL
▨	SILTY CLAY
▨	SILTY CLAY TILL
▤	SHALE



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FAX: (705) 721-7864	FAX: (905) 542-2769	FAX: (905) 725-1315	FAX: (416) 754-8516	FAX: (705) 684-8522	FAX: (905) 725-1315	FAX: (905) 542-2769

APPENDIX

BOREHOLE LOGS (FIGURES 1 TO 27) AND BOREHOLE LOCATION PLAN (DRAWING NO. 1) FROM SOIL REPORT REFERENCE NO. 1207-S148, DATED JANUARY 2013

REFERENCE NO. 1611-S034(A)

JOB NO: 1207-S148

LOG OF BOREHOLE NO: 1

FIGURE NO: 1

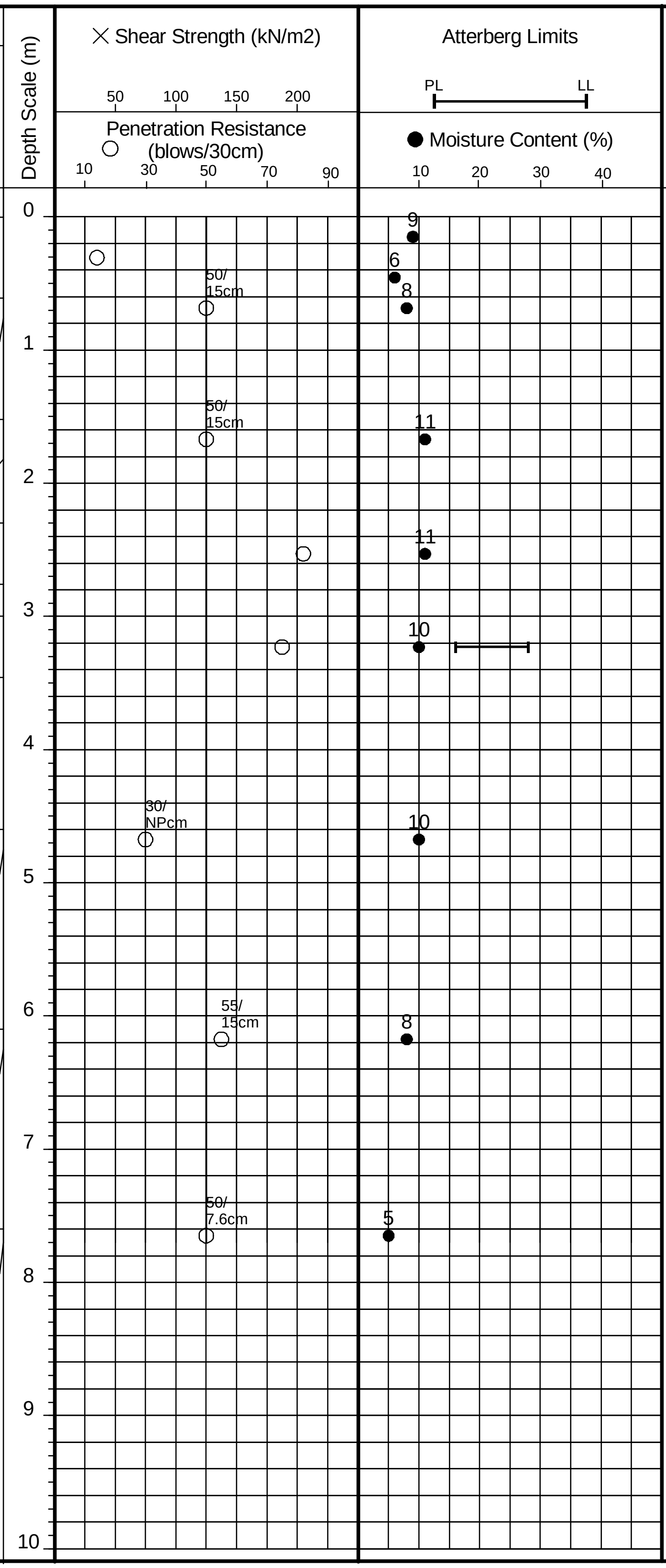
JOB DESCRIPTION: Proposed Residential Development

JOB LOCATION: 1401 Bronte Road, Town of Oakville

METHOD OF BORING: Flight-Auger

DATE: August 9, 2012

Depth Elev. (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
0.0	Ground Surface			
130.3	**18 cm TOPSOIL**	1A	DO	14
	Brown, stiff to hard	1B		
	weathered	2	DO	50/ 15
	SILTY CLAY, Till	3	DO	50/ 15
	sandy, a trace of gravel occ. sand and silt seams and layers, cobbles and boulders	4	DO	82
		5	DO	75
	rock slab/boulder			
	changing to grey			
	rock slab/boulder	6	DO	30/ NP
	reddish-brown	7	DO	55/ 15
7.0 123.3	Brown, very dense **SILTY SAND, Till** a trace of clay and gravel occ. silt and clay seams and layers, cobbles and boulders	8	DO	50/ 7.6
7.7 122.6	**END OF BOREHOLE**			



WATER LEVEL

Dry on completion

Soil Engineers Ltd.

JOB NO: 1207-S148

LOG OF BOREHOLE NO: MW2

FIGURE NO: 2A

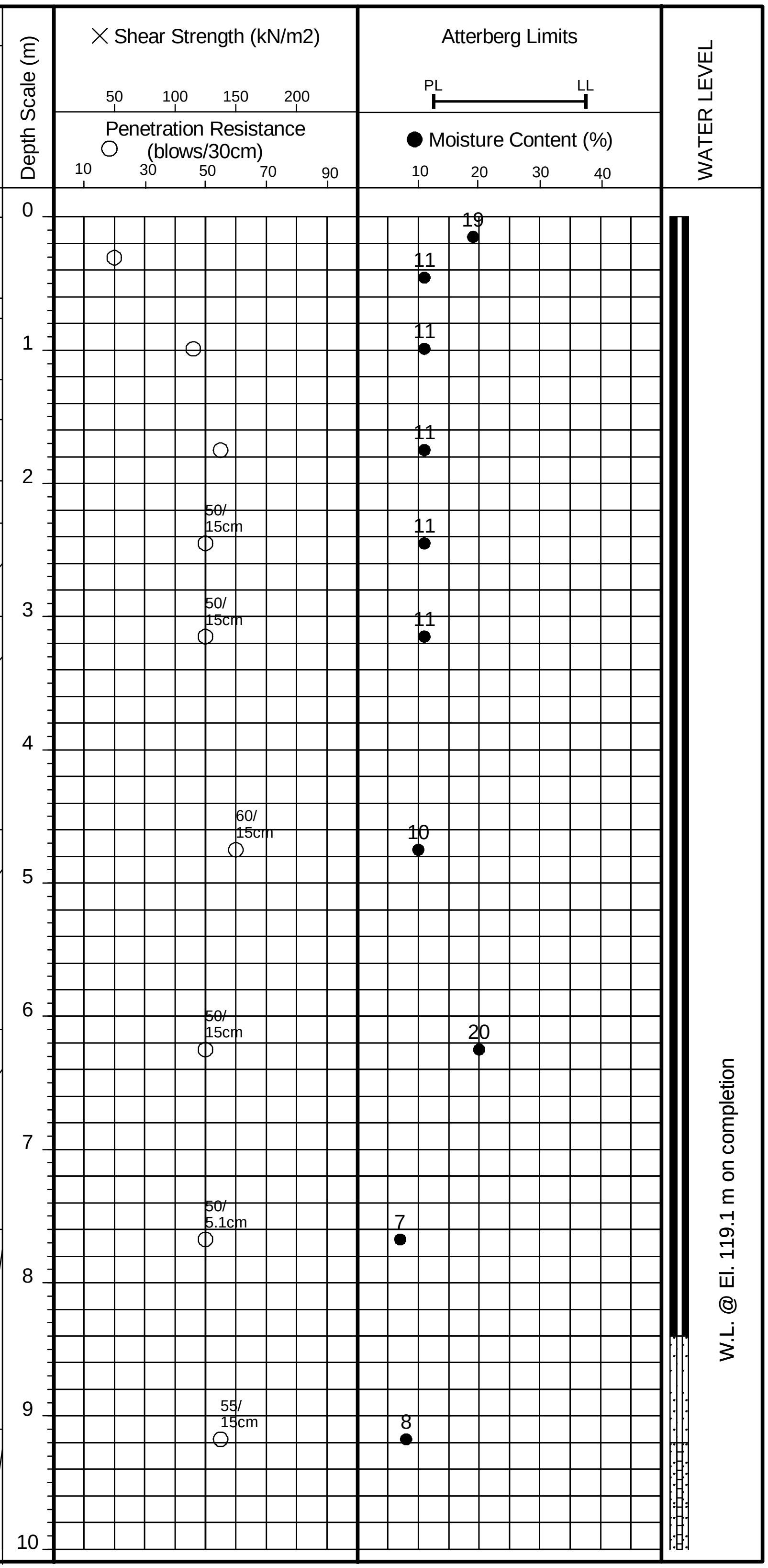
JOB DESCRIPTION: Proposed Residential Development

JOB LOCATION: 1401 Bronte Road, Town of Oakville

METHOD OF BORING: Flight-Auger

DATE: August 9, 2012

Depth Elev. (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
0.0	Ground Surface			
129.8	**18 cm TOPSOIL**	1A	DO	20
	Brown, very stiff to hard weathered	1B		
		2	DO	46
	SILTY CLAY, Till	3	DO	55
	sandy, a trace of gravel occ. sand and silt seams and layers, cobbles and boulders	4	DO	50/ 15
		5	DO	50/ 15
	changing to grey			
	grey	6	DO	60/ 15
	brown silt layer	7	DO	50/ 15
7.0 122.8	Reddish-brown, very dense **SILTY SAND, Till** a trace of clay and gravel occ. silt and clay seams and layers, cobbles and boulders	8	DO	50/ 5.1
8.4 121.4	Reddish-brown, hard **SILTY CLAY, Till** sandy, a trace of gravel occ. sand and silt seams and layers, cobbles and boulders	9	DO	55/ 15
10.0				



Soil Engineers Ltd.

JOB NO: 1207-S148

LOG OF BOREHOLE NO: MW2

FIGURE NO: 2B

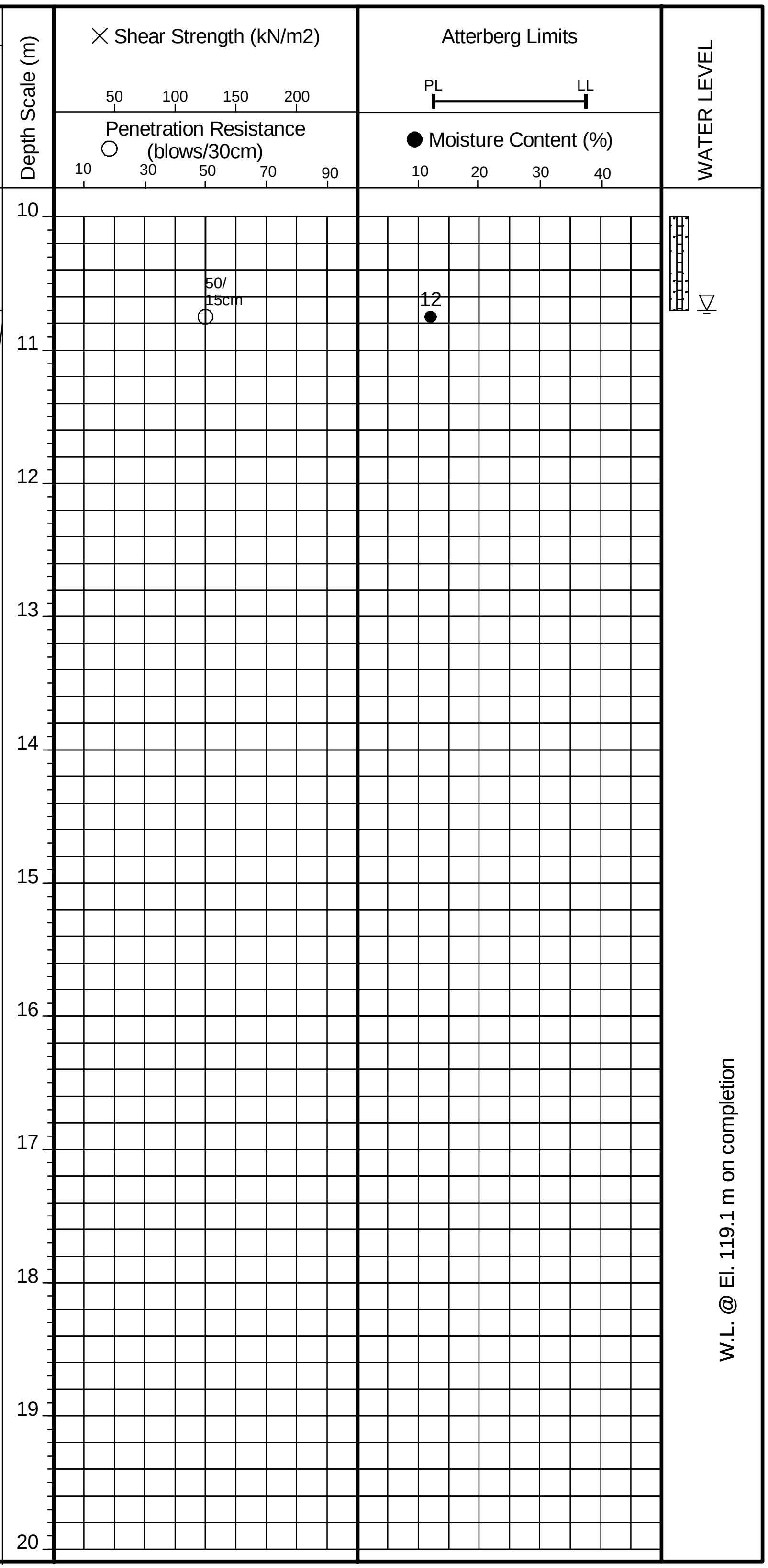
JOB DESCRIPTION: Proposed Residential Development

JOB LOCATION: 1401 Bronte Road, Town of Oakville

METHOD OF BORING: Flight-Auger

DATE: August 9, 2012

Depth Elev. (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
10.0 119.8	Reddish-brown, very dense, wet **FINE TO COARSE SAND** some silt, a trace of gravel	10	DO	50/ 15
10.8 119.0	**END OF BOREHOLE** Installed 50-mm diameter PVC monitoring well to 10.7 m with sand backfill from 8.4 to 10.7 m. Bentonite seal from 0.0 to 8.4 m. Mounted with a steel protective casing.			



Soil Engineers Ltd.

JOB NO: 1207-S148

LOG OF BOREHOLE NO: 3

FIGURE NO: 3

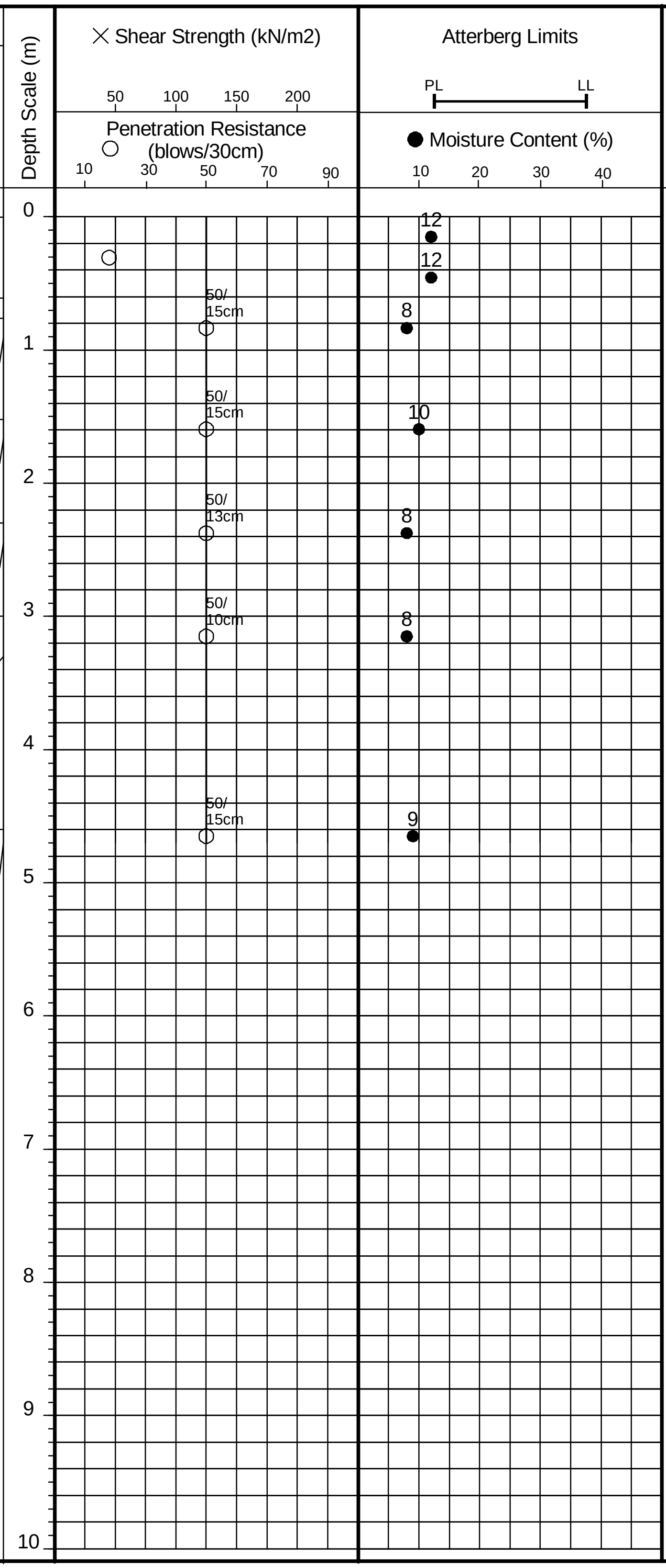
JOB DESCRIPTION: Proposed Residential Development

JOB LOCATION: 1401 Bronte Road, Town of Oakville

METHOD OF BORING: Flight-Auger

DATE: August 9, 2012

Depth Elev. (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
0.0	Ground Surface			
127.9	**13 cm TOPSOIL**	1A	DO	18
	Brown, very stiff to hard weathered	1B		
		2	DO	50/ 15
	SILTY CLAY, Till	3	DO	50/ 15
	sandy, a trace of gravel occ. sand and silt seams and layers, cobbles and boulders	4	DO	50/ 13
	reddish-brown	5	DO	50/ 10
	reddish-brown changing to grey	6	DO	50/ 15
4.7 123.2	**END OF BOREHOLE**			



WATER LEVEL

Dry on completion

Soil Engineers Ltd.

JOB NO: 1207-S148

LOG OF BOREHOLE NO: 4

FIGURE NO: 4

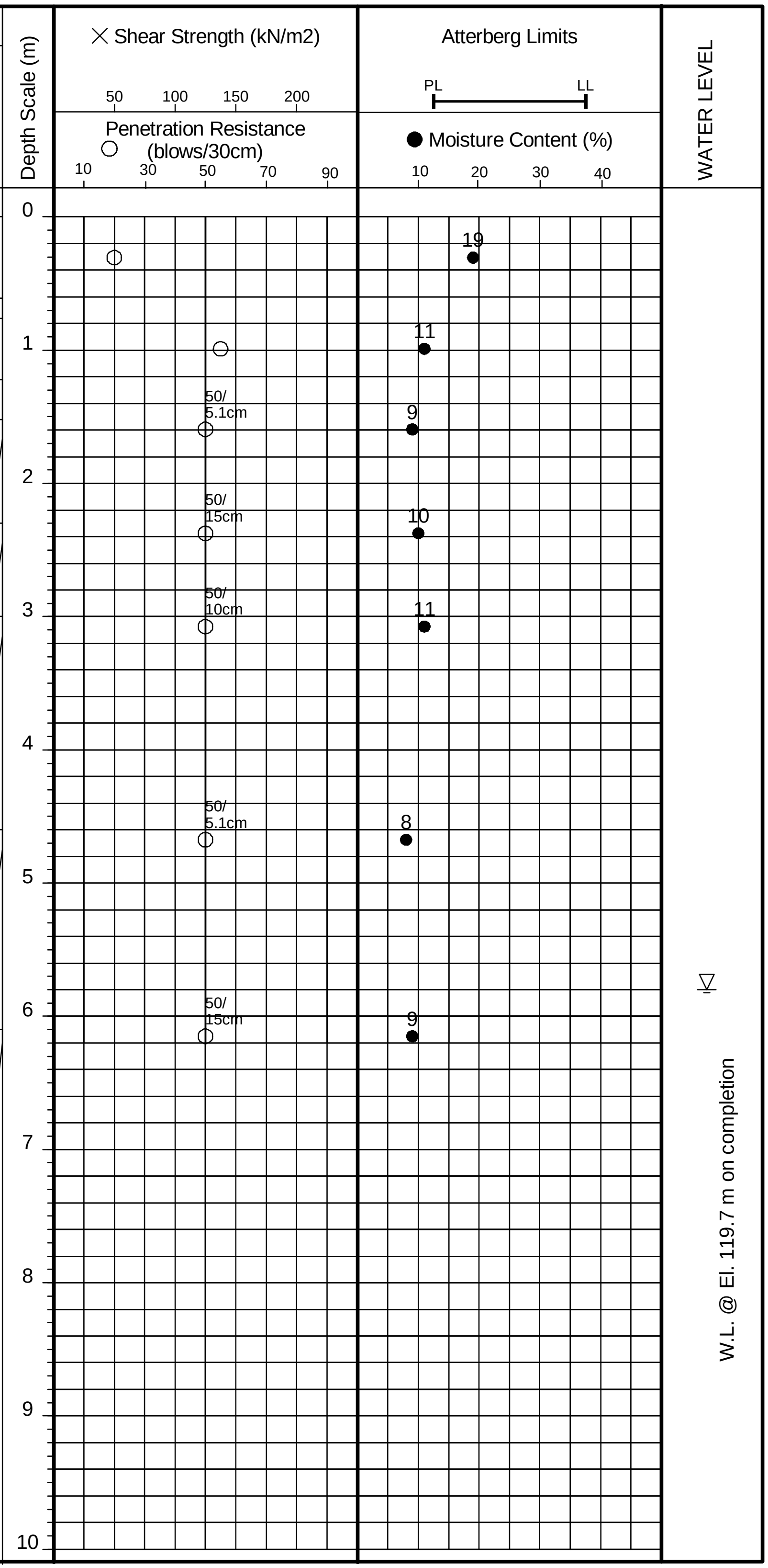
JOB DESCRIPTION: Proposed Residential Development

JOB LOCATION: 1401 Bronte Road, Town of Oakville

METHOD OF BORING: Flight-Auger

DATE: August 9, 2012

Depth Elev. (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
0.0	Ground Surface			
125.5	Brown **EARTH, Fill** silty clay with topsoil inclusions	1	DO	20
0.8 124.7	Reddish-brown, hard	2	DO	55
	rock slab, occ. boulder	3	DO	50/ 5.1
	SILTY CLAY, Till	4	DO	50/ 15
	sandy, a trace of gravel occ. sand and silt seams and layers, cobbles and boulders	5	DO	50/ 10
	rock slab/boulder	6	DO	50/ 5.1
	spoon wet	7	DO	50/ 15
6.2 119.3	**END OF BOREHOLE**			



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JOB NO: 1207-S148

LOG OF BOREHOLE NO: MW5

FIGURE NO: 5

JOB DESCRIPTION: Proposed Residential Development

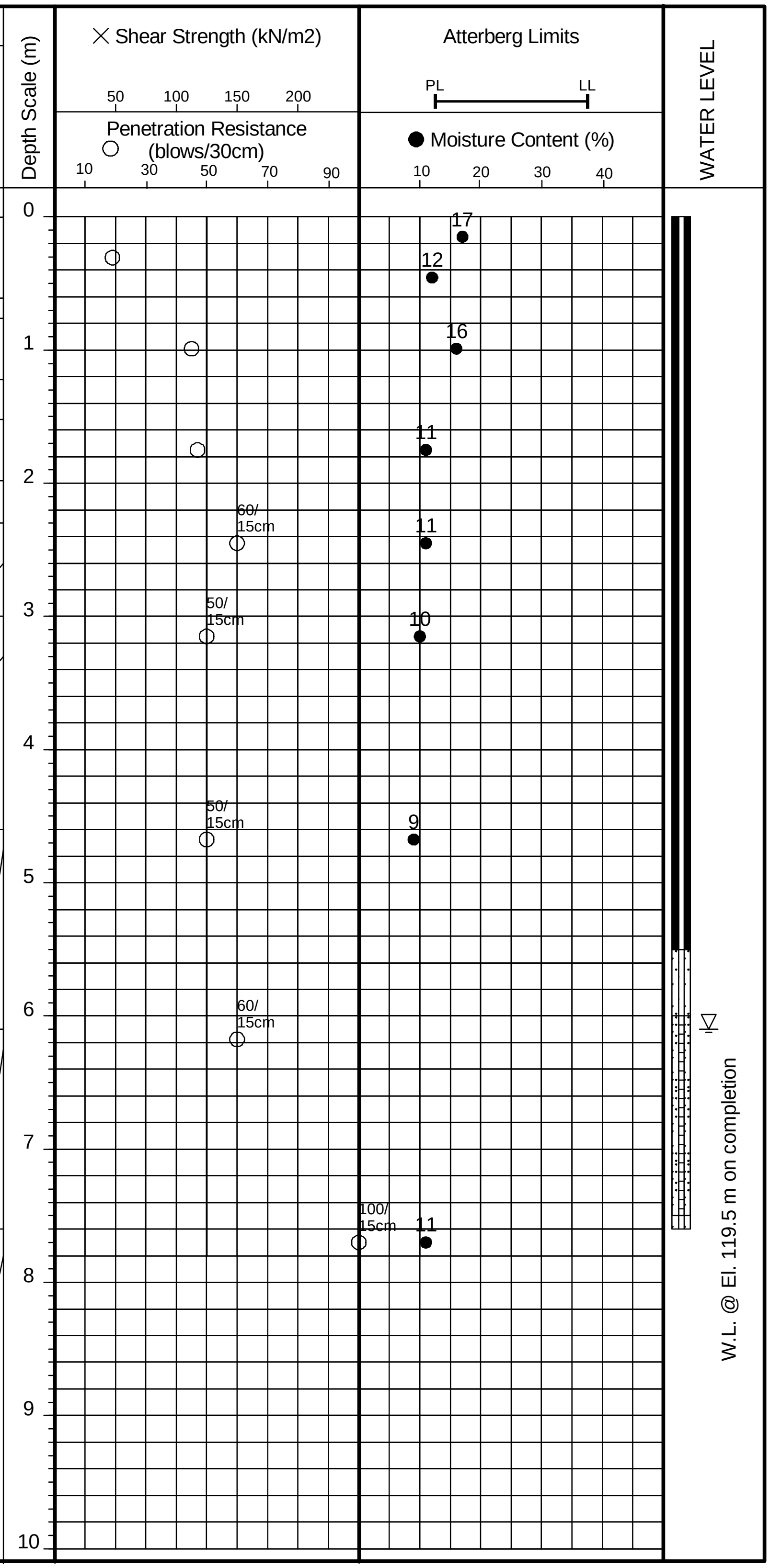
JOB LOCATION: 1401 Bronte Road, Town of Oakville

METHOD OF BORING: Flight-Auger

DATE: August 9, 2012

Depth Elev. (m)	SOIL DESCRIPTION
0.0	Ground Surface
125.6	**25 cm TOPSOIL** Brown, very stiff to hard weathered **SILTY CLAY, Till** changing to reddish-brown sandy, a trace of gravel occ. sand and silt seams and layers, cobbles and boulders
5.6 120.0	Reddish-brown, very dense, wet **FINE TO COARSE SAND AND ROCK FRAGMENTS**
7.8 117.8	**END OF BOREHOLE** Installed 50-mm diameter PVC monitoring well to 7.5 m with sand backfill from 5.5 to 7.6 m. Bentonite seal from 0.0 to 5.5 m. Mounted with a steel protective casing.

SAMPLES		
Number	Type	N-Value
1A	DO	19
1B		
2	DO	45
3	DO	47
4	DO	60/ 15
5	DO	50/ 15
6	DO	50/ 15
7	DO	60/ 15
8	DO	100/ 15



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JOB NO: 1207-S148

LOG OF BOREHOLE NO: MW6D

FIGURE NO: 6A

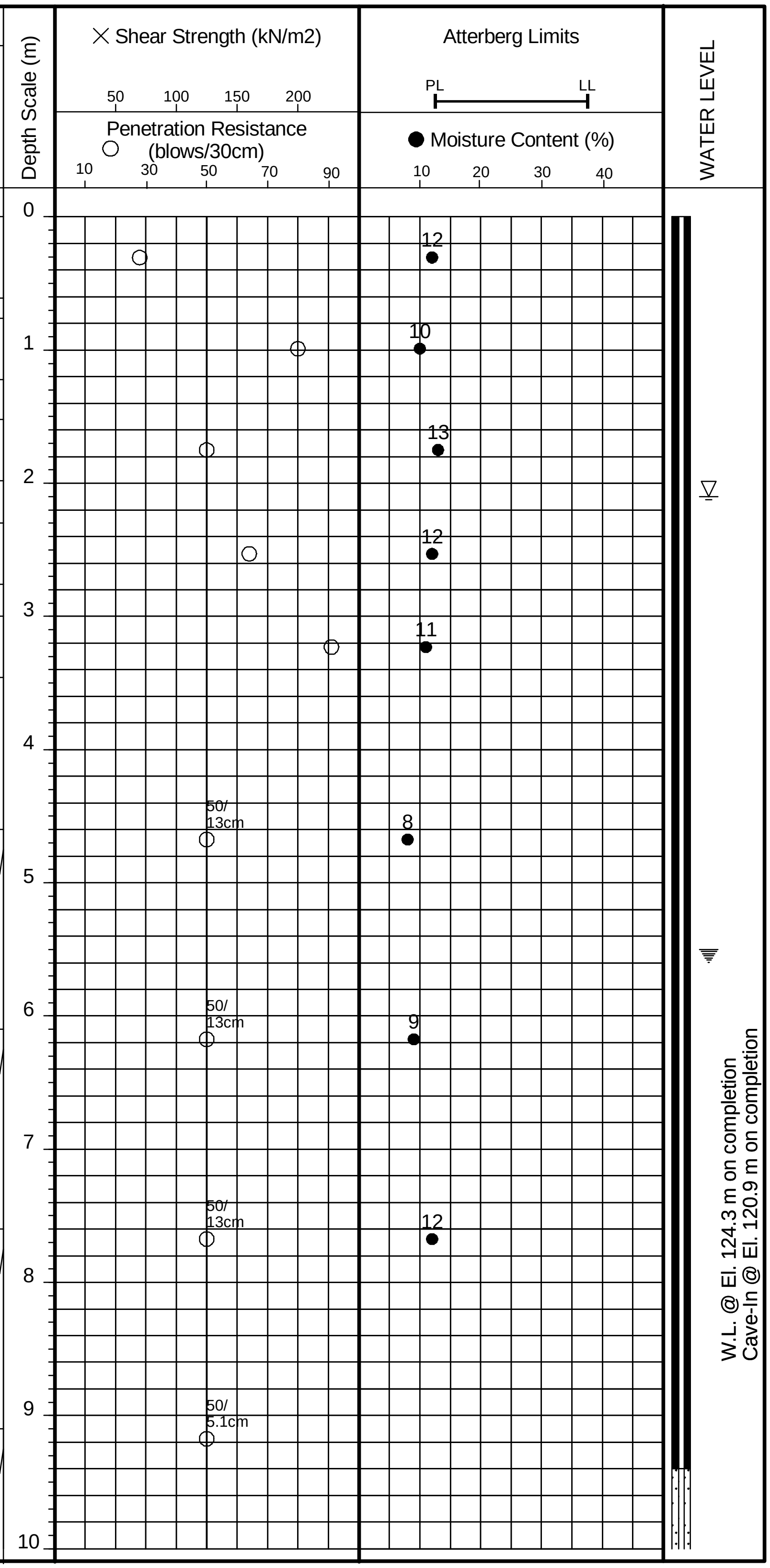
JOB DESCRIPTION: Proposed Residential Development

JOB LOCATION: 1401 Bronte Road, Town of Oakville

METHOD OF BORING: Flight-Auger

DATE: August 7, 2012

Depth Elev. (m)	SOIL DESCRIPTION	SAMPLES		
		Number	Type	N-Value
0.0	Ground Surface			
126.4	**15 cm TOPSOIL**			
	Brown/reddish-brown, very stiff to hard	1	DO	28
	weathered			
	SILTY CLAY, Till	2	DO	80
	sandy, a trace of gravel occ. sand and silt seams and layers, cobbles and boulders	3	DO	50
		4	DO	64
		5	DO	91
4.0 122.4	Reddish-brown, very dense			
	SILTY SAND, Till	6	DO	50/ 13
	a trace to some clay a trace of gravel occ. silt and clay seams and layers, cobbles and boulders			
		7	DO	50/ 13
7.0 119.4	Reddish-brown, very dense, wet			
	FINE TO COARSE SAND	8	DO	50/ 13
	some silt, a trace of gravel			
	empty spoon and auger except for cobble at the tip of spoon	9	DO	50/ 5.1
10.0				



W.L. @ El. 124.3 m on completion

Cave-In @ El. 120.9 m on completion

JOB NO: 1207-S148

LOG OF BOREHOLE NO: MW6D

FIGURE NO: 6B

JOB DESCRIPTION: Proposed Residential Development

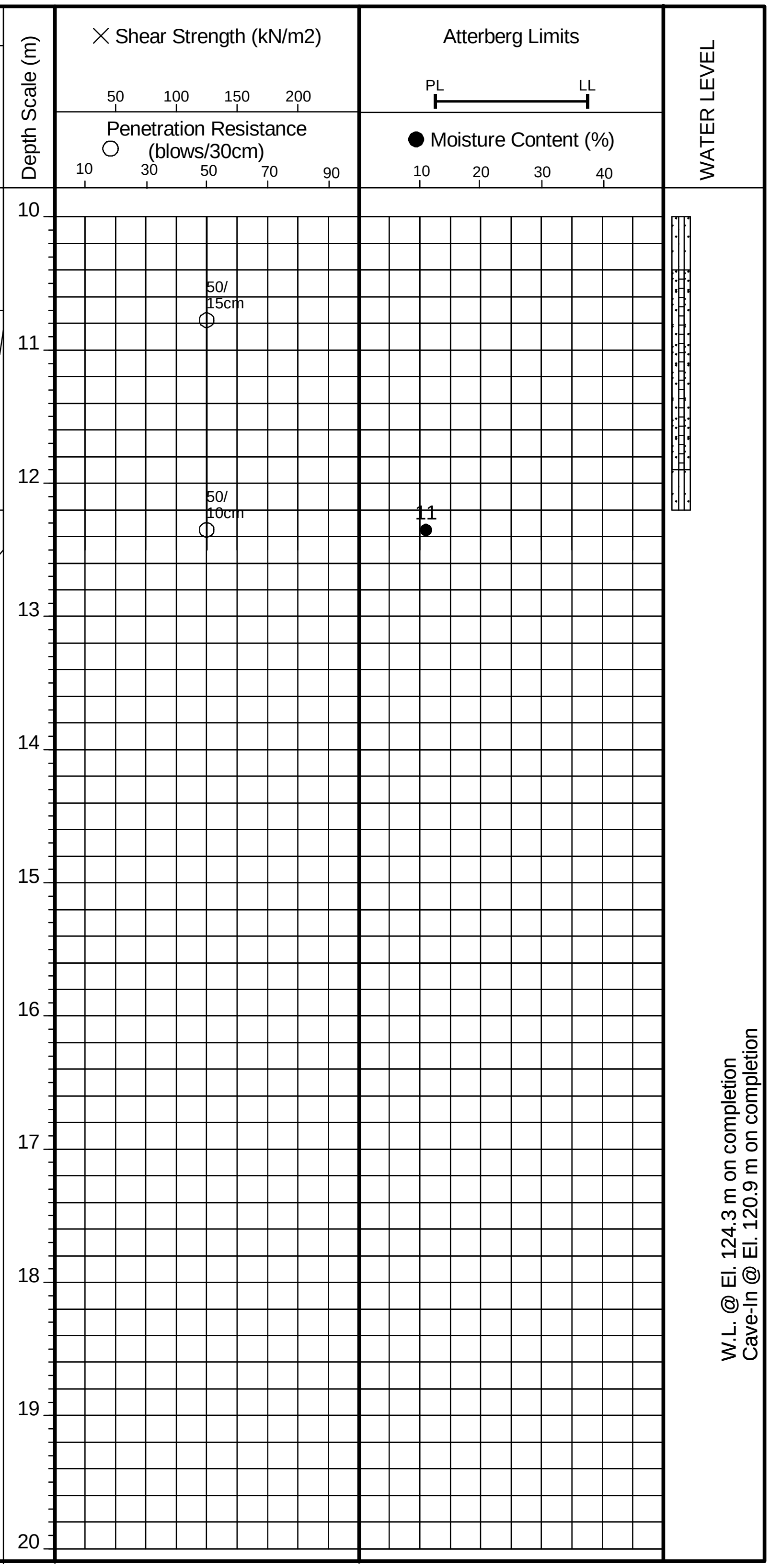
JOB LOCATION: 1401 Bronte Road, Town of Oakville

METHOD OF BORING: Flight-Auger

DATE: August 7, 2012

Depth Elev. (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
10.0 116.4	Reddish-brown, very dense, wet			
	no sample			
	FINE TO COARSE SAND	10	DO	50/ 15
	some silt, a trace of gravel			
		11	DO	50/ 10
12.5 113.9	**END OF BOREHOLE**			

Installed 50-mm diameter PVC monitoring well to 11.9 m with sand backfill from 9.4 to 12.2 m. Bentonite seal from 0.0 to 9.4 m. Mounted with a steel protective casing.



W.L. @ El. 124.3 m on completion
Cave-In @ El. 120.9 m on completion

Soil Engineers Ltd.

JOB NO: 1207-S148

LOG OF BOREHOLE NO: MW6S

FIGURE NO: 7

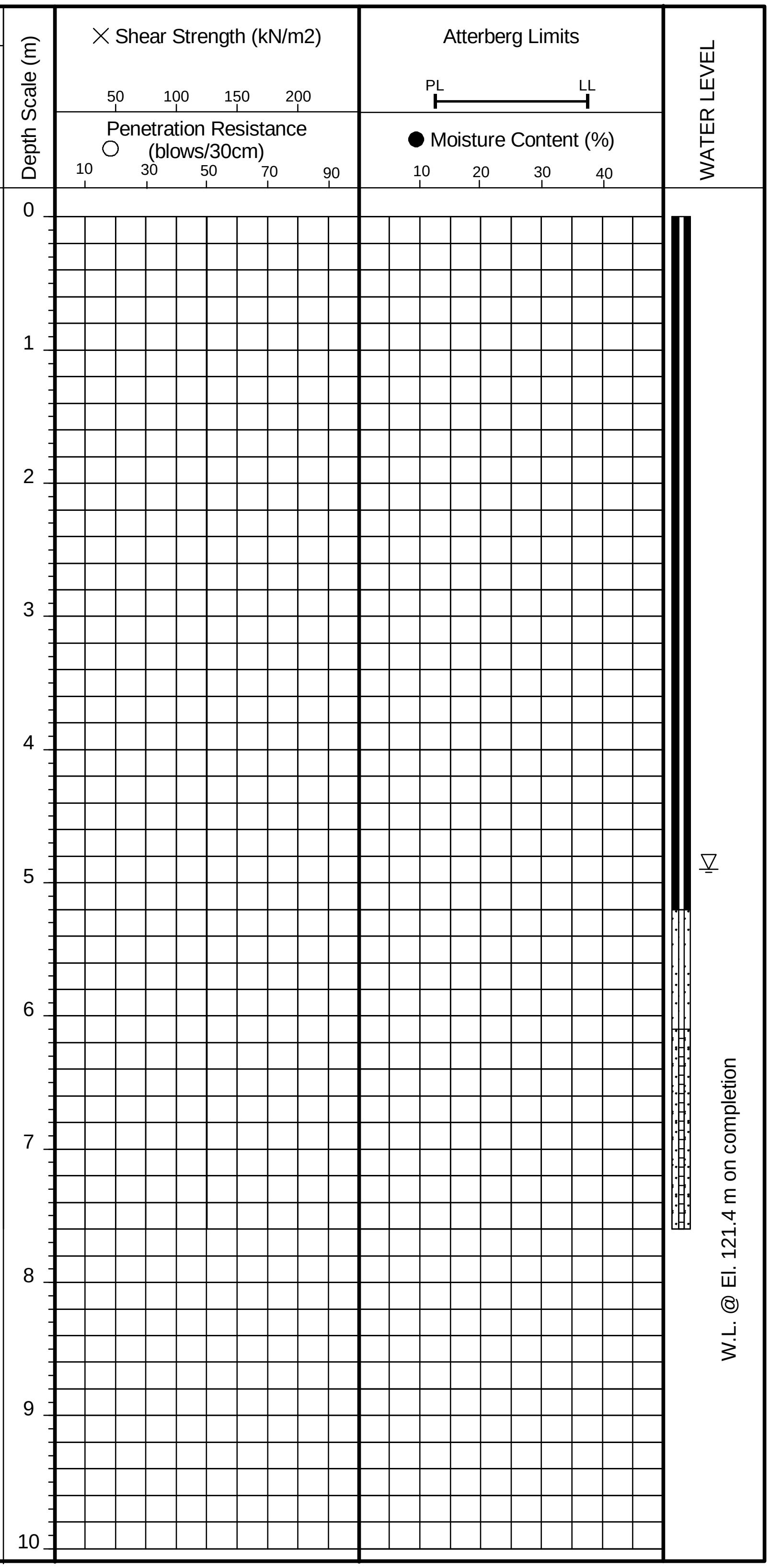
JOB DESCRIPTION: Proposed Residential Development

JOB LOCATION: 1401 Bronte Road, Town of Oakville

METHOD OF BORING: Flight-Auger

DATE: August 7, 2012

Depth Elev. (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
0.0 126.3	Ground Surface **BOREHOLE FOR SHALLOW NESTED WELL INSTALLATION ONLY (NO SAMPLING)**			
7.6 118.7	**END OF BOREHOLE** Installed 50-mm diameter PVC monitoring well to 7.6 m with sand backfill from 5.2 to 7.6 m. Bentonite seal from 0.0 to 5.2 m. Mounted with a steel protective casing.			



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JOB NO: 1207-S148

LOG OF BOREHOLE NO: 7

FIGURE NO: 8

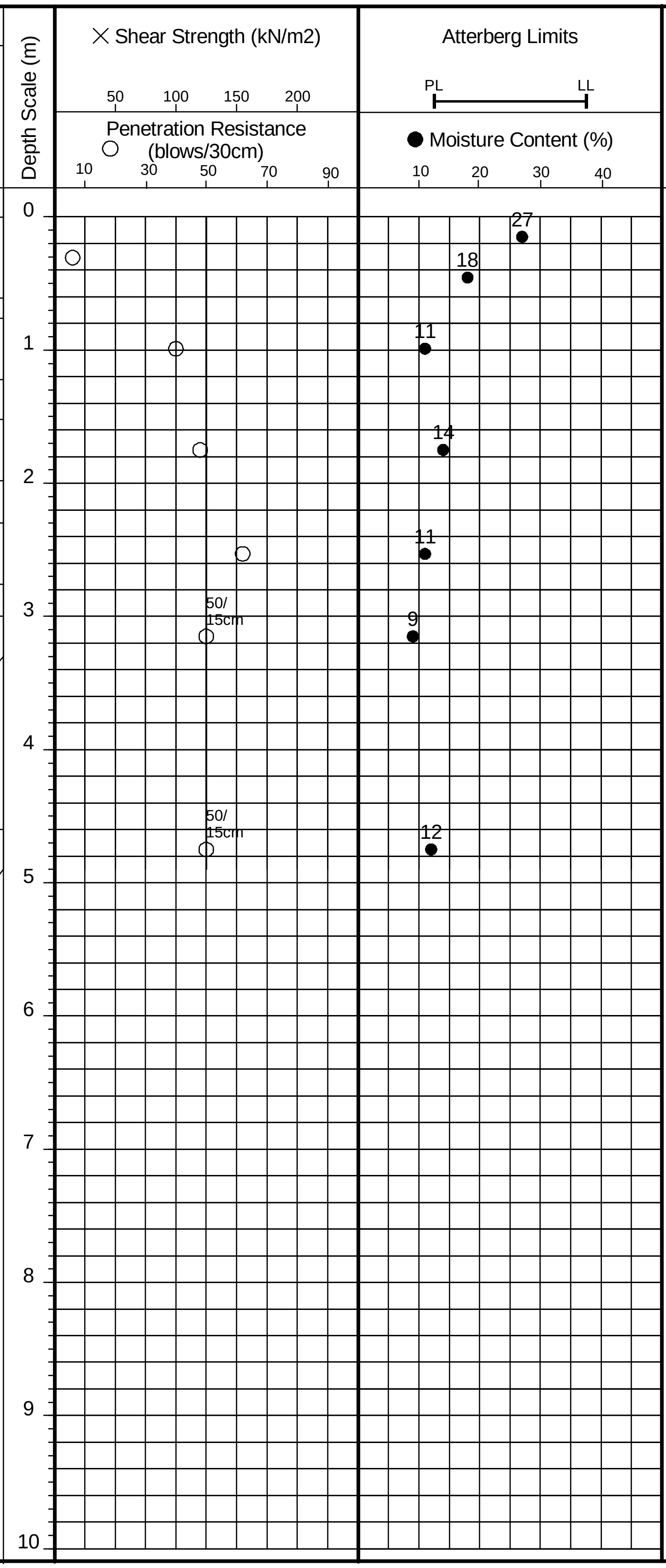
JOB DESCRIPTION: Proposed Residential Development

JOB LOCATION: 1401 Bronte Road, Town of Oakville

METHOD OF BORING: Flight-Auger

DATE: August 15, 2012

Depth Elev. (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
0.0 127.9	Ground Surface			
	30 cm TOPSOIL	1A	DO	6
	Brown, firm, weathered **SILTY CLAY**	1B		
0.8 127.1	Brown/reddish-brown, hard	2	DO	40
		3	DO	48
	SILTY CLAY, Till			
		4	DO	62
	sandy, a trace of gravel occ. sand and silt seams and layers, cobbles and boulders	5	DO	50/ 15
		6	DO	50/ 15
4.9 123.0	**END OF BOREHOLE**			



WATER LEVEL

Dry on completion

JOB NO: 1207-S148

LOG OF BOREHOLE NO: 8

FIGURE NO: 9

JOB DESCRIPTION: Proposed Residential Development

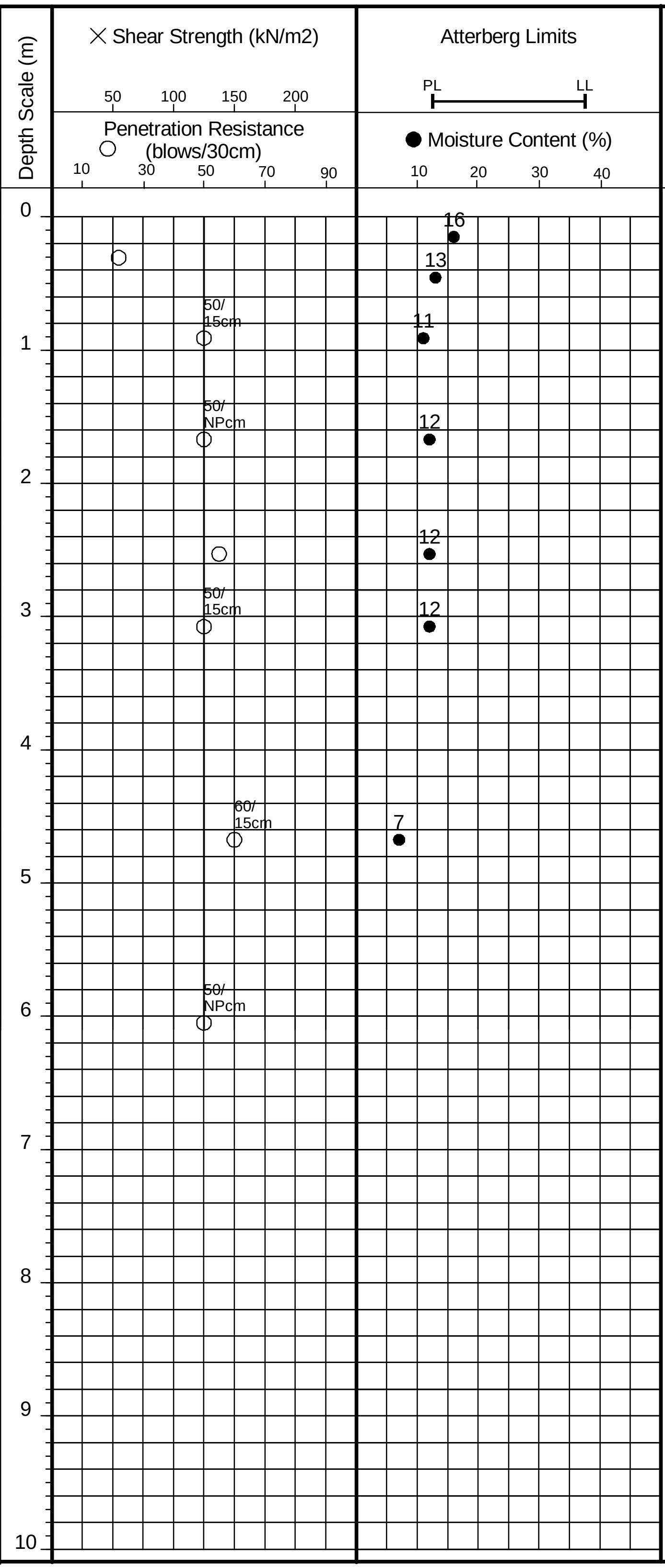
JOB LOCATION: 1401 Bronte Road, Town of Oakville

METHOD OF BORING: Flight-Auger

DATE: August 13, 2012

Depth Elev. (m)	SOIL DESCRIPTION
0.0	Ground Surface
126.9	**18 cm TOPSOIL**
	Brown/reddish-brown, very stiff to hard
	weathered
	SILTY CLAY, Till
	sandy, a trace of gravel occ. sand and silt seams and layers, cobbles and boulders
	rock fragments/boulders
4.0 122.9	Reddish-brown, very dense
	SILTY SAND, Till
	a trace of clay and gravel occ. silt and clay seams and layers frequent rock fragments or boulders
6.1 120.8	**END OF BOREHOLE**

SAMPLES		
Number	Type	N-Value
1A	DO	22
1B		
2	DO	50/ 15
3	DO	50/ NP
4	DO	55
5	DO	50/ 15
6	DO	60/ 15
7	DO	50/ NP



WATER LEVEL

W.L. @ El. 121.3 m on completion

Cave-In @ El. 121.1 m on completion

Soil Engineers Ltd.

JOB NO: 1207-S148

LOG OF BOREHOLE NO: 9

FIGURE NO: 10

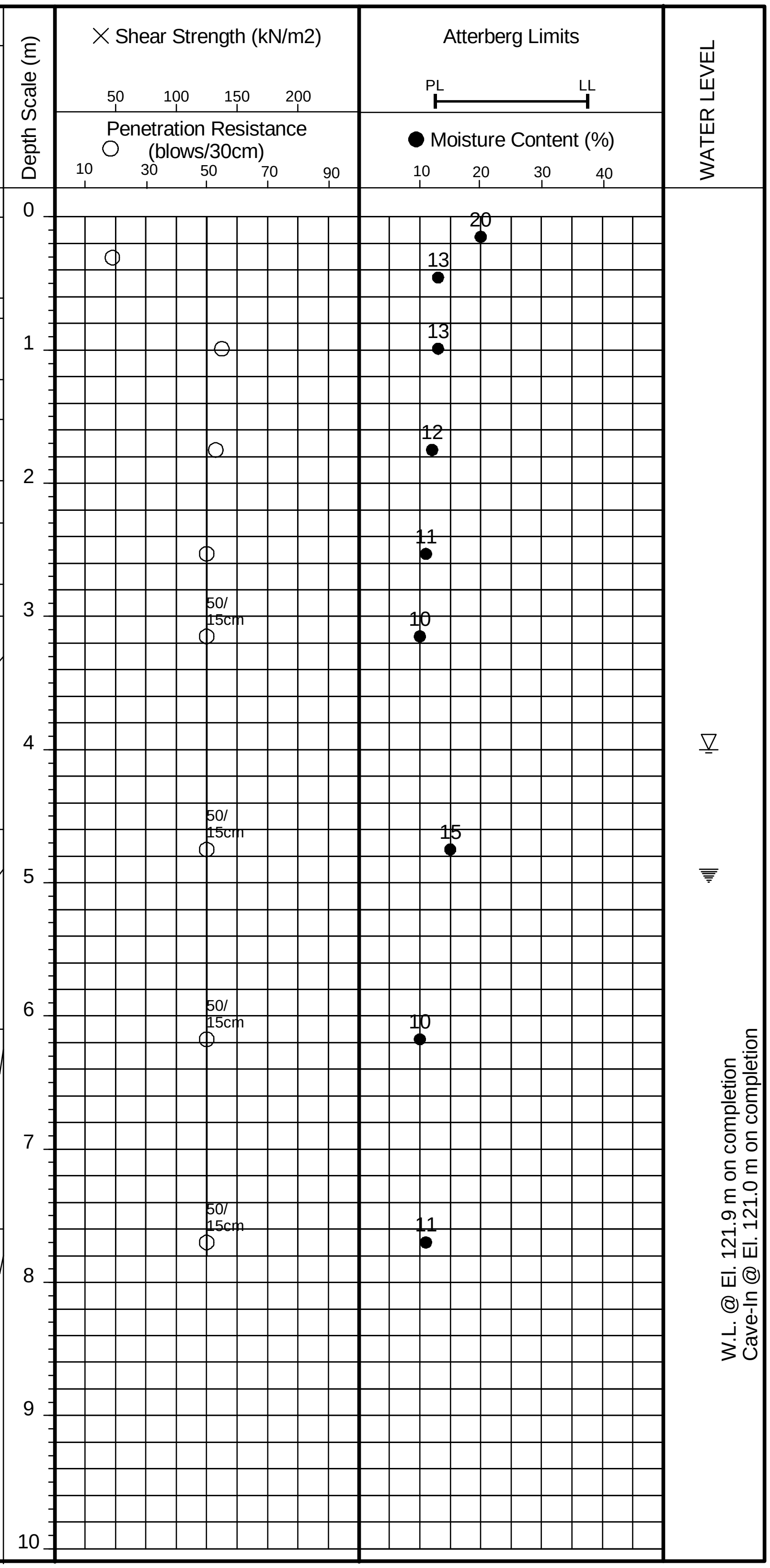
JOB DESCRIPTION: Proposed Residential Development

JOB LOCATION: 1401 Bronte Road, Town of Oakville

METHOD OF BORING: Flight-Auger

DATE: August 15, 2012

Depth Elev. (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
0.0	Ground Surface			
125.9	**15 cm TOPSOIL**	1A	DO	19
	Brown/reddish-brown, very stiff to hard weathered	1B		
		2	DO	55
	SILTY CLAY, Till	3	DO	53
	sandy, a trace of gravel occ. sand and silt seams and layers, cobbles and boulders	4	DO	50
		5	DO	50/15
4.0 121.9	Brown, very dense, wet **FINE TO COARSE SAND** some silt, a trace of gravel	6	DO	50/15
5.6 120.3	Reddish-brown, very dense, wet **SILTY SAND, Till** a trace of clay and gravel occ. silt and clay seams and layers, cobbles and boulders	7	DO	50/15
		8	DO	50/15
7.8 118.1	**END OF BOREHOLE**			



W.L. @ El. 121.9 m on completion
Cave-In @ El. 121.0 m on completion

JOB NO: 1207-S148

LOG OF BOREHOLE NO: 10

FIGURE NO: 11

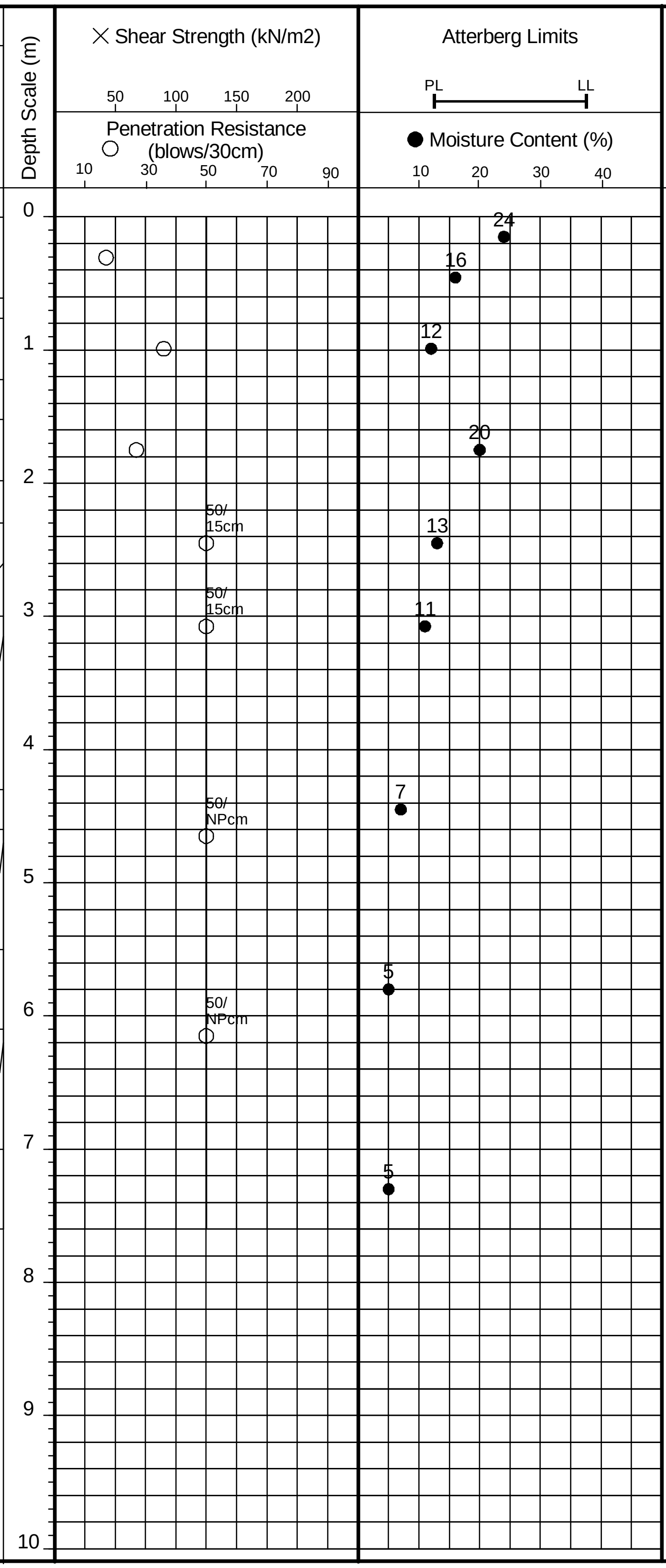
JOB DESCRIPTION: Proposed Residential Development

JOB LOCATION: 1401 Bronte Road, Town of Oakville

METHOD OF BORING: Flight-Auger

DATE: August 15, 2012

Depth Elev. (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
0.0	Ground Surface			
124.8	**13 cm TOPSOIL**	1A	DO	17
	Brown, very stiff to hard weathered	1B		
		2	DO	36
	SILTY CLAY, Till	3	DO	27
	silty clay changing to reddish-brown	4	DO	50/ 15
	sandy, a trace of gravel occ. sand and silt seams and layers, cobbles and boulders	5	DO	50/ 15
4.0 120.8	Reddish-brown weathered	6A	AS	-
		6	DO	50/ NP
	SHALE BEDROCK			
	occ. sound layers hard augering from 4.6 to 7.6 m	7A	AS	-
		7	DO	50/ NP
		8A	AS	-
7.6 117.2	**END OF BOREHOLE**			



WATER LEVEL

Dry on completion

JOB NO: 1207-S148

LOG OF BOREHOLE NO: 11

FIGURE NO: 12

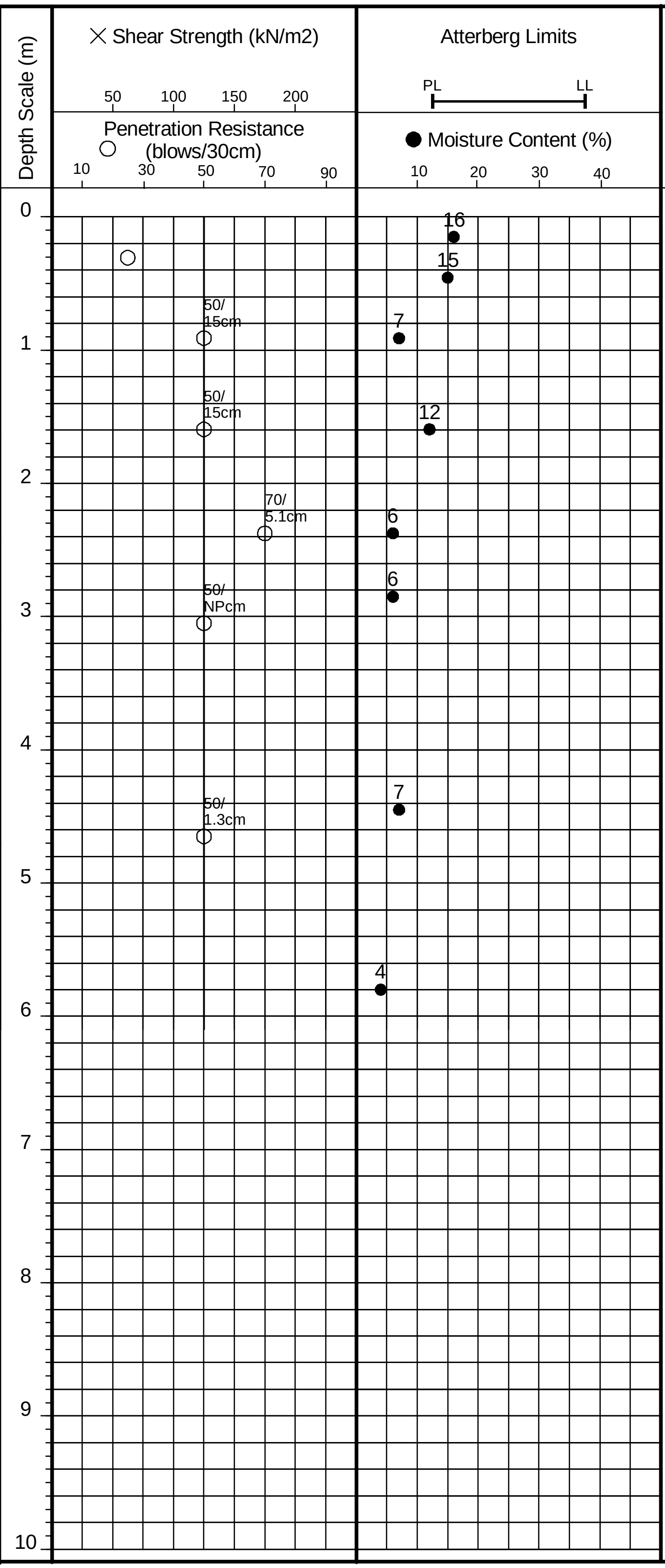
JOB DESCRIPTION: Proposed Residential Development

JOB LOCATION: 1401 Bronte Road, Town of Oakville

METHOD OF BORING: Flight-Auger

DATE: August 14, 2012

Depth Elev. (m)	SOIL DESCRIPTION	SAMPLES		
		Number	Type	N-Value
0.0	Ground Surface			
122.9	**15 cm TOPSOIL**	1A	DO	25
	Brown/reddish-brown, very stiff to hard	1B		
	weathered			
	SILTY CLAY, Till	2	DO	50/ 15
	sandy, a trace of gravel occ. sand and silt seams and layers, cobbles and boulders	3	DO	50/ 15
2.3 120.6	Reddish-brown weathered	4	DO	70/ 5.1
		5A	AS	-
	SHALE BEDROCK	5	DO	50/ NP
	occ. sound layers easy augering from 2.3 to 4.6 m hard augering from 4.6 to 6.1 m	6A	AS	-
		6	DO	50/ 1.3
	with sound layers			
		7A	AS	-
6.1 116.8	**END OF BOREHOLE**			



WATER LEVEL

Dry on completion

Soil Engineers Ltd.

JOB NO: 1207-S148

LOG OF BOREHOLE NO: 12

FIGURE NO: 13

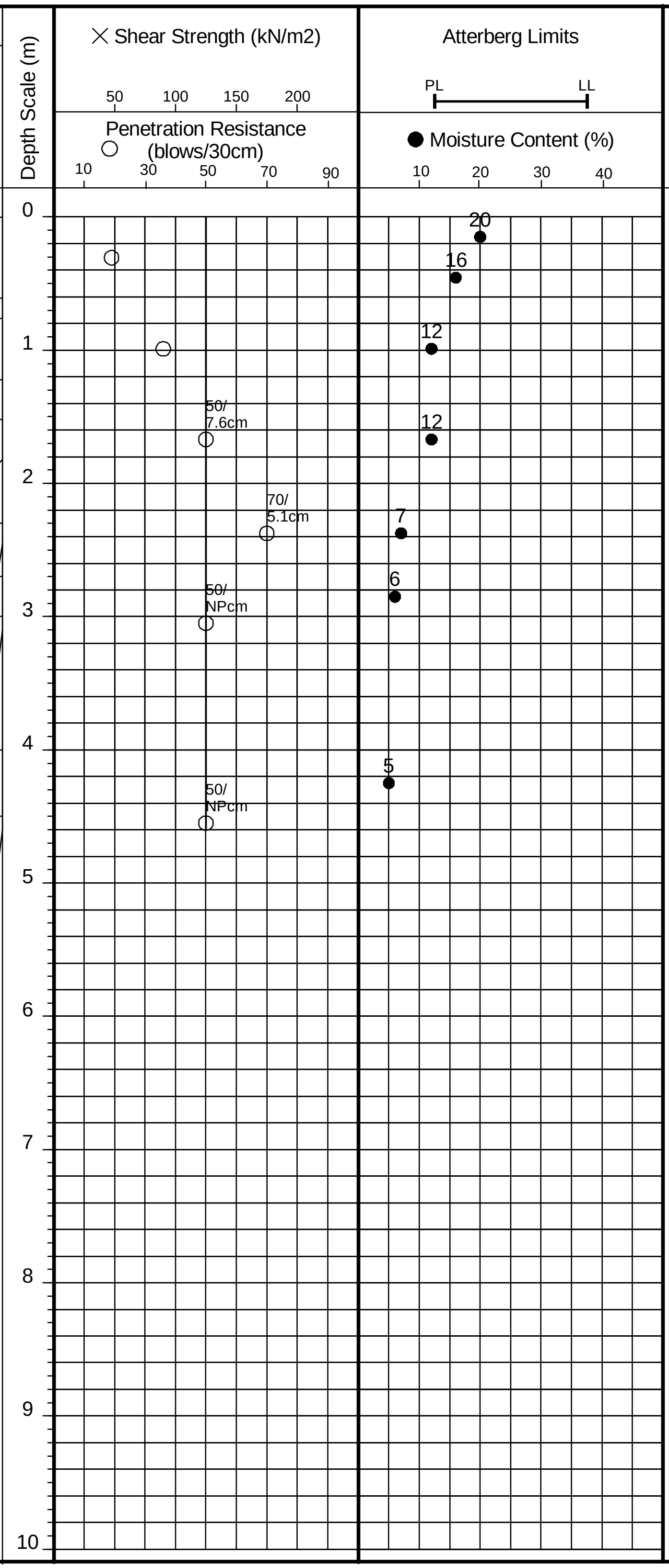
JOB DESCRIPTION: Proposed Residential Development

JOB LOCATION: 1401 Bronte Road, Town of Oakville

METHOD OF BORING: Flight-Auger

DATE: August 14, 2012

Depth Elev. (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
0.0	Ground Surface			
123.7	**15 cm TOPSOIL**	1A	DO	19
	Brown/reddish-brown, very stiff to hard weathered	1B		
	SILTY CLAY, Till	2	DO	36
	sandy, a trace of gravel occ. sand and silt seams and layers, cobbles and boulders	3	DO	50/ 7.6
	changing to shale			
2.3 121.4	Reddish-brown	4	DO	70/ 5.1
	weathered	5A	AS	-
	SHALE BEDROCK	5	DO	50/ NP
	easy augering from 3.0 to 4.6 m	6A	AS	-
4.6 119.1	**END OF BOREHOLE**	6	DO	50/ NP



WATER LEVEL

Dry on completion

Soil Engineers Ltd.

JOB NO: 1207-S148

LOG OF BOREHOLE NO: MW13

FIGURE NO: 14

JOB DESCRIPTION: Proposed Residential Development

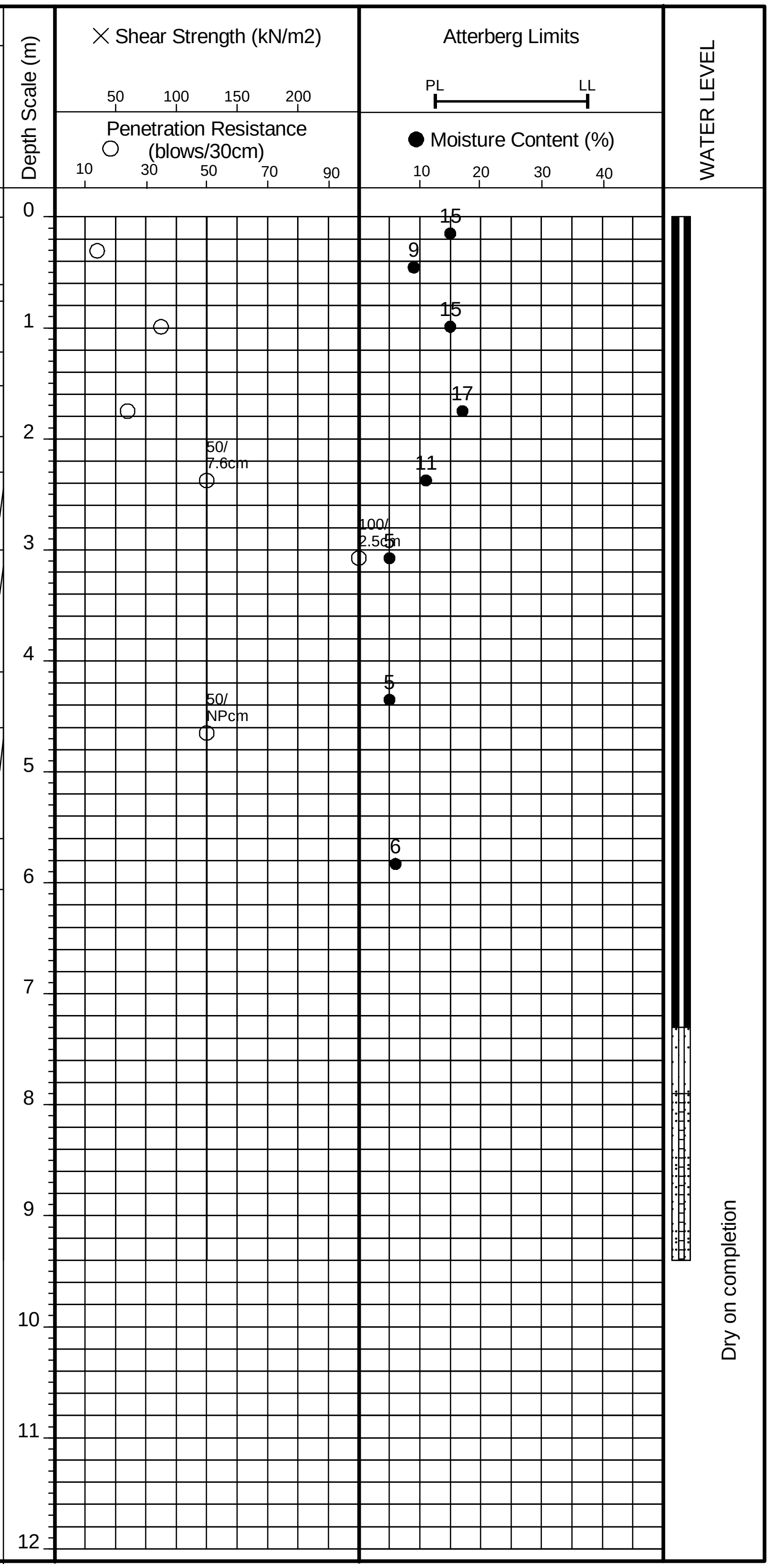
JOB LOCATION: 1401 Bronte Road, Town of Oakville

METHOD OF BORING: Flight-Auger

DATE: August 14 and 15, 2012

Depth Elev. (m)	SOIL DESCRIPTION
0.0	Ground Surface
124.6	**18 cm TOPSOIL** Brown/reddish-brown, stiff to hard weathered **SILTY CLAY, Till** sandy, a trace of gravel occ. sand and silt seams and layers, cobbles and boulders
3.0 121.6	Reddish-brown **SHALE BEDROCK** occ. sound layers easy augering from 3.0 to 6.1 m hard augering from 6.1 to 9.1 m
9.4 115.2	**END OF BOREHOLE** Refusal to augering. Installed 50-mm diameter PVC monitoring well to 9.4 m with sand backfill from 7.3 to 9.4 m. Bentonite seal from 0.0 to 7.3 m. Mounted with a steel protective casing.

SAMPLES		
Number	Type	N-Value
1A	DO	14
1B		
2	DO	35
3	DO	24
4	DO	50/ 7.6
5	DO	100/ 2.5
6A	AS	-
6	DO	50/ NP
7A	AS	-



Soil Engineers Ltd.

JOB NO: 1207-S148

LOG OF BOREHOLE NO: 14

FIGURE NO: 15

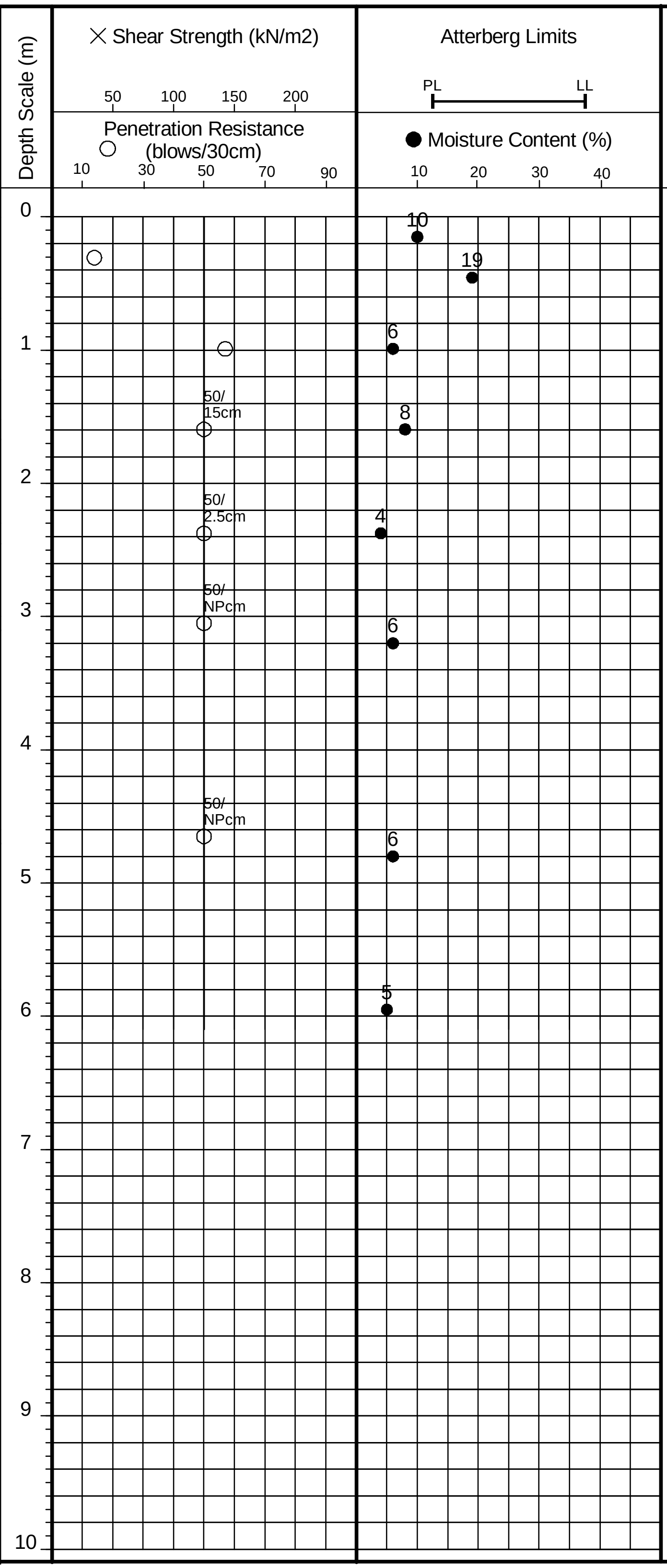
JOB DESCRIPTION: Proposed Residential Development

JOB LOCATION: 1401 Bronte Road, Town of Oakville

METHOD OF BORING: Flight-Auger

DATE: August 13, 2012

Depth Elev. (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	WATER LEVEL
0.0	Ground Surface				
123.6	**18 cm TOPSOIL**	1A	DO	14	
	Reddish-brown, stiff to hard weathered	1B			
	SILTY CLAY, Till	2	DO	57	
	sandy, a trace of gravel occ. sand and silt seams and layers, cobbles and boulders	3	DO	50/ 15	
2.3 121.3	weathered Reddish-brown	4	DO	50/ 2.5	
	SHALE BEDROCK	5 5A	DO AS	50/ NP	
	occ. sound layers hard augering from 3.0 to 6.1 m	6 6A	DO AS	50/ NP	
		7A	AS	-	
6.1 117.5	**END OF BOREHOLE**				Dry on completion



Soil Engineers Ltd.

JOB NO: 1207-S148

LOG OF BOREHOLE NO: 15

FIGURE NO: 16

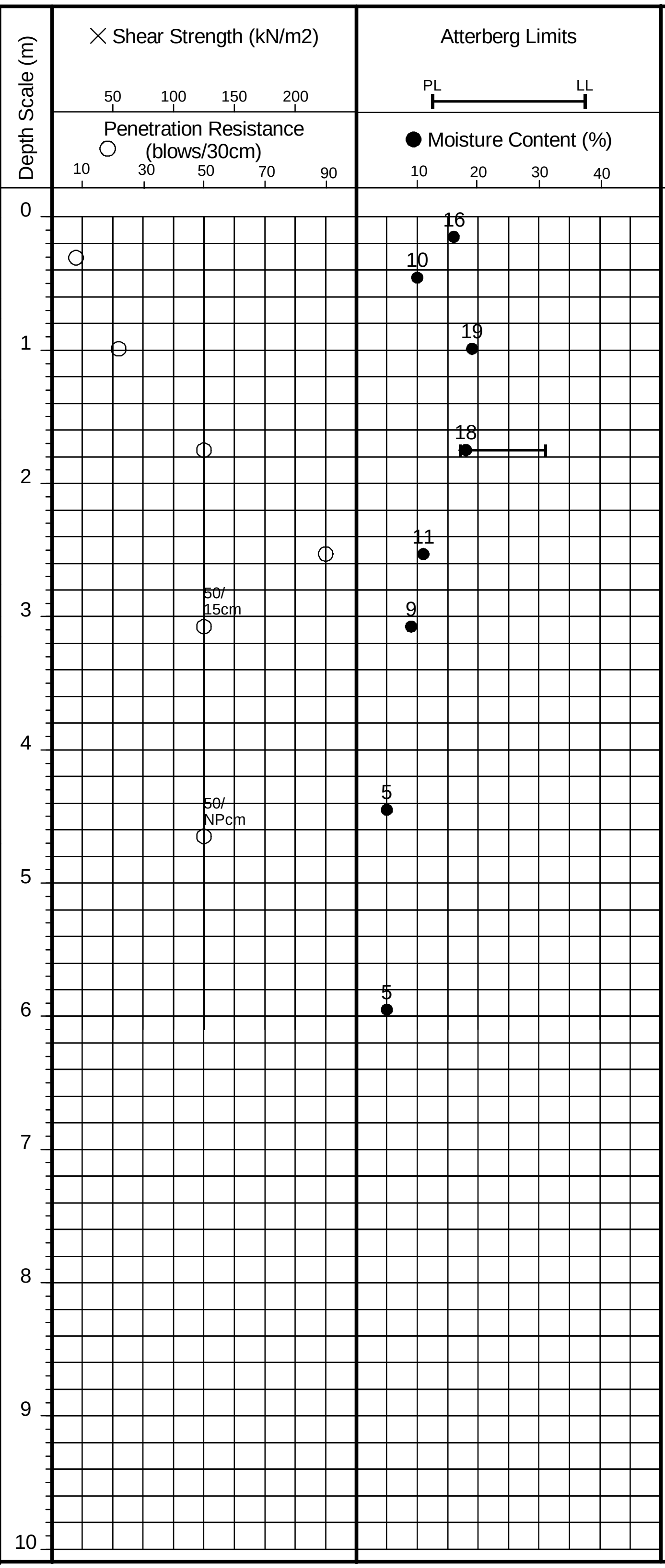
JOB DESCRIPTION: Proposed Residential Development

JOB LOCATION: 1401 Bronte Road, Town of Oakville

METHOD OF BORING: Flight-Auger

DATE: August 15, 2012

Depth Elev. (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
0.0	Ground Surface			
125.4	**30 cm TOPSOIL**	1A	DO	8
	Brown/reddish-brown, firm to hard weathered	1B		
	SILTY CLAY, Till	2	DO	22
	sandy, a trace of gravel occ. sand and silt seams and layers, cobbles and boulders	3	DO	50
		4	DO	90
		5	DO	50/ 15
	changing to shale			
4.3 121.1	Reddish-brown weathered	6A	AS	-
	SHALE BEDROCK	6	DO	50/ NP
	occ. sound layers easy augering to 5.2 m hard augering from 5.2 to 6.1 m	7A	AS	-
6.1 119.3	**END OF BOREHOLE**			



WATER LEVEL

Dry on completion

Soil Engineers Ltd.

JOB NO: 1207-S148

LOG OF BOREHOLE NO: 16

FIGURE NO: 17

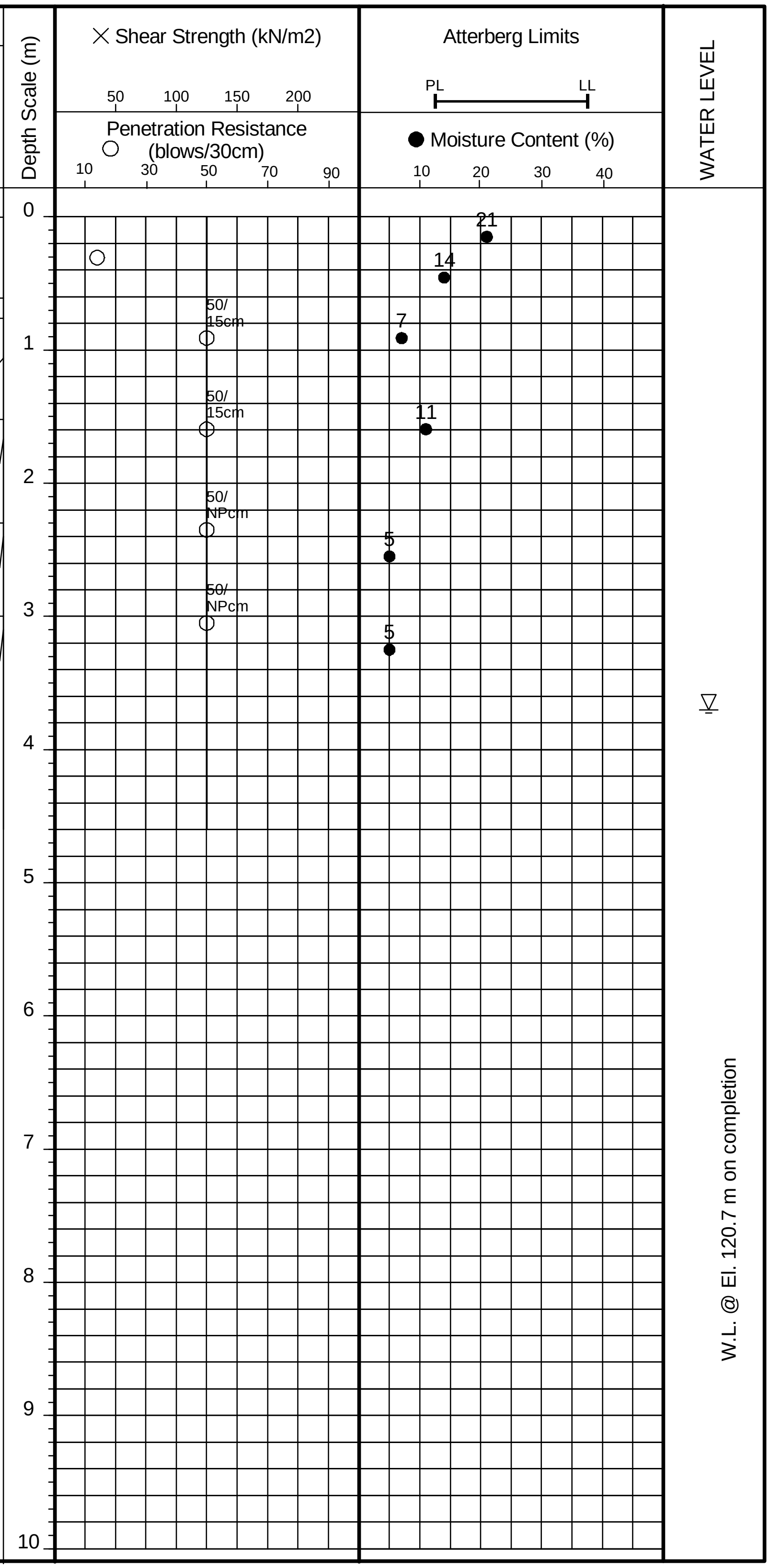
JOB DESCRIPTION: Proposed Residential Development

JOB LOCATION: 1401 Bronte Road, Town of Oakville

METHOD OF BORING: Flight-Auger

DATE: August 13, 2012

Depth Elev. (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
0.0	Ground Surface			
124.4	**15 cm TOPSOIL**	1A	DO	14
	Brown/reddish-brown, stiff to hard weathered	1B		
	SILTY CLAY, Till	2	DO	50/15
	sandy, a trace of gravel occ. sand and silt seams and layers, cobbles and boulders	3	DO	50/15
	changing to shale			
2.3 122.1	Reddish-brown	4 4A	DO AS	50/ NP
	SHALE BEDROCK	5 5A	DO AS	50/ NP
	occ. sound layers hard augering from 2.3 to 4.6 m			
	material becoming wet			
4.6 119.8	**END OF BOREHOLE**			



Soil Engineers Ltd.

JOB NO: 1207-S148

LOG OF BOREHOLE NO: MW17

FIGURE NO: 18

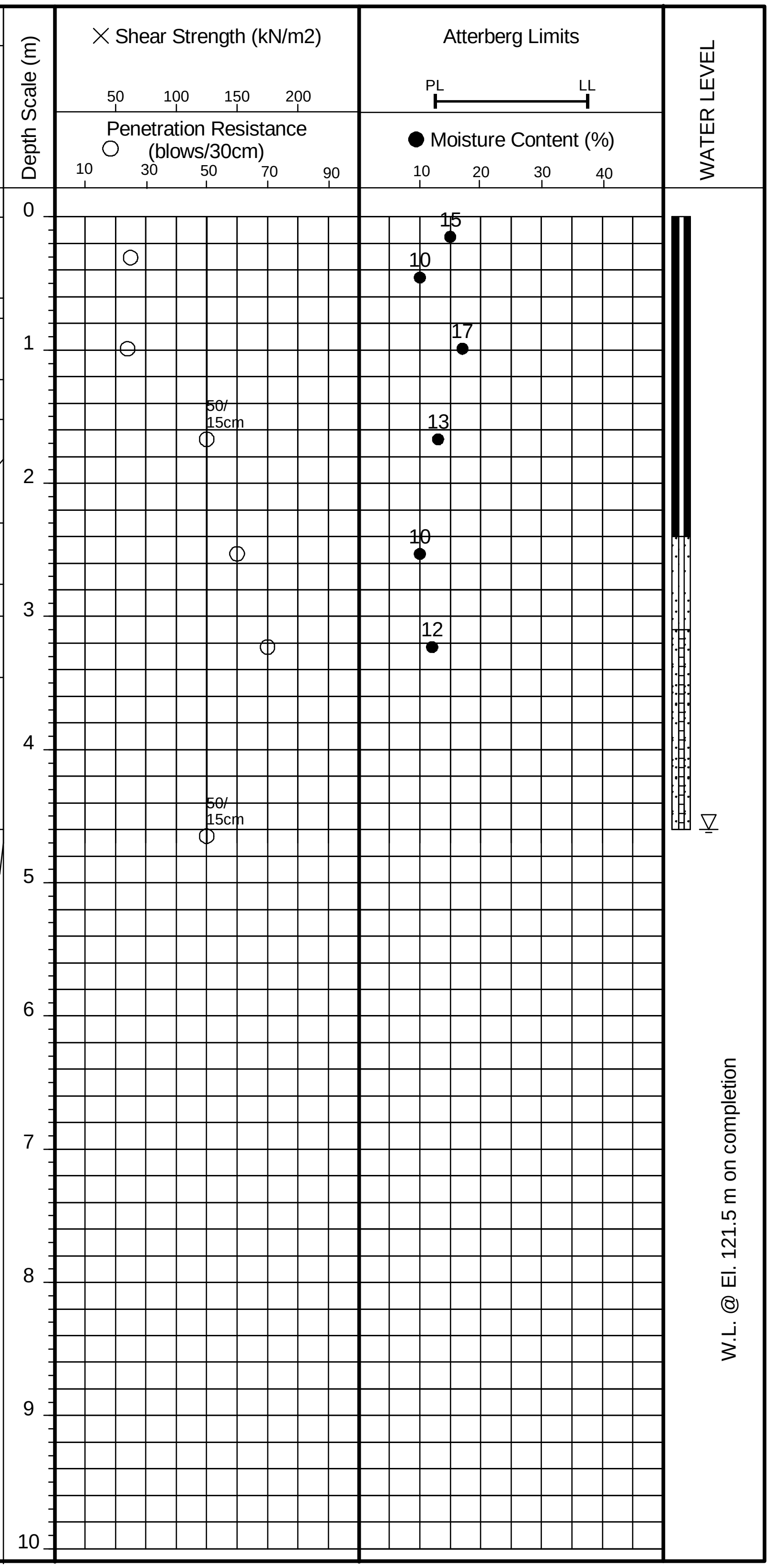
JOB DESCRIPTION: Proposed Residential Development

JOB LOCATION: 1401 Bronte Road, Town of Oakville

METHOD OF BORING: Flight-Auger

DATE: August 13, 2012

Depth Elev. (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
0.0	Ground Surface			
126.1	**13 cm TOPSOIL**	1A	DO	25
	Brown/reddish-brown, very stiff weathered	1B		
	SILTY CLAY, Till sandy, a trace of gravel occ. sand and silt seams and layers, cobbles and boulders	2	DO	24
1.4 124.7	Reddish-brown, very dense	3	DO	50/ 15
	SILTY SAND, Till			
	a trace of clay and gravel occ. silt and clay seams and layers, cobbles and boulders	4	DO	60
		5	DO	70
	auger material and spoon wet	6	AS	50/ 15
4.7 121.4	**END OF BOREHOLE**			
	Installed 50-mm diameter PVC monitoring well to 4.6 m with sand backfill from 2.4 to 4.6 m. Bentonite seal from 0.0 to 2.4 m. Mounted with a steel protective casing.			



Soil Engineers Ltd.

JOB NO: 1207-S148

LOG OF BOREHOLE NO: 18

FIGURE NO: 19

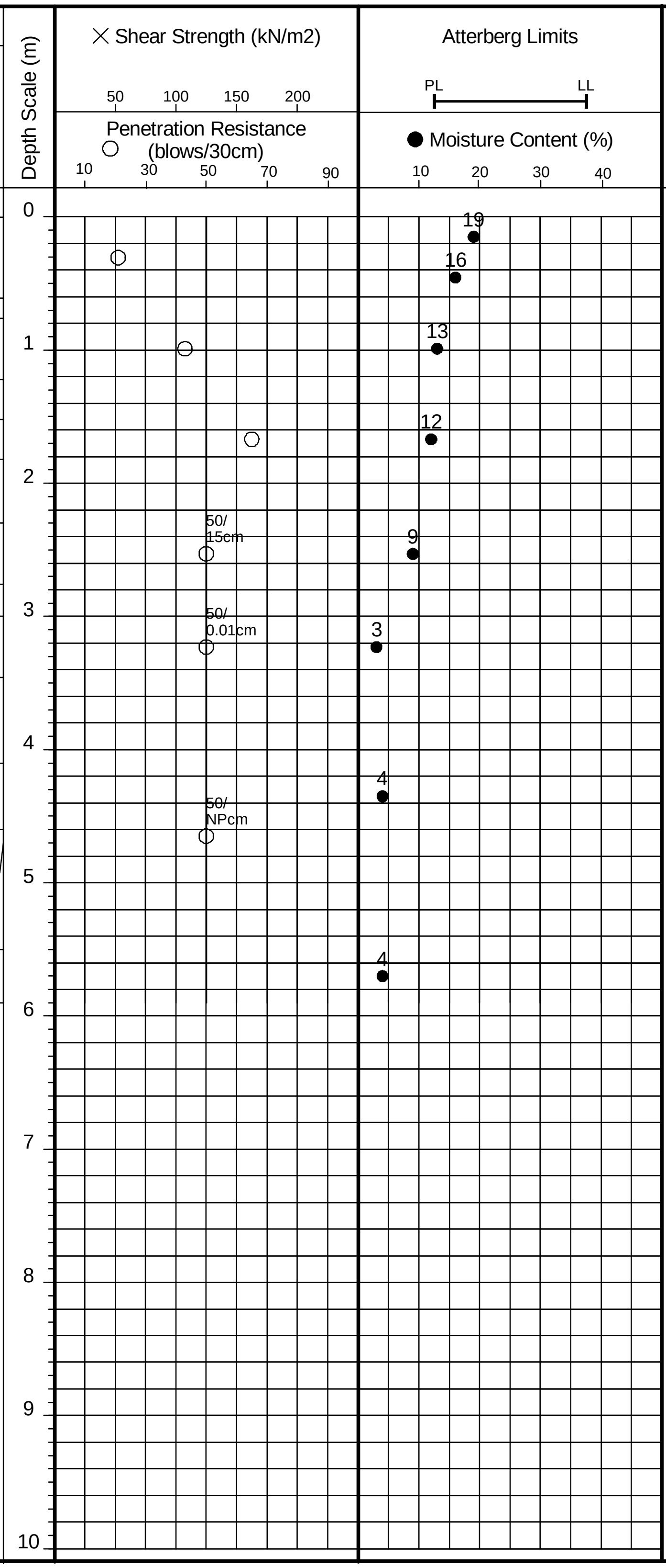
JOB DESCRIPTION: Proposed Residential Development

JOB LOCATION: 1401 Bronte Road, Town of Oakville

METHOD OF BORING: Flight-Auger

DATE: August 13, 2012

Depth Elev. (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
0.0	Ground Surface			
124.7	**30 cm TOPSOIL**	1A	DO	21
	Brown/reddish-brown, very stiff to hard; weathered	1B		
		2	DO	43
	SILTY CLAY, Till			
	sandy, a trace of gravel occ. sand and silt seams and layers, cobbles and boulders	3	DO	65
		4	DO	50/ 15
	rock fragments			
3.0 121.7	Reddish-brown	5	DO	50/ 0.01
	SHALE BEDROCK			
	occ. sound layers hard augering from 3.0 to 4.6 m very hard augering from 4.6 to 5.9 m	6A	AS	-
		6	DO	50/ NP
		7A	AS	-
5.9 118.8	**END OF BOREHOLE** Refusal to augering.			



WATER LEVEL

Dry on completion

Soil Engineers Ltd.

JOB NO: 1207-S148

LOG OF BOREHOLE NO: MW19

FIGURE NO: 20

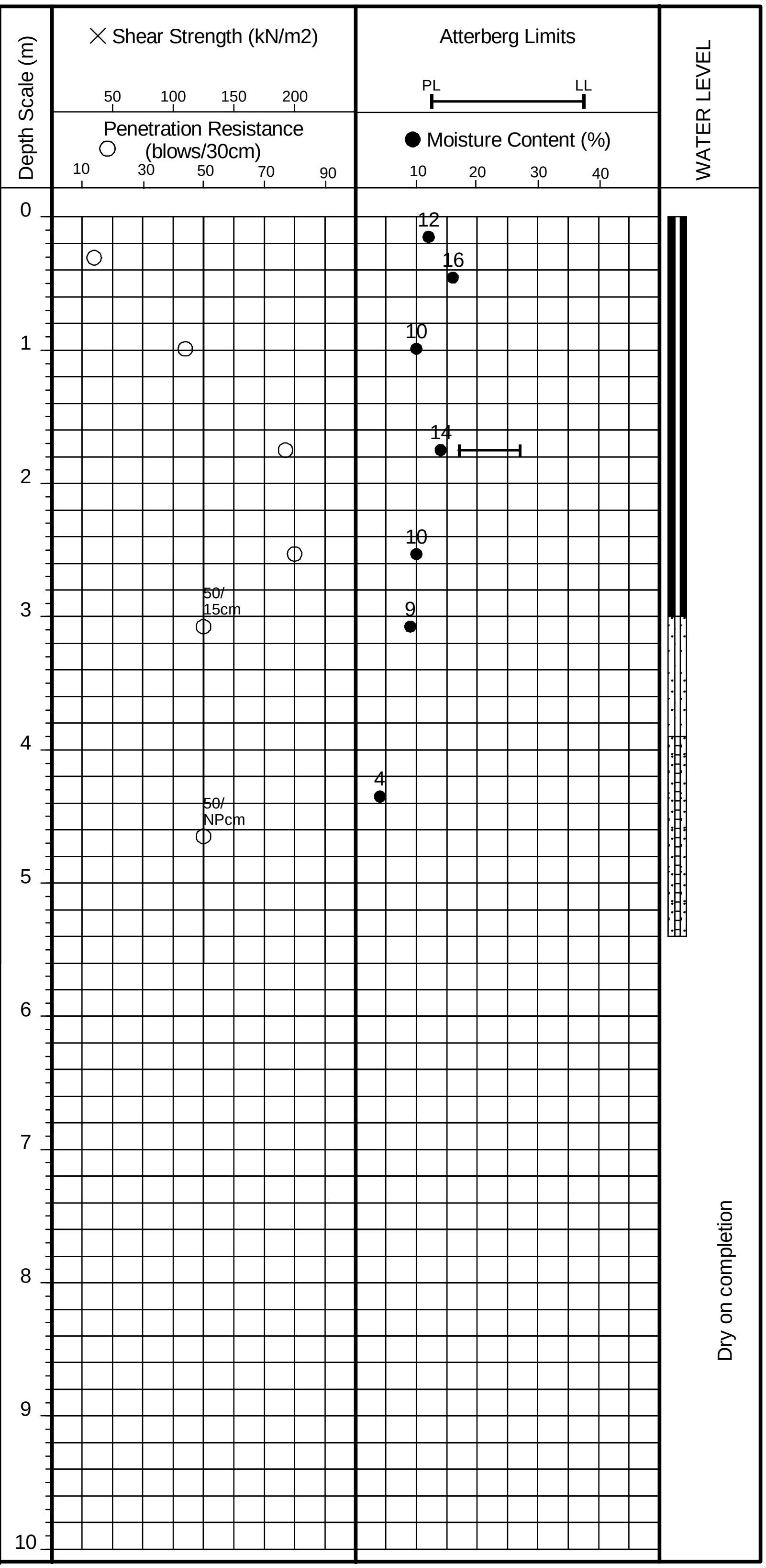
JOB DESCRIPTION: Proposed Residential Development

JOB LOCATION: 1401 Bronte Road, Town of Oakville

METHOD OF BORING: Flight-Auger

DATE: August 7, 2012

Depth Elev. (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
0.0	Ground Surface			
123.5	**25 cm TOPSOIL**	1A	DO	14
	Brown/reddish-brown, stiff to hard weathered	1B		
	SILTY CLAY	2	DO	44
	a trace of sand occ. sand and silt seams and layers	3	DO	77
2.1 121.4	Reddish-brown, hard			
	SILTY CLAY, Till	4	DO	80
	sandy, a trace of gravel changing to shale			
3.0 120.5	Reddish-brown	5	DO	50/ 15
	SHALE BEDROCK			
	occ. sound layers very hard augering from 3.0 to 5.6 m	6A	AS	-
		6	DO	50/ NP
5.6 117.9	**END OF BOREHOLE** Refusal to augering. Installed 50-mm diameter PVC monitoring well to 5.4 m with sand backfill from 3.0 to 5.4 m. Bentonite seal from 0.0 to 3.0 m. Mounted with a steel protective casing.			



Soil Engineers Ltd.

JOB NO: 1207-S148

LOG OF BOREHOLE NO: 20

FIGURE NO: 21

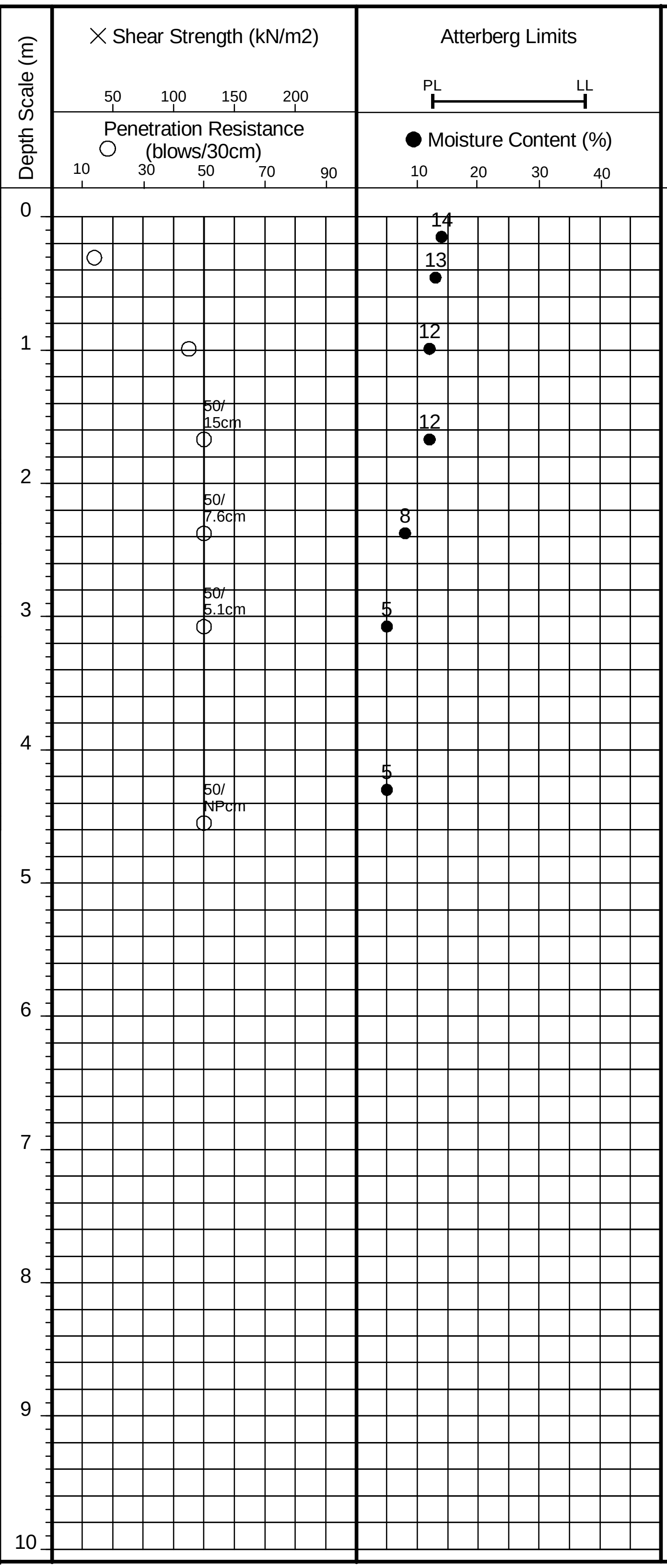
JOB DESCRIPTION: Proposed Residential Development

JOB LOCATION: 1401 Bronte Road, Town of Oakville

METHOD OF BORING: Flight-Auger

DATE: August 7, 2012

Depth Elev. (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
0.0 124.3	Ground Surface **30 cm TOPSOIL**	1A	DO	14
	Brown/reddish-brown, stiff to hard weathered	1B		
	SILTY CLAY	2	DO	45
	a trace of sand occ. sand and silt seams and layers	3	DO	50/ 15
	changing to shale	4	DO	50/ 7.6
3.0 121.3	Reddish-brown **SHALE BEDROCK**	5	DO	50/ 5.1
	occ. sound layers hard augering from 4.0 to 4.6 m	6A	AS	-
		6	DO	50/ NP
4.6 119.7	**END OF BOREHOLE**			



WATER LEVEL

Dry on completion

Soil Engineers Ltd.

JOB NO: 1207-S148

LOG OF BOREHOLE NO: MW21

FIGURE NO: 22

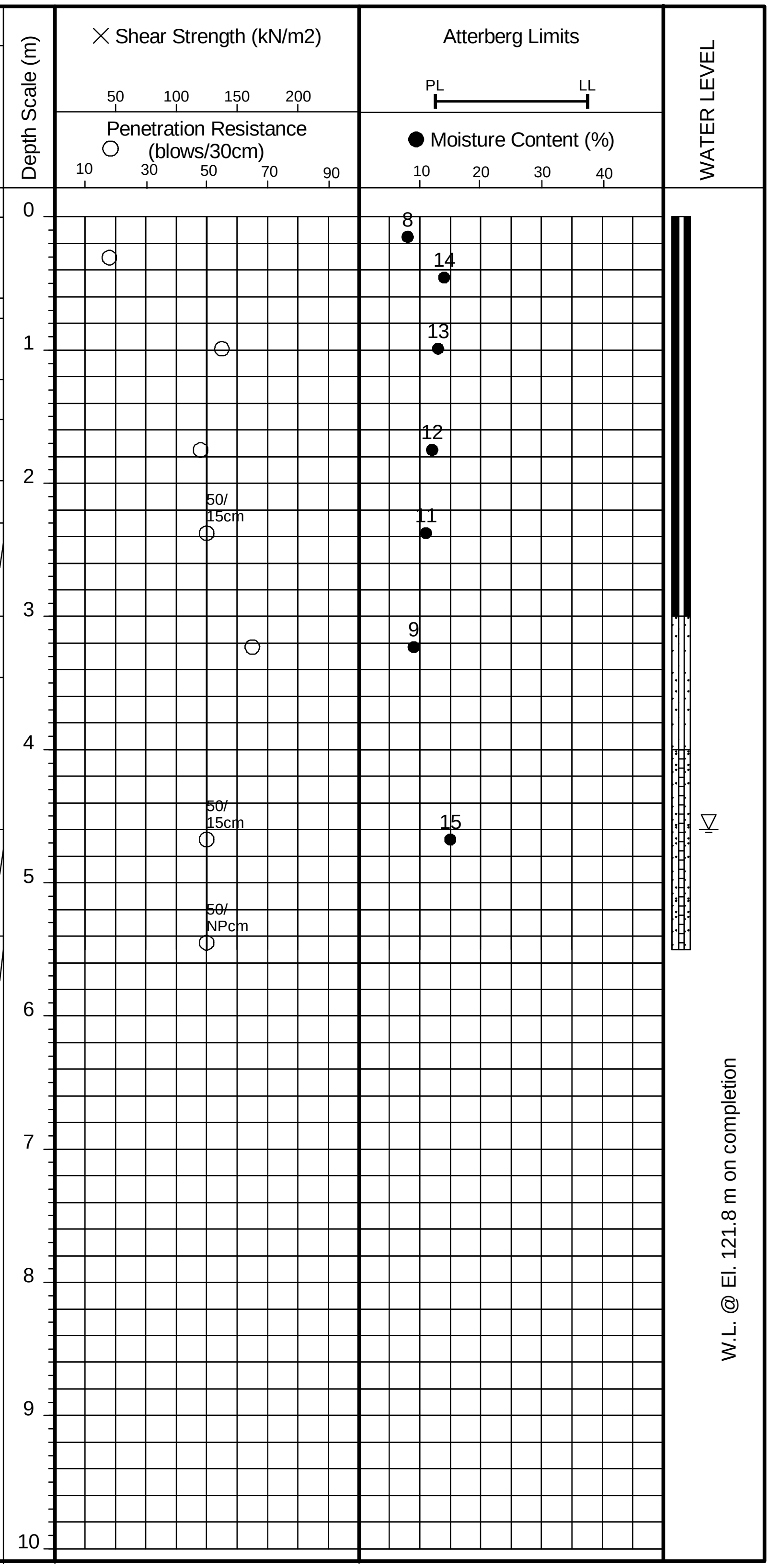
JOB DESCRIPTION: Proposed Residential Development

JOB LOCATION: 1401 Bronte Road, Town of Oakville

METHOD OF BORING: Flight-Auger

DATE: August 7, 2012

Depth Elev. (m)	SOIL DESCRIPTION	SAMPLES		
		Number	Type	N-Value
0.0	Ground Surface			
126.4	**23 cm TOPSOIL, Fill**	1A	DO	18
	Brown **EARTH, Fill** silty clay with topsoil inclusions	1B		
0.9 125.5	Reddish-brown, hard **SILTY CLAY, Till** sandy, a trace of gravel occ. sand and silt seams and layers, cobbles and boulders	2	DO	55
		3	DO	48
		4	DO	50/ 15
2.7 123.7	Brown, very dense **SILTY SAND, Till** a trace of clay, some gravel occ. silt seams and layers, cobbles and boulders	5	DO	65
4.0 122.4	Brown, very dense, wet **FINE TO COARSE SAND AND ROCK FRAGMENTS**	6	DO	50/ 15
5.5 120.9	**END OF BOREHOLE** Installed 50-mm diameter PVC monitoring well to 5.5 m with sand backfill from 3.0 to 5.5 m. Bentonite seal from 0.0 to 3.0 m. Mounted with a steel protective casing.	7	DO	50/ NP



Soil Engineers Ltd.

JOB NO: 1207-S148

LOG OF BOREHOLE NO: 22

FIGURE NO: 23

JOB DESCRIPTION: Proposed Residential Development

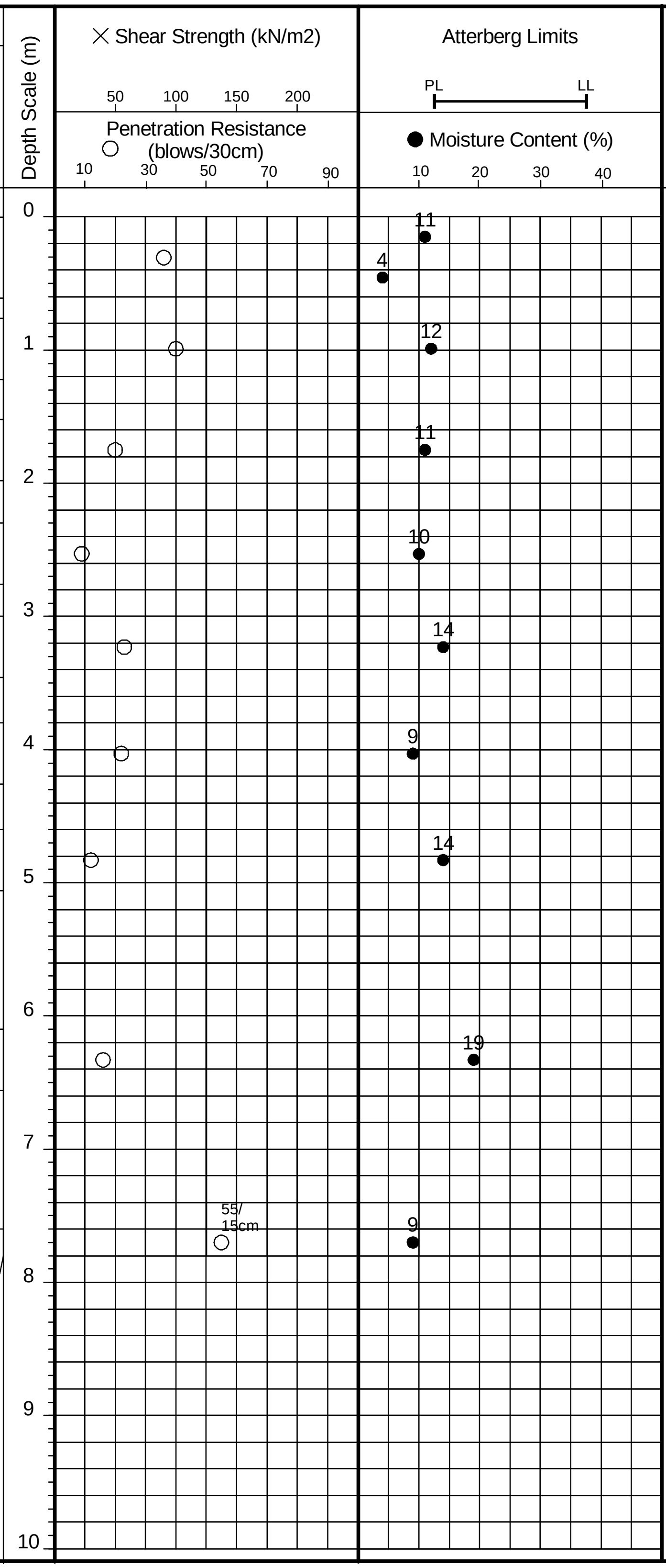
JOB LOCATION: 1401 Bronte Road, Town of Oakville

METHOD OF BORING: Flight-Auger

DATE: August 13, 2012

Depth Elev. (m)	SOIL DESCRIPTION
0.0	Ground Surface
132.4	**10 cm TOPSOIL, Fill** Brown/reddish-brown **EARTH, Fill** (borehole located on a berm between fairways) silty clay and silty sand materials some gravel
3.8 128.6	Brown, compact **FINE TO COARSE SAND** a trace of silt — — wet a trace to some gravel
5.6 126.8	Grey, compact, wet **SANDY SILT** a trace of clay occ. sand seams and layers
7.0 125.4	Reddish-brown, hard **SILTY CLAY, Till** sandy, a trace of gravel occ. sand and silt seams and layers, cobbles and boulders
7.8 124.6	**END OF BOREHOLE**

SAMPLES Number	Type	N-Value
1A 1B	DO	36
2	DO	40
3	DO	20
4	DO	9
5	DO	23
6	DO	22
7	DO	12
8	DO	16
9	DO	55/ 15



WATER LEVEL

▽

W.L. @ El. 127.5 m on completion
Cave-In @ El. 127.4 m on completion

Soil Engineers Ltd.

JOB NO: 1207-S148

LOG OF BOREHOLE NO: 23

FIGURE NO: 24

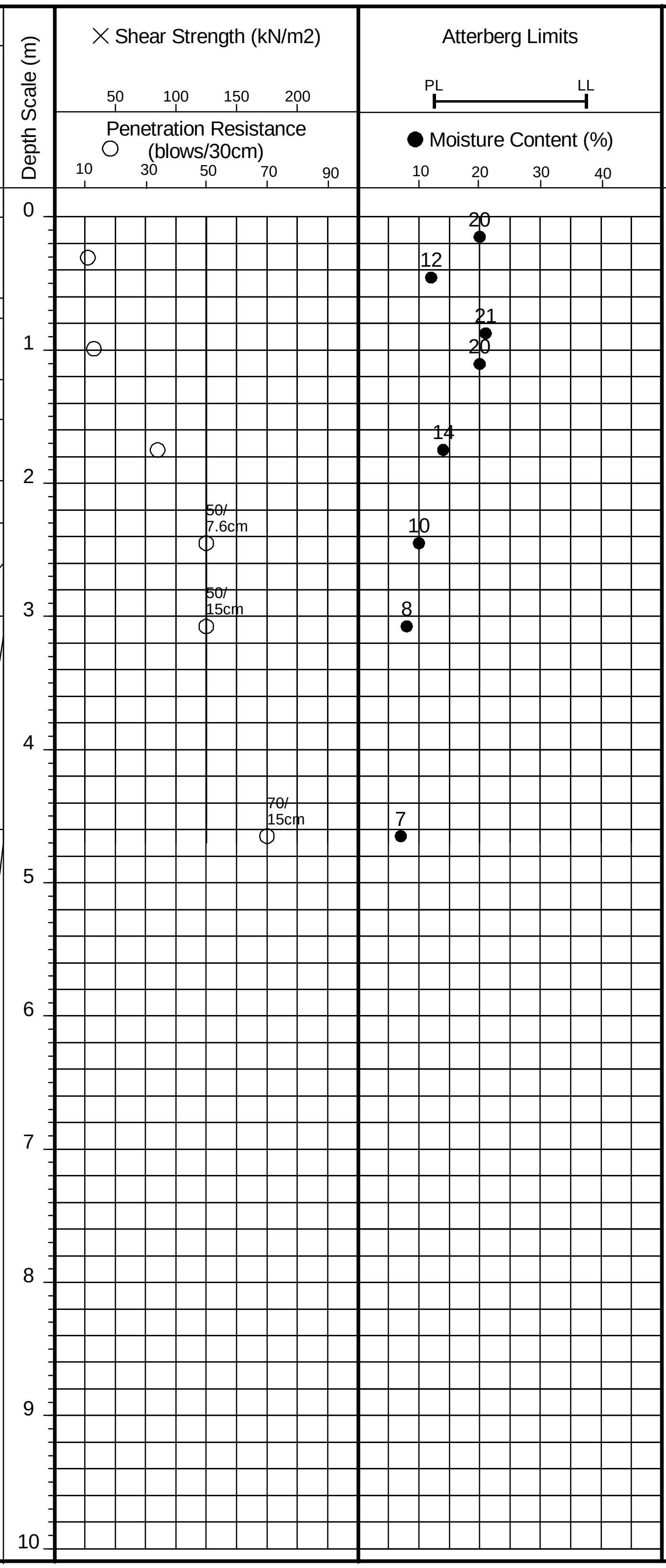
JOB DESCRIPTION: Proposed Residential Development

JOB LOCATION: 1401 Bronte Road, Town of Oakville

METHOD OF BORING: Flight-Auger

DATE: August 13, 2012

Depth Elev. (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
0.0	Ground Surface			
127.8	**30 cm TOPSOIL, Fill**	1A	DO	11
		1B		
0.6 127.2	Brown **EARTH, Fill** silty clay with topsoil inclusions			
	Brown, compact, very moist to wet **SANDY SILT** silt layer	2A 2B	DO	13
1.4 126.4	Reddish-brown, hard **SILTY CLAY, Till**	3	DO	34
	sandy, a trace of gravel occ. sand and silt seams and layers, cobbles and boulders occ. clay layers	4	DO	50/ 7.6
		5	DO	50/ 15
4.0 123.8	Brown, very dense **SILTY SAND, Till** a trace of clay and gravel occ. silt and clay seams and layers, cobbles and boulders	6	DO	70/ 15
4.7 123.1	**END OF BOREHOLE**			



WATER LEVEL

Dry on completion

Soil Engineers Ltd.

JOB NO: 1207-S148

LOG OF BOREHOLE NO: 24

FIGURE NO: 25

JOB DESCRIPTION: Proposed Residential Development

JOB LOCATION: 1401 Bronte Road, Town of Oakville

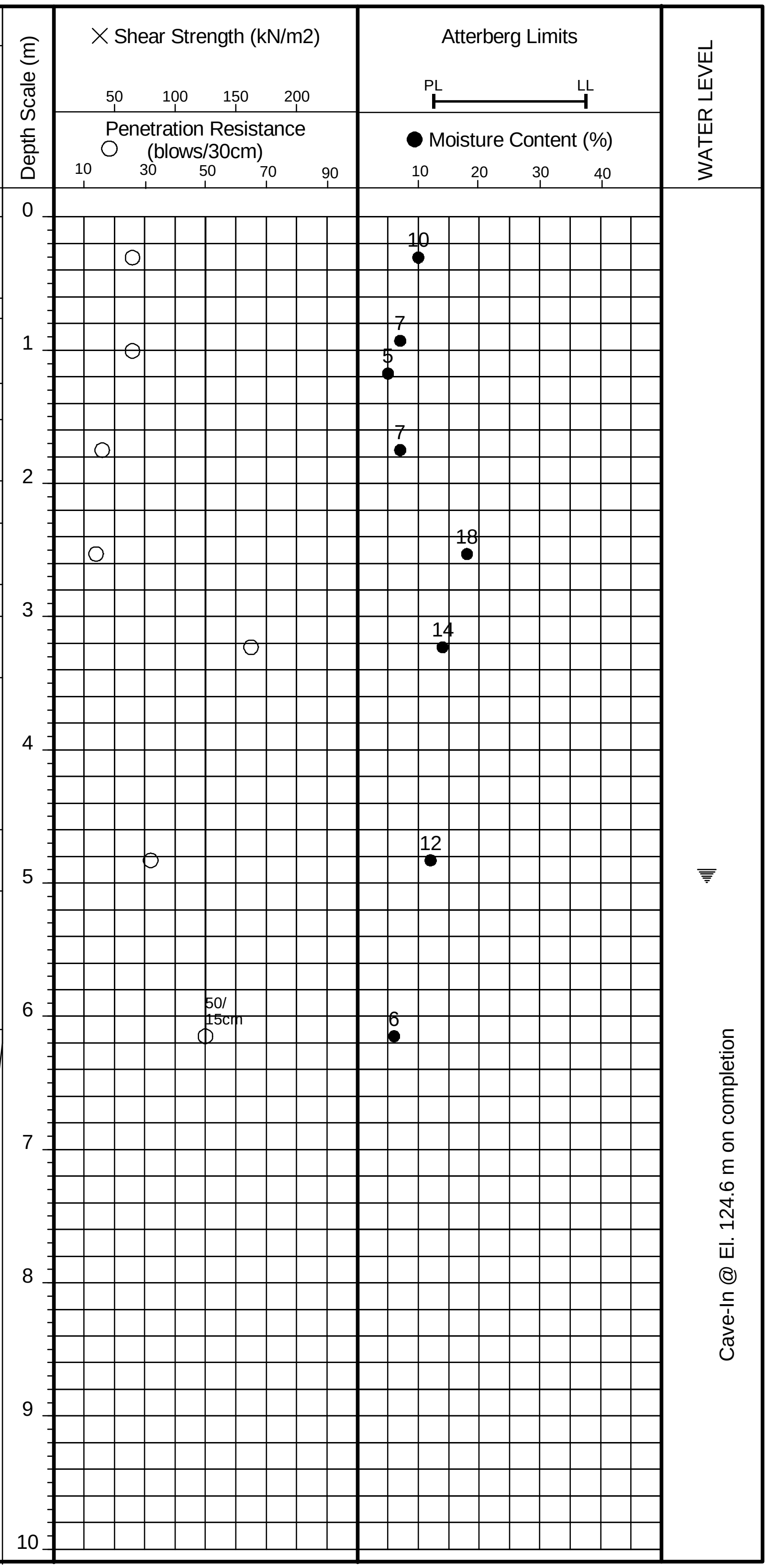
METHOD OF BORING: Flight-Auger

DATE: August 9, 2012

Depth Elev. (m)	SOIL DESCRIPTION
0.0	Ground Surface
129.5	Brown **EARTH, Fill** silty clay and silty sand materials with topsoil inclusions
1.1 128.4	Brown, compact, damp to wet **FINE TO COARSE SAND** some silt, a trace of gravel _ _ wet
2.9 126.6	Brown, very dense, wet **SILTY FINE SAND** a trace of clay occ. silt seams and layers
4.0 125.5	Grey, hard **SILTY CLAY, Till** sandy, a trace of gravel occ. sand and silt seams and layers, cobbles and boulders
5.6 123.9	Reddish-grey, very dense **SILTY SAND, Till** a trace of clay and gravel occ. silt and clay seams and layers, cobbles and boulders
6.2 123.3	**END OF BOREHOLE**

SAMPLES

Number	Type	N-Value
1	DO	26
2A 2B	DO	26
3	DO	16
4	DO	14
5	DO	65
6	DO	32
7	DO	50/ 15



Soil Engineers Ltd.

JOB NO: 1207-S148

LOG OF BOREHOLE NO: MW25

FIGURE NO: 26A

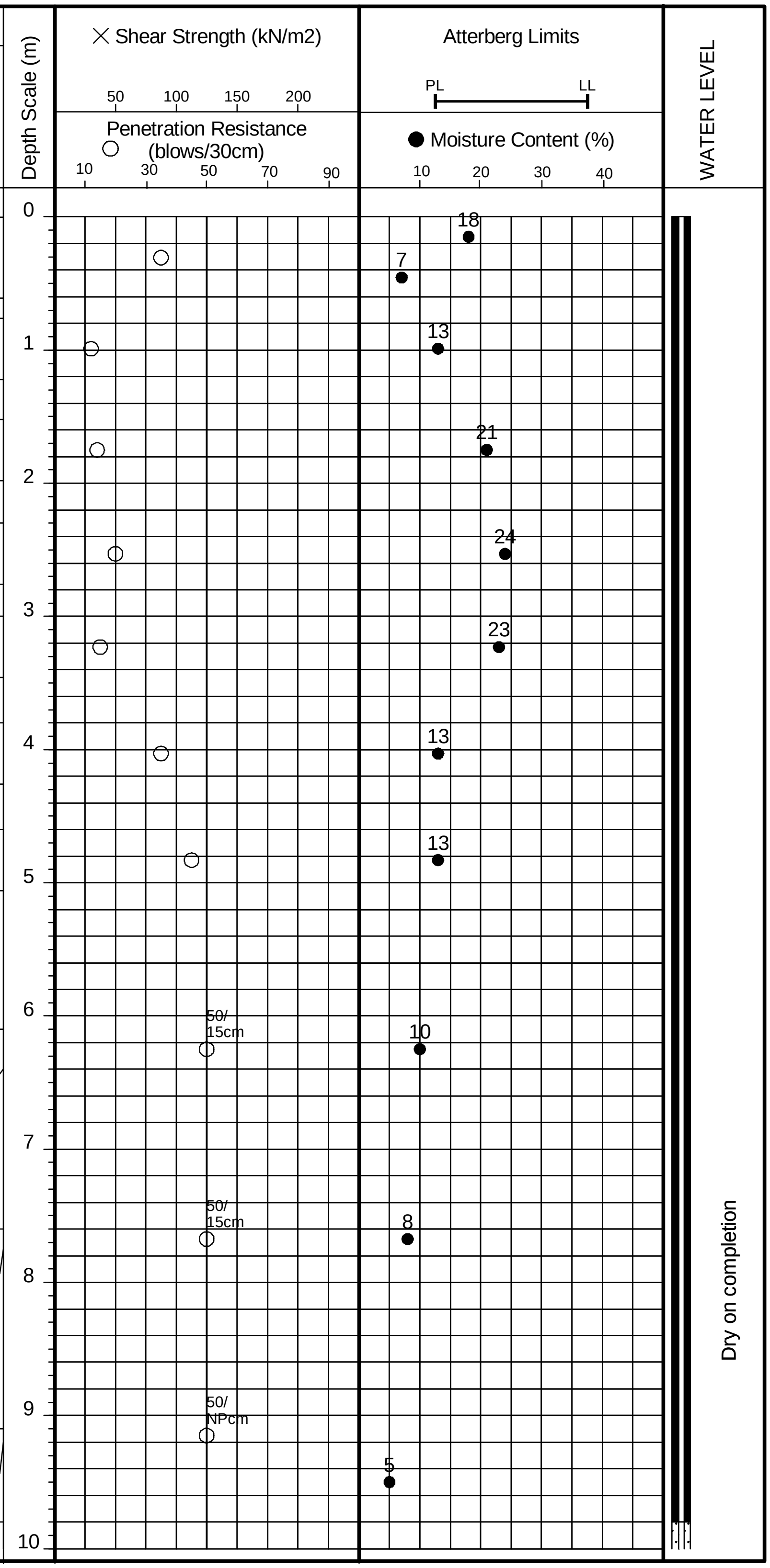
JOB DESCRIPTION: Proposed Residential Development

JOB LOCATION: 1401 Bronte Road, Town of Oakville

METHOD OF BORING: Flight-Auger

DATE: August 14, 2012

Depth Elev. (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
0.0	Ground Surface			
127.0	**10 cm TOPSOIL, Fill**	1A	DO	35
	Dark brown/reddish-brown	1B		
	EARTH, Fill (borehole located on a berm)	2	DO	12
	silty clay with topsoil inclusions and organics	3	DO	14
		4	DO	20
		5	DO	15
3.8 123.2	Brown/reddish-brown, hard	6	DO	35
	SILTY CLAY, Till	7	DO	45
	sandy, a trace of gravel occ. sand and silt seams and layers, cobbles and boulders	8	DO	50/ 15
		9	DO	50/ 15
	changing to shale			
9.1 117.9	Reddish-brown	10	DO	50/ NP
	SHALE BEDROCK	10A	AS	-
10.0	easy augering from 9.1 to 10.7 m			



JOB NO: 1207-S148

LOG OF BOREHOLE NO: MW25

FIGURE NO: 26B

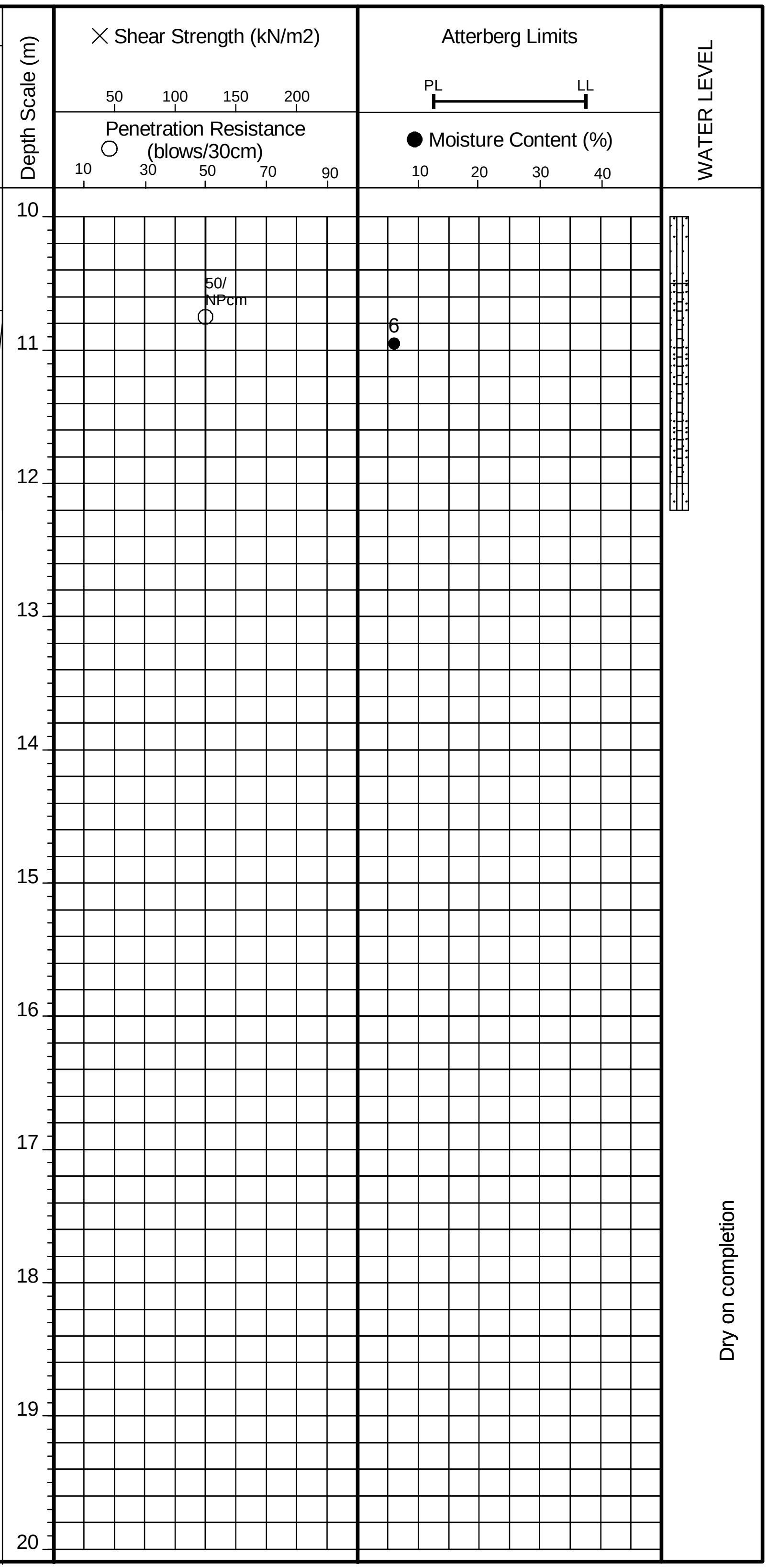
JOB DESCRIPTION: Proposed Residential Development

JOB LOCATION: 1401 Bronte Road, Town of Oakville

METHOD OF BORING: Flight-Auger

DATE: August 14, 2012

Depth Elev. (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
10.0 117.0	Reddish-brown **SHALE BEDROCK** occ. sound layers hard augering from 10.7 to 12.2 m	11 11A	DO AS	50/ NP
12.2 114.8	**END OF BOREHOLE** Installed 50-mm diameter PVC monitoring well to 12.0 m with sand backfill from 9.8 to 12.2 m. Bentonite seal from 0.0 to 9.8 m. Mounted with a steel protective casing.			



JOB NO: 1207-S148

LOG OF BOREHOLE NO: 26

FIGURE NO: 27

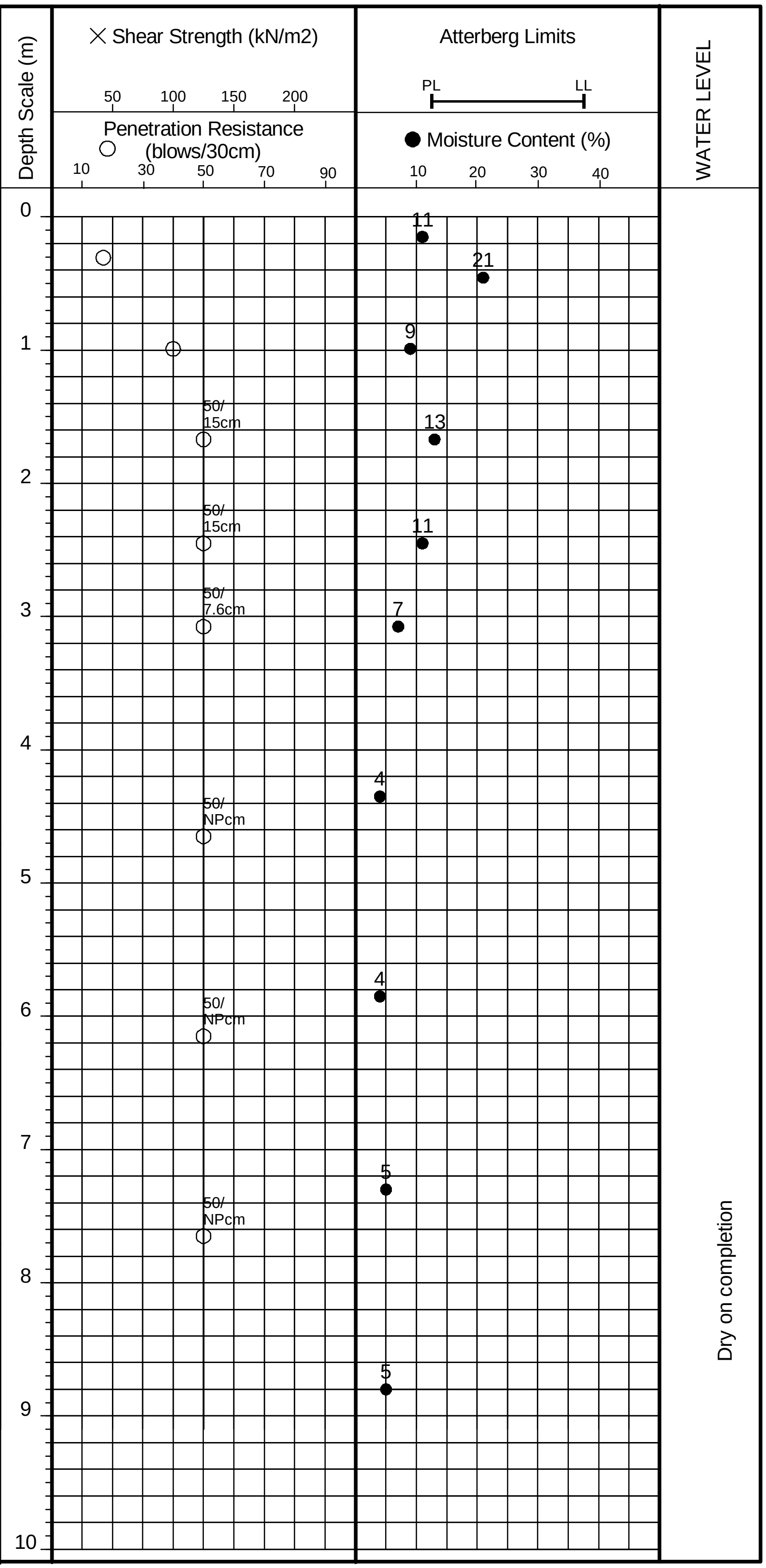
JOB DESCRIPTION: Proposed Residential Development

JOB LOCATION: 1401 Bronte Road, Town of Oakville

METHOD OF BORING: Flight-Auger

DATE: August 14, 2012

Depth Elev. (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
0.0	Ground Surface			
121.9	**15 cm SAND/GRAVEL, Fill** (borehole located on the edge of walkway)	1A	DO	17
		1B		
	weathered			
	Brown/reddish-brown, hard	2	DO	40
	SILTY CLAY, Till	3	DO	50/ 15
	sandy, a trace of gravel occ. sand and silt seams and layers, cobbles and boulders	4	DO	50/ 15
	changing to shale			
3.0 118.9	Reddish-brown	5	DO	50/ 7.6
	SHALE BEDROCK	6A	AS	-
		6	DO	50/ NP
	occ. sound layers easy augering from 3.0 to 6.1 m hard augering from 6.1 to 9.1 m	7A	AS	-
		7	DO	50/ NP
		8A	AS	-
		8	DO	50/ NP
		9A	AS	-
9.1 112.8	**END OF BOREHOLE**			



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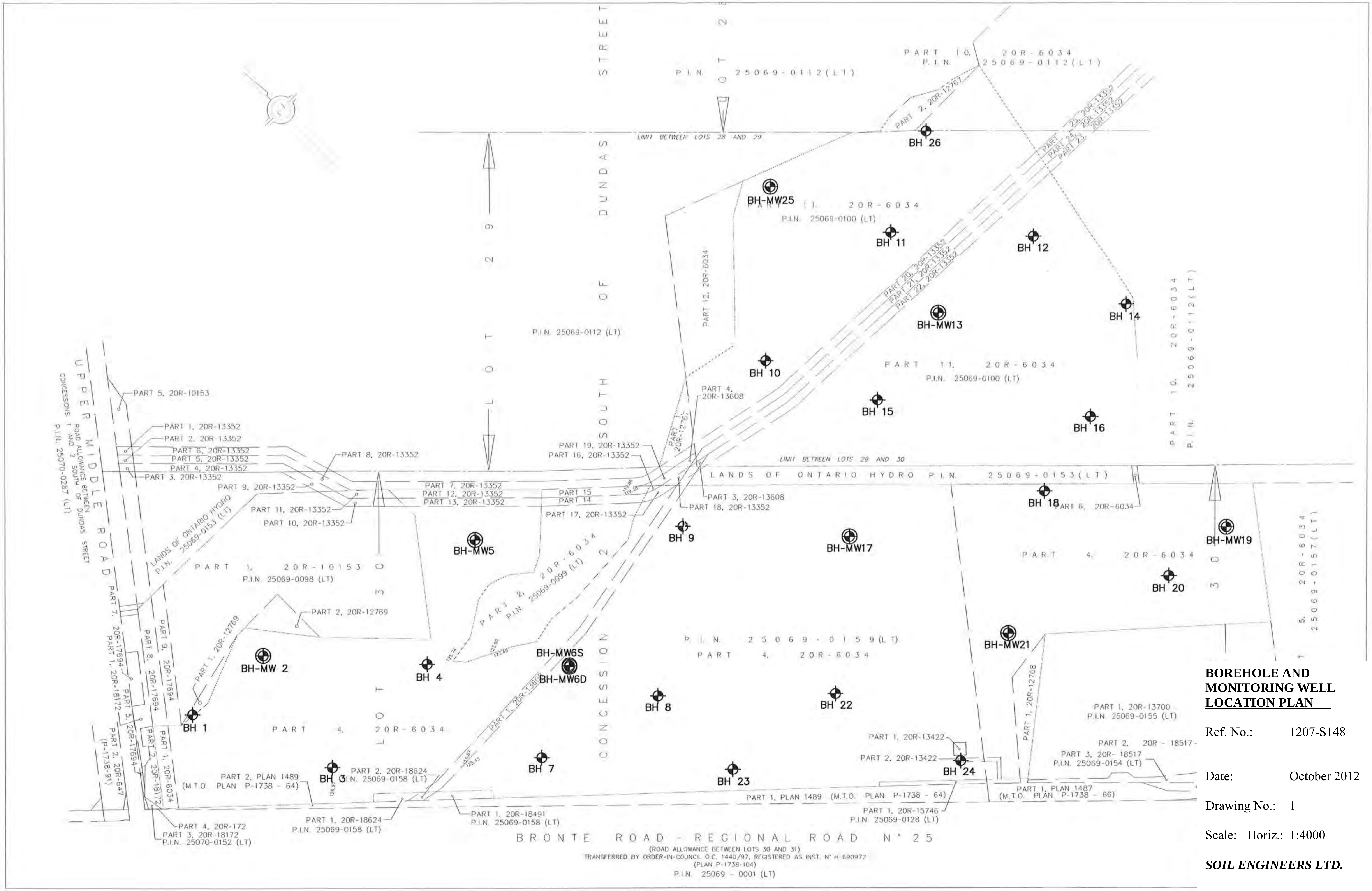

BOREHOLE AND MONITORING WELL LOCATION PLAN

Ref. No.: 1207-S148

Date: October 2012

Drawing No.: 1

Scale: Horiz.: 1:4000

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APPENDIX D

DRAWINGS