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Project name:
AMZL DYT3 Ottawa

Project ref:
60634622

From:
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Date:
March 24, 2023

Technical Memorandum (Rev.3)

Subject: 60634622 Supplementary Geotechnical Investigation at DYT3 Ottawa, Ontario

The DYT3 site (the site) is located at 2625 Sheffield Road in Ottawa, Ontario. A supplementary geotechnical field investigation program was carried out at the site between March 14 and March 15, 2022, under the full-time supervision of AECOM staff. A total of four (4) boreholes, two (2) sampled borehoels and two (2) Dynamic Core Penetration Tests (DCPTs), were advanced near the existing structure, and the borehole locations and logs are provided in **Appendix A**. The laboratory test results are provided in **Appendix B**.

Subsurface Conditions at the Borehole Locations

A granular fill layer was encountered in Boreholes BH-S1/MW and BH-S2/MW beneath the asphalt. The thickness of granular fill ranged from 76 to 180 mm. This granular fill extended to 66.92 to 66.72 metres above sea level (mASL).

A layer of sand fill underlain by a layer of granular fill was encountered in Boreholes BH-S1/MW and BH-S2/MW. The thickness of sand fill ranged from 1.2 to 1.3 m. The sand fill was encountered at the elevations ranged from 66.2 to 66.72 mASL and extended to 65.5 mASL. Standard Penetration Testing (SPT) N blow counts ranged from 10 to over 50 blows per 0.3 m of penetration, indicating a compact to very dense soil.

The native silty clay to clayey silt underlain by the layers of fill was encountered in Boreholes BH-S1/MW and BH-S2/MW. The silty clay was encountered at elevation 62.5 mASL and extended to 58.0 to 56.3 mASL. Standard Penetration Testing (SPT) N values ranged from Weight Hammer (WH) to 10 blows per 0.3 m of penetration, indicating a very soft to stiff cohesive soil. The sand seams were present within the clay layer at about 62.3mASL. According to the field vane tests at 7mbgs, the undisturbed and remolded shear strength was 34.1 kPa and 8.5kP, respectively. The sensitivity ratio was about 4. This clay was medium to very sensitive and significant settlement would be expected under loading conditions. The natural water content for the very soft clay (w=about 53.5%) was higher than the liquid limit (LL=40%), indicating a highly flocculent quick clay, i.e., the clay would liquefy when it is remolded.

The native silty clay till was underlain by a layer of native silty clay in Borehole BH-S1/MW. The silty clay till was encountered at the elevation of 58.0 mASL and it extended to 56.0 mASL. Standard Penetration Testing (SPT) N values were over 50 blows per 0.3 m of penetration, indicating a hard cohesive soil.

Bedrock was encountered in Borehole BH-S2/MW below the native silty clay materials and also in DCPT-1 and DCPT-2. The bedrock surface was encountered at elevations ranging from 57.3 to 56.3 mASL. Bedrock coring was carried out in BH-S2/MW. The bedrock is comprised of Carlsbad formation shale, which is highly weathered and in dark grey in colour with horizontal bedding. The vertical and inclined open joints were infilled with clay as were observed in the core samples. The top 2m of the shale bedrock was highly weathered with an RQD of 0% and a fracture index of about 10.

The groundwater level was observed at a depth of 4.27 mbgs at the time of drilling in the open hole. Monitoring wells were installed in Boreholes BH-S1/MW and BH-S2/MW to allow for long-term groundwater monitoring at these two locations.

Foundation Options and Recommendations

According to the historical foundation design of the building, shallow foundations have been used to support the old building. Therefore, it is feasible to use the spread footings and strip footings as the foundation design option.

Foundations Options

Typically, shallow foundations are not suitable for heavily to moderately loaded structures based on the compressible soils encountered at the site. Loading of the sensitive clay would cause significant post-construction settlement. Since the existing building is supported by shallow foundations, the soil under the existing building footprint has been consolidated. But additional loading due to an increase in building structural load will still generate some settlement. It is recommended to increase the design settlement criteria to 50mm in the Ottawa region where substantial soft soils are existing. The bearing capacities are evaluated with the detailed foundation location plan.

Based on the above considerations, the recommended option from a geotechnical/foundations perspective is to support the proposed building on spread and strip footings with a foundation depth of 1.5mbgs. The lightweight backfill is required to replace the existing and regular backfill above the footing to minimize the long-term consolidation settlement for the footings with a foundation depth of 2.7mbgs.. Otherwise, deep foundations shall be used with pile caps at 2.7mbgs.

Foundation Design Capacities

Shallow foundations

The bearing capacity at the ultimate limit state (ULS) is estimated based on the two-layer method proposed by Meyerhof and Hanna (1978) and Meyerhof (1974). The bearing capacity at the service limit state (SLS) is estimated via numerical software Settle 3 by Rocscience inc. The footings should be placed at a minimum of 1.5 m below the ground surface.

The soil layers considered in the analysis were divided into five(5) sublayers, as seen in **Table 1**. The consolidation test results are shown in **Appendix B.** The settlement analysis via Settle 3D is shown in **Appendix C**.

Table 1 Soil layers for bearing capacity analysis

Soil Layer	Thickness (m)	Compactness /Consistency	Unit Weight (kN/m³)	S_u (kPa)	Φ (°)	E (MPa)	Consolidation Settlement Parameter					
							C_c	C_r	OCR	P_c (kPa)	e_0	C_v (cm²/s)
Fill	1.5	Dense to very dense	21	-	35	52.5	-	-	-	-	-	-
Top silty clay with sand	1.5	Stiff to firm	20	35*	-	40.0	-	-	-	-	-	-
Silty Clay	3	Very soft	20		-	-	0.339	0.033	1	-	1.4	7.45E-4
Silty Clay Bottom	1	Frim to Stiff	20		-	-	0.339	0.033	-	110	0.55	7.45E-4
Silty Clay/Clayey Silt Till	2	Very stiff to hard	20	-	-	40.0	-	-	-	-	-	-
Engineered Fill	-	100% SPMDD	21	-	36	62.5	-	-	-	-	-	-
***Weighted average value**												

Based on the subsurface soil conditions described in Table 1, the bearing capacity in terms of the ULS and SLS estimated for the different sizes of spread footing is shown in Table 2. It should be noted that the footing is generally ULS controlled because

the founding soil layer is stiff to firm silty clay underlain by very soft silty clay. The ULS could be increased by subexcaving the clay and replaced with compacted engineered fill such as OPSS Granular A. At lease 0.3 m thick Granular A pad compacted at SPMDD of 100% will improve the geotechnical resistance at ULS. Geogrid (e.g., Terrafix TBX2000) between native clayey soil and granular pad will provide a better load distribution resulting in the improvement of the bearing capacity as well. It should be noted that a smaller capacity (either ULS or SLS) should be used for the foundation design.

Table 2 ULS and SLS for Shallow Foundation Option

Footing size	Factored Geotechnical Resistance at ULS (kPa)	Factored Geotechnical Resistance at ULS with 0.3 m of Granular A Pad (kPa)	Geotechnical Reaction at SLS* (kPa)
Strip footing 1.5m wide	110	115	90
2m x 2m	130	140	200
3m x 3m	120	130	150
4m x 4m	110	120	100
4m x 4m**	120	130	100**
5m x 5m	110	120	100 (General) /140 (only interior)
6m x 6m**	120	130	80**

Note: * The SLS is calculated based on the settlement of 50mm at 15-year design life.
** - 2.7 m embedded depth and backfill with lightweight fill. Otherwise 1.5 m embedded depth for footing and backfill with Grauluar B.

Driven Steel H-Piles

Steel H-piles (HP 310 x 110) can be used to support the structure. The piles will be installed through the native silty clay to clayey silt and are expected to drive into weathered bedrock. The termination elevation is anticipated at 56mASL. The pile cap elevation should be below the frost line of 1.5m below the ground surface. The in-situ load test with Pile Driving Analyzer (PDA) is needed to determine the actual capacity of the H-Pile. The factored geotechnical resistances for H-piles are shown in Table 3.

Table 3 ULS and SLS for Driven H-Pile (HP 310x110)

Pile Foundation Stratum	Estimated Tip Elevation	Approx. Design Length	Factored Geotechnical Axial Resistance at ULS (kN/Pile)	Geotechnical Axial Resistance at SLS (kN/Pile)
Bedrock (fractured)	52mASL	12 m	600*	>ULS capacity

Note: * The ULS capacity should be determined via field pile load test

Drilled Concrete Caissons

To provide sufficient geotechnical resistance, the caissons should be socketed at least 2.5m into the bedrock. Temporary steel liners should be advanced to address the shallow groundwater levels and prevent caving within the wet granular soils. The following table summarizes the recommended factored geotechnical resistance at ULS and the geotechnical reaction at SLS for the caisson diameters and bearing elevation for limit states design.

Table 4 ULS and SLS for Caissons

Pile Foundation Stratum	Estimated Tip Elevation (mASL)	Approx. Design Length (m)	Socket Length (m)	Factored Geotechnical Axial Resistance at ULS (kN/Pile)		Geotechnical Axial Resistance at SLS (kN/Pile)	
				0.9m dia.	**1.2m dia.**	**0.9m dia.**	**1.2m dia.**
Bedrock	53.83	13.17	2.5	1100 kN	1500 kN	>ULS Capacity	

Resistance of Piles to Lateral Loads

The resistance to lateral loading is derived from the soil in front of the piles for vertical piles. That resistance may be estimated using Subgrade Reaction Theory (with deformations less than 5% of pile diameter), in which the coefficient of horizontal subgrade reactions K_S is based on the following equations:

In cohesionless soil:

$$K_S = n_h(z/d)$$

Where:

K_S = coefficient of horizontal subgrade reaction (MPa/m)
n_n = constant of horizontal subgrade reaction (MPa/m)
d = pile diameter (m)
z = depth below ground surface (m)

In cohesive soil:

$$K_S = 67C_u/d$$

Where:

K_S = coefficient of horizontal subgrade reaction (MPa/m)
C_u = undrained shear strength of the soil (MPa)
d = pile diameter (m)

According to the vane test results, the undrained shear strength of the native silty clay is 34.1 kPa and 8.5kPa for undisturbed and remold strength, respectively, at this site. For the lateral resistance calculation, it is recommended that 5 kPa within the native silty clay should be used, considering the disturbance and sensitivity of the clay soil.

Lateral loading could be resisted fully or partially by use of battered piles. The piles could be installed at a better of up to 4 vertical to 1 horizontal.

Group action for lateral loading should be considered where the pile spacing in the direction of the loading is less than eight pile diameters. Group action can be evaluated by reducing the coefficient of lateral subgrade reaction in the direction of loading by a reduction fact R, as indicated in Table 5. Subgrade reaction reduction factors for other pile spacing values may be interpolated for pile spacing in between those listed in this table.

Table 5 – Lateral Load Capacity Reduction Factor for Pile Group

Pile Spacing in Direction of Loading D = Pile Diameter/Width	Subgrade Reaction Reduction Factor R
8d	1
6d	0.7
4d	0.4
3d	0.25

Negative Skin Friction (Downdrag Loads) on Piles

The negative skin friction within the native clay soil that are subject to settlement should be considered with the final civil/structual design. The amount of negative skin friction as well as depth to the neutral plane should be refined during the detailed design stage and based on the actual fill height, design pile length for each specific area.

Lightweight Fill

For the footings at the depth of 2.7mbgs, the Geospec@ lightweight fill EPS 22 block or equivalent shall be used as backfill materials to reduce the overall stress on the underlain compressible clay layer. The minimum replacement shall be 2.1m EPS22 lightweight fill and 0.4m granular fill/pavement structure on top of EPS 22 block. The lightweight fill shall be placed above the founding elevation and extend 0.5×B (foundation width) in all directions from the footing edge.

Subgrade modulus

The vertical modulus of subgrade reaction ($K_{0.3}$) on the engineered fill of 30 MPa/m to 50 MPa/m (for square plate 30 x 30 cm or 30 cm wide strip resting on pre-compressed layers) may be used for the design. It should be noted that reduction of $K_{0.3}$ due to shape and size of foundations (i.e., Ks) should be considered.

Table 6 Subgrade Reaction Modulus

Size of slab	Ks		
	Min. $K_{0.3}$= 30 Mpa/m	Max. $K_{0.3}$= 50 Mpa/m	Mean $K_{0.3}$=40 MPa/m
2m x 2m	10.0	16.5	13.2
3m x 3m	9.1	15.1	12.1
4m x 4m	8.7	13.4	11.6
5m x 5m	8.4	14.0	11.2

Seismic Site Classification

Table 7 summarizes the site classification based on the soil properties in the top 20 m of the subsurface. Considering the undrained shear strength and SPT values of the very soft to stiff silty clay to clayey silt encountered, a seismic site classification of the building and proposed canopy area is ***Site Class E.***

Table 7 Site Classification for Seismic Site Response (CFEM 2006)

Site Class	Ground Profile Name	Shear Wave Velocity $\overline{V_s}$ (m/s)	Standard Penetration Resistance $\overline{N}_{60}$	Soil Undrained Shear Strength s_u (kPa)
A	Hard Rock	$\overline{V_s} > 1500$	Not Applicable	Not Applicable
B	Rock	$760 < \overline{V_s} \leq 1500$	Not Applicable	Not Applicable
C	Very Dense Soil and Soft Rock	$360 < \overline{V_s} \leq 760$	$\overline{N}_{60} > 50$	$s_u > 100$
D	Stiff Soil	$180 < \overline{V_s} \leq 360$	$15 \leq \overline{N}_{60} \leq 50$	$50 < s_u \leq 100$
E	Soft Soil	$\overline{V_s} \leq 180$	$\overline{N}_{60} < 15$	$s_u < 50$
		Any profile with more than 3m of soil with the following characteristics: • Plasticity Index PI > 20; • Moisture Content w ≥ 40%; and • Undrained Shear Strength $s_u < 25$ kPa		
F	Other Soil	Site Specific Evaluation Required		

Spectral accelerations and PGA values given in Table 8 should be adjusted using Tables 4.2 to 4.9 in CHBDC S6-14. The design PGA and $S_a(T)$, should be selected based on project-specific requirements as described in the minimum performance level in CHBDC S6-14. Seismic earth pressures acting on the structure may be estimated using Mononobe-Okabe or Wood methods depending on the rigidity or tolerable movement of the structures.

Table 8 Spectral Acceleration Sa (T) and PGA (CHBDC S6-14)

2%/50 years (0.000404 per annum) probability				
Sa(0.2)	Sa(0.5)	Sa(1.0)	Sa(2.0)	PGA
0.465	**0.248**	**0.122**	**0.058**	**0.297 g**
5%/50 years (0.001 per annum)				

Sa(0.2)	Sa(0.5)	Sa(1.0)	Sa(2.0)	PGA
0.269	0.144	0.072	0.033	0.172 g
10%/50 years (0.001 per annum)				
Sa(0.2)	Sa(0.5)	Sa(1.0)	Sa(2.0)	PGA
0.169	0.091	0.045	0.021	0.107 g
40%/50 years (0.001 per annum)				
Sa(0.2)	Sa(0.5)	Sa(1.0)	Sa(2.0)	PGA
0.057	0.032	0.015	0.006	0.034 g

Liquefaction Consideration

To delineate liquefaction susceptibility, this memo has adopted the empirical criteria recommended in the Canadian Foundation Engineering Manual:

- $w/w_L \geq 0.85$ and $I_P \leq 12$: Susceptible to liquefaction or cyclic mobility;
- $w/w_L \geq 0.80$ and $10 \leq I_P \leq 12$: Moderately susceptible to liquefaction;
- $w/w_L < 0.85$ and $I_P \geq 12$: No liquefaction or cyclic mobility.

Where w is the in-situ soil water content, w_L is the liquid limit of the soil and I_P is the plasticity index of the soil.

The clay present on site is susceptible to liquefaction as the natural water content is higher than its liquid limit.

Minimum Insulation Calculation

A design methodology for insulated foundations has been presented by Robinsky and Bespflug (1973). Summaries of their design charts for heated and unheated structures are shown in Figure 1 and Figure 2, respectively (CFEM, 2006).

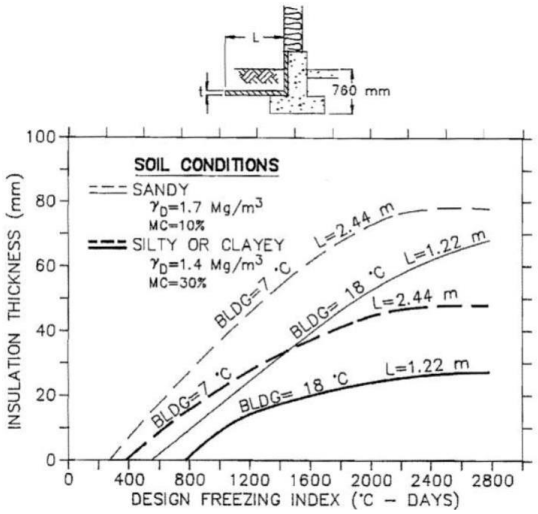

Figure 1 Design curves for minimum insulation requirments for heated structures (adapted from Robinsky and Bespflug, 1973)

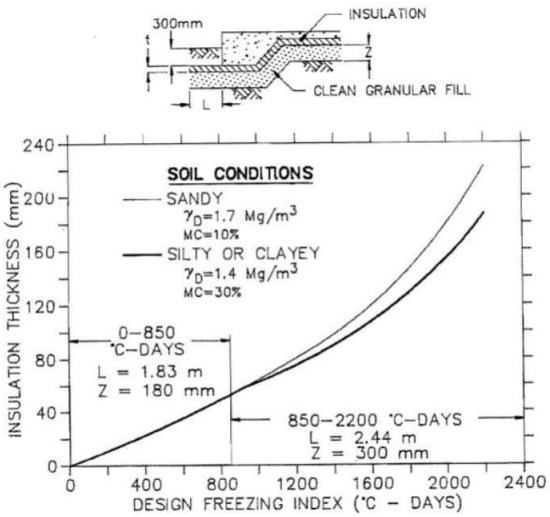

Figure 2 Design curves for minimum insulation requirments for unheated structures (adapted from Robinsky and Bespflug, 1973)

Design freezing Index of Ottawa is around 1100°C Day. As the footings will be founded on granular materials and all the backfill materials are granular materials, the sandy soil conditions are adopted while using the figures. When the building temperature of 18°C is to be maintained, Insulation should be placed with minimum soil covers of 300 mm and extend at least 1.22 m from the edge of the building. For the heated structures, the minimum installation thickness is about 20 mm according to **Figure 1**. As the perimeter of the building should be considered as unheated structures, the minimum insulation thickness is about 60 mm according to **Figure 2.**

Closure

We trust that this meets your expectations. If you have any questions or need clarification, please do not hesitate to contact the undersigned.

AECOM Canada Ltd.

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Encl.

Appendix A Borehole Location and Borehole Logs

LEGEND

- Geotechnical Borehole - 20 m Depth
- DCPT - 20 m Depth
- Geotechnical Borehole - AECOM, 2020 Investigation

NOTES:

REFERENCE DRAWINGS

NO.	DATE	DESCRIPTION

REVISIONS

REV.	DATE	DESCRIPTION	BY	CHK
0	2022.03.03	BH Plan	JH	TA

CLIENT NAME:
AMAZON LOGISTICS

PROJECT LOCATION:
2625 Sheffield Rd, Ottawa ON

PROJECT NUMBER: 60634622

PROPOSED BOREHOLE LOCATION PLAN

DRAWN BY: JH	SCALE: 1:1500	DRAWING No. 1
CHECKED: TA	DATE: MAR 2022	REVISION 0

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TERMINOLOGY USED IN BOREHOLE LOGS

Topsoil: Mixture of soil and humus capable of supporting good vegetative growth.

Peat: A mass of organic matter usually fibrous in texture in various stages of decomposition, generally dark brown to black in colour and of spongy consistency.

Fill: The term fill has been used to describe materials which have been placed by non-natural processes. Fills can often be heterogeneous in nature and those relying on this report should expect them to contain deleterious materials. Such materials can include wood, bricks, slag, porcelain, organics, and obstructions such as scrap metal, storage tanks, and abandoned concrete/steel structures.

Due to the uncertainty of the placement method of the material, the boring samples obtained for this report are not expected to represent other materials at any horizontal or vertical distance from where the sample was obtained.

Fill material may be contaminated by toxic/hazardous waste that renders it unacceptable for deposition in any but designated land fill site. Unless specifically stated, the fill on this site has not been tested for contaminants that can be considered toxic or hazardous. Testing to determine the toxicity of fill materials can be conducted, if requested.

Till: The term till on the borehole logs indicates that the material originates from a geological process associated with glaciation. Till must be considered heterogeneous in composition and containing pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (60 to 200 mm) and boulders (over 200 mm). Contractors may therefore encounter cobbles and boulders during excavation, even if they are not indicated by the logs. It should be appreciated that normal sampling equipment cannot differentiate the size or type of any obstruction. Due to the horizontal and vertical variability of till, the sample description may be applicable to a very limited zone. Caution is essential when dealing with sensitive excavations or dewatering programs in till materials.

Terminology describing soil structure

Desiccated: having visible signs of weathering by oxidization of clay minerals, shrinkage cracks, etc.

Stratified: alternating layers of varying material or color with the layers greater than 6 mm thick.

Laminated: alternating layers of varying material or color with the layers less than 6 mm thick.

Fissured: material breaks along plane of fracture.

Varved: composed of regular alternating layers of silt and clay.

Slickensided: fracture planes appear polished or glossy, sometimes striated.

Blocky: cohesive soil that can be broken down into small angular lumps which resist further breakdown.

Lensed: inclusion of small pockets of different soil, such as small lenses of sand scattered through a mass of clay; not thickness.

Seam: a thin, confined layer of soil having different particle size, texture, or color from materials above and below.

Homogeneous: same color and appearance throughout.

Well Graded: having wide range in grain sized and substantial amounts of all predominantly on grain size.

Uniformly Graded: predominantly on grain size.

Residual: completed weathered sedimentary rock mixed with native soils.

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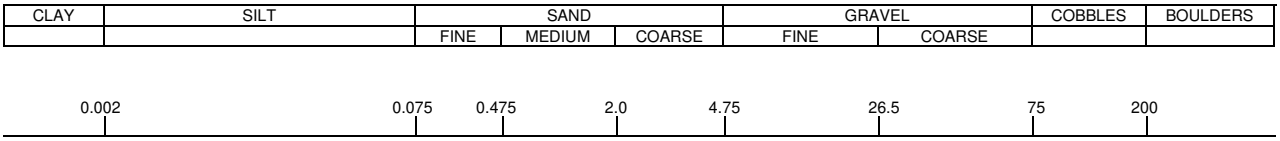
All soil sample descriptions included in this report generally follow the Canadian Foundations Engineering Manual and the Unified Soil Classification System. These systems follow the standard proposed by the International Society for Soil Mechanics and Foundation Engineering. Laboratory grain size analyses provided by AECOM follow the same system. Note that, with exception of those samples where a grain size distribution analysis has been completed, all samples have been classified by visual inspection. Visual inspection classification is not sufficient to provide exact gain sizing.

ISSMFE / USCS SOIL CLASSIFICATION



EQUIVALENT GRAIN DIAMETER IN MILLIMETRES

The standard terminology to describe cohesive soils includes consistency, which is based on undrained shear strength as measured by in-situ vane tests, penetrometer tests, unconfined compression tests or similar field and laboratory analysis. Standard Penetration Test 'N' values can also be used to provide an approximate indication of the consistency and shear strength of fine grained, cohesive soils.

The standard terminology to describe cohesionless soils includes the compactness condition as determined by the Standard Penetration Test 'N' value.

Cohesionless Soils		Cohesive Soils			Composition	
Compactness Condition	**SPT N-Index (blows per 0.3 m)**	**Consistency**	**Undrained Shear Strength (kPa)**	**SPT N-Index (blows per 0.3 m)**	**Term**	**Criteria**
Very loose	0 – 4	Very soft	< 12	< 2	Trace	1% - 10%
Loose	4 – 10	Soft	12 - 25	2 – 4	Some	10% - 20%
Compact	10 – 30	Firm	25 – 50	4 – 8	Adjective	20% - 35%
Dense	30 – 50	Stiff	50 – 100	8 – 15	And	> 35%
Very Dense	> 50	Very Stiff	100 - 200	15 – 30	Noun	> 35% & largest fraction
		Hard	> 200	> 30		

Standard Penetration Test (SPT):

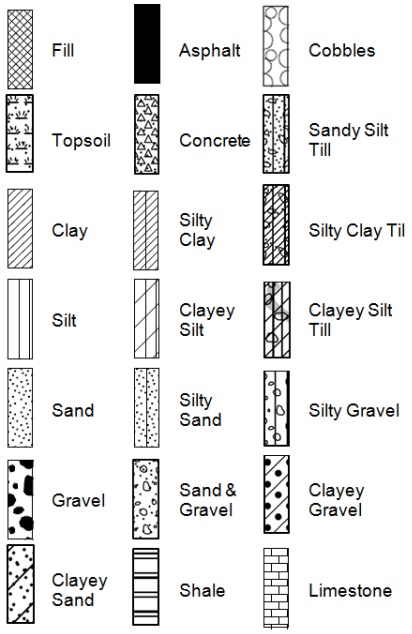
The number of blows required to drive a 50 mm (2 in.) open split spoon sampler from a depth of 150 mm (6 in.) to 450 mm (18 in.) in undisturbed soil. Each blow is driven by a 63.6 kg (140 lb.) hammer free falling a distance of 0.76 m (30 in.).

Sample & Soil Abbreviations	
CORE	Rock core sample
AS	Auger sample
FV	Field vane
PP	Pocket penetrometer
SG	Specific Gravity
GS	Grab sample
SS	Split spoon sample
DCPT	Dynamic cone penetration test
GR	Gravel
SA	Sand
SI	Silt
CL	Clay

Contaminant Abbreviations	
BNAE	base/neutral/acid extractables
BTEX	benzene, toluene, ethylbenzene, xylenes
OCP	organochlorine pesticides
MI	metals & inorganics
PAH	polycyclic aromatic hydrocarbons
PCB	polychlorinated biphenyls
PHC	CCME petroleum hydrocarbons (fractions 1 – 4)
VOC	volatile organic compounds (includes BTEX)

Plasticity Description	Liquid Limit (w_l)
Low	$w_l < 30$
Medium	$30 < w_l < 50$
High	$50 < w_l$

Strata/Graphic Plot



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Explanatory Sheet To Rock Core Log

Column No.	Description
1.	Elevation and Depth of Geotechnical Boundary in Borehole
2.	Drilling Method Used
3.	General Description of Geotechnical Unit: Quantitative description including rock type (s), percentage of rock types, frequency and sizes of interbeds, colour, texture, weathering, strength and general joint spacing

Hardness

H1	Extremely Hard	Cannot be scratched with a pocket knife or sharp pick. Can only be chipped with repeated heavy hammer blows
H2	Very Hard	Cannot be scratched with a pocket knife or sharp pick. Breaks with repeated heavy hammer blows
H3	Hard	Can be scratched with a pocket knife or sharp pick with difficulty (heavy pressure) Breaks with heavy hammer blows
H4	Moderately Hard	Can be scratched with a pocket knife or sharp pick with light or moderate pressure. Breaks with moderate hammer blows
H5	Moderately Soft	Can be grooved 1.6 mm (1/16 in) with a pocket knife or sharp pick
H6	Soft	Can be grooved or gouged easily with a pocket knife or sharp pick with slight pressure, can be scratech with a finger nail. Breaks with light or moderate manual pressure
H7	Very Soft	Can readily be indented, grooved or gouged with a finger nail, or Carved with pocket knife. Breaks with light manual pressure
Strength (from ISRM)		Approx UCS
Svh	Very High Strength	>200 MPa
Sh	High Strength	50 to 200 MPa
Sm	Medium Strength	15 to 50 MPa
Sl	Low Strength	4 to 15 MPa
Svl	Very Low Strength	1 to 4 MPa

4	Geological Symbol for Rock or Soil Material
5.	Elevation of Geotechnical Boundary
6.	Run Number: Drill run number
7.	Penetration Rate: meters per min
8.	Colour & Return Percentage:
9.	Core Recovery: Core recovery is the total length of core pieces, irrespective of their individual lengths, obtained in a core run and expressed as a percentage of the length of that core run.
10.	Rock Quality Designation (RQD): The total length of those pieces of sound core which are 10 cm (4 inches) or greater in length in a core run expressed as a percentage of the total length of that core run. Sound pieces of rack are those pieces separated by natural breaks and not machine breaks or subsequent artificial breaks.

0 - 25 percent	Very Poor Quality
25 - 40 percent	Poor Quality
40 - 75 percent	Fair Quality
75 - 90 percent	Good Quality
90 - 100 percent	Very Good Quality

11. Fracturing:

Fu	Unfractured	No Fractures
Fvs	Very Slightly Fractured	Core length greater than 0.9 m (3 ft)
Fsl	Slightly Fractured	Core length from 0.3 to 0.9 m (1 to 3 ft)
Fm	Moderately Fractured	Core length from 0.1 to 0.3 m (4 in. to 1 ft)
Fi	Intensely Fractured	Core lengths from 0.25 to 0.1 m (1 in. to 4 in.)
Fvi	Very Intensely Fractured	Mostly chips and fragments

12. Degreed of dip of discontinuity measured from the axis of rock core.

AECOM

13. Discontinuity Description

Fracture Width (FW)

FWt	Tight	No visible separation
FWs	Slightly Open	FW< 0.8 mm (1/32 in.)
FWm	Moderately Open	0.8 mm (1/32 in.)≤FW<3.2 mm (1/8 in.)
FWo	Open	3.2 mm (1/8 in.) ≤FW<9.7 mm (3/8 in.)
FWmw	Moderatley Wide	9.7 mm(3/8 in.) ≤FW<25.4 mm (1 in.)
FWw	Wide	FW≥25.4 mm(1 in.)

Fracture Filling or Coating Thickness(FF)

FFc	Clean	No film coating
FFvt	Very Thin	FF< 0.8 mm (1/32 in.)
FFm	Moderately Thin	0.8 mm (1/32 in.)≤FF<3.2 mm (1/8 in.)
FFt	Thin	3.2 mm (1/8 in.) ≤FF<9.7 mm (3/8 in.)
FFmt	Moderately Thick	9.7 mm(3/8 in.) ≤FF<25.4 mm (1 in.)
FFw	Thick	FF≥25.4 mm(1 in.)

Roughness

Rst	Stepped	Near normal steps and ridges occur on the fracture surface
Rr	Rough	Large angular asperities can be seen
Rm	Moderately Rough	Asperities are cleanly visible and fracture surface feels abrasive
Rs	Slightly Rough	Small asperities on the fracture surface are visible and can be felt
Rsm	Smooth	No asperities, smooth to the touch

Bedding Spacing (Sb)

Bm	Massive	≤Sb > 3 m (10 ft)
Bvt	Very Thickly Bedded	0.9 m (3 ft) ≤ Sb ≤ 3 m (10 ft)
Bt	Thickly Bedded	0.3 m (1 ft) ≤ Sb ≤ 0.9 m (3 ft)
Bm	Moderately Bedded	0.1 m (4 in.) ≤ Sb ≤ 0.3 m (1 ft)
Bt	Thinly Bedded	25 mm (1 in.) ≤ Sb ≤ 0.1 m (4 in.)
Bvt	Very Thinly Bedded	6 mm (1/4 in.) ≤ Sb ≤ 25 mm (1 in.)
Bl	Laminated	SB ≤ 6 mm (1/4 in.)

Orientation

Of	Flat	= 0 - 20°
Od	Dipping	= 20 - 50°
Ov	Vertical	= 50 - 90°

Surface Shape

Planar	Flat surface
Wavy	Undulating surface

Fracture Type:

B	Bedding
J	Fault
C	Joint
F	Foliation
S	Shear Plane
M	Mechanical Breaks

14. Hydraulic Conductivity (cm/sec)

15. Point Load Index:

Extremely Strong	> 10
Very Strong	4 - 10
Strong	2 - 4
Medium Strong	1 - 2

PROJECT: DYT3 - Ottawa
LOCATION: 2625 Sheffield Rd
COORDINATES: N 5028171.5; E 452674.6
DATUM: Geodetic
AECOM PROJECT #: 60634622
CLIENT: Amazon Logistics

RECORD OF BOREHOLE: BH-S1/MW

SHEET 1 OF 2

START DATE: Mar 14, 2022
END DATE: Mar 15, 2022
BORING METHOD: 200 mm O.D. Hollow Stem Auger
CONTRACTOR: Canadian Environmental Drilling
PENETRATION TEST HAMMER, 64kg; DROP, 760mm
SAMPLER HAMMER, 64kg; DROP, 760mm

DEPTH SCALE (METRES)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	N VALUE	Dynamic Cone Penetration Testing (blows/0.3m)	SHEAR STRENGTH Cu, kPa (nat V. + Q ●; rem V. ⊕ U △) / WATER CONTENT PERCENT (Wp, w, Wl)	ADDITIONAL LAB. TESTING & GRAIN SIZE DISTRIBUTION (%)	WELL INSTALLATION AND WATER LEVELS
		PAVEMENT		67.00						GR SA SI CL	
0	Power Auger Drilling; 200 mm O.D. Hollow Stem Auger	**ASPHALT:** 100 mm thick		0.00							
		FILL: sand and gravel, 76 mm thick, some rock pieces, brown, moist, very dense		0.10 / 0.20	1	SS	50/150mm				
1		**FILL:** sand, occasional cobbles, trace gravel, brown, moist, very dense			2	SS	50/150mm			18 57 (25)	
				65.50							
		SILTY CLAY: trace gravel, some sand, brown to grey, moist to wet, stiff to firm		1.50	3	SS	8				
2		---------- firm			4	SS	5			2 39 59	
3					5	SS	4				
4											▽ 2022.03.15
		---------- Sand Seam ----------			1	TW					
5					1	TW					
					6	SS	5				
6											
					7	SS	5			7 46 33 14	
7											
8											
				58.00							
9		**SILTY CLAY TILL:** trace gravel, some sand, grey, wet, hard		9.00	8	SS	50/76mm				
10		*CONTINUED NEXT PAGE*									

(LOG TO BE READ IN CONJUNCTION WITH REPORT)

DEPTH SCALE
1 : 50

AECOM

LOGGED: BK
CHECKED: TA

AECOM_BH_001 60634622 - DYT3 OTTAWA 2022_04_12.GPJ GAL-MISS.GDT 22-10-11

PROJECT: DYT3 - Ottawa
LOCATION: 2625 Sheffield Rd
COORDINATES: N 5028171.5; E 452674.6
DATUM: Geodetic
AECOM PROJECT #: 60634622
CLIENT: Amazon Logistics

RECORD OF BOREHOLE: BH-S1/MW

SHEET 2 OF 2

START DATE: Mar 14, 2022
END DATE: Mar 15, 2022
BORING METHOD: 200 mm O.D. Hollow Stem Auger
CONTRACTOR: Canadian Environmental Drilling
PENETRATION TEST HAMMER, 64kg; DROP, 760mm
SAMPLER HAMMER, 64kg; DROP, 760mm

DEPTH SCALE (METRES)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	N VALUE	Dynamic Cone Penetration Testing (blows/0.3m) 20 40 60 80 / 100 200 300 400	SHEAR STRENGTH Cu, kPa (nat V. + Q ●, rem V. ⊕ U △) 20 40 60 80 / WATER CONTENT PERCENT Wp — w — Wl 10 20 30 40	ADDITIONAL LAB. TESTING & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	WELL INSTALLATION AND WATER LEVELS
		CONTINUED FROM PREVIOUS PAGE									
10	Power Auger Drilling	**SILTY CLAY TILL:** trace gravel, some sand, grey, wet, hard			9	SS	50/ 76mm		○		
				56.03							
11		**AUGER REFUSAL**		10.97							
		END OF BOREHOLE									
		Notes:									
		1. This log is to be read with the subject report and project number as presented above.									
12		2. Interpretation assistance by AECOM is required for projects excluding the above mentioned project.									
		3. No abnormal odour or staining was observed unless otherwise indicated.									
		4. The groundwater was observed at the depth of 4.27 mbgs in the open hole.									
13		5. The monitoring well was installed upon the completion of drilling.									
14											
15											
16											
17											
18											
19											
20											

(LOG TO BE READ IN CONJUNCTION WITH REPORT)

DEPTH SCALE
1 : 50

AECOM

LOGGED: BK
CHECKED: TA

AECOM_BH_001 60634622 - DYT3 OTTAWA 2022_04_12.GPJ GAL-MISS.GDT 22-10-11

PROJECT: DYT3 - Ottawa
LOCATION: 2625 Sheffield Rd
COORDINATES: N 5027916.8; E 452712.8
DATUM: Geodetic
AECOM PROJECT #: 60634622
CLIENT: Amazon Logistics

RECORD OF BOREHOLE: BH-S2/MW

SHEET 1 OF 3

START DATE: Mar 15, 2022
END DATE: Mar 15, 2022
BORING METHOD: 200 mm O.D. Hollow Stem Auger
CONTRACTOR: Canadian Environmental Drilling
PENETRATION TEST HAMMER, 64kg; DROP, 760mm
SAMPLER HAMMER, 64kg; DROP, 760mm

DEPTH SCALE (METRES)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	N VALUE	Dynamic Cone Penetration Testing (blows/0.3m)	SHEAR STRENGTH Cu, kPa (nat V. + Q ●; rem V. ⊕ U △) / WATER CONTENT PERCENT (Wp, W, Wl)	ADDITIONAL LAB. TESTING & GRAIN SIZE DISTRIBUTION (%)	WELL INSTALLATION AND WATER LEVELS
		PAVEMENT		67.00						GR SA SI CL	
0	Power Auger Drilling; 200 mm O.D. Hollow Stem Auger	**ASPHALT:** 100 mm thick		0.00							
		FILL: sand and gravel, 180 mm thick, some rock pieces, brown, moist, compact		0.10 / 66.72							
		FILL: sand, trace gravel, brown, moist, compact		0.28	1	SS	11				
1					2	SS	10			11 63 (26)	
				65.50							
		SILTY CLAY: trace gravel, some sand, brown to grey, moist to wet, very soft to stiff		1.50	3	SS	5				
2					4	SS	3				
3		very soft			5	SS	WH		52.86	1 9 44 46	
4											▽ 2022.03.15
5					6	SS	WH		59.34		
6					1	TW				0 1 56 43	
7						VANE			⊕ +		
		stiff, wet			7	SS	10				
8											
9					2	TW					
10		*CONTINUED NEXT PAGE*									

(LOG TO BE READ IN CONJUNCTION WITH REPORT)

DEPTH SCALE
1 : 50

AECOM

LOGGED: BK
CHECKED: TA

AECOM_BH_001 60634622 - DYT3 OTTAWA 2022_04_12.GPJ GAL-MISS.GDT 22-10-11

PROJECT: DYT3 - Ottawa
LOCATION: 2625 Sheffield Rd
COORDINATES: N 5027916.8; E 452712.8
DATUM: Geodetic
AECOM PROJECT #: 60634622
CLIENT: Amazon Logistics

RECORD OF BOREHOLE: BH-S2/MW

START DATE: Mar 15, 2022
END DATE: Mar 15, 2022
BORING METHOD: 200 mm O.D. Hollow Stem Auger
CONTRACTOR: Canadian Environmental Drilling
PENETRATION TEST HAMMER, 64kg; DROP, 760mm
SAMPLER HAMMER, 64kg; DROP, 760mm

DEPTH SCALE (METRES)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: N VALUE	Dynamic Cone Penetration Testing (blows/0.3m) 20 40 60 80 / 100 200 300 400	SHEAR STRENGTH Cu, kPa (nat V. + Q ●, rem V. ⊕ U △) 20 40 60 80 / WATER CONTENT PERCENT Wp W WI 10 20 30 40	ADDITIONAL LAB. TESTING & GRAIN SIZE DISTRIBUTION (%)	WELL INSTALLATION AND WATER LEVELS
		CONTINUED FROM PREVIOUS PAGE								GR SA SI CL	
10		**SILTY CLAY:** trace gravel, some sand, brown to grey, moist to wet, very soft to stiff		56.33							
11	Coring	**SHALE BEDROCK:** Refer to RECORD OF DRILLHOLE: BH-S2/MW Highly weathered, grey, horizontal bedding, vertical and inclined open joints, clay infillng RUN 1 10.67-10.98 TCR=100%, SCR=42%, RQD=0%, FI=9 RUN 2 10.98-12.50 TCR=93%, SCR=27%, RQD=0%, FI=10 RUN 3 12.50-12.80 TCR=100%, SCR=13%, RQD=0%, FI=9		10.67							
12	Coring			54.20							
13		**END OF BOREHOLE** Notes: 1. This log is to be read with the subject report and project number as presented above. 2. Interpretation assistance by AECOM is required for projects excluding the above mentioned project. 3. No abnormal odour or staining was observed unless otherwise indicated. 4. The groundwater was observed at the depth of 4.27 mbgs in the open hole. 5. The monitoring well was installed upon the completion of drilling.		12.80							
14											
15											
16											
17											
18											
19											
20											

(LOG TO BE READ IN CONJUNCTION WITH REPORT)

DEPTH SCALE
1 : 50

AECOM

LOGGED: BK
CHECKED: TA

PROJECT: DYT3 - Ottawa
LOCATION: 2625 Sheffield Rd
COORDINATES: N 5027916.8; E 452712.8
DATUM: Geodetic
AECOM PROJECT #: 60634622
CLIENT: Amazon Logistics

RECORD OF DRILLHOLE: BH-S2/MW

START DATE: Mar 15, 2022
END DATE: Mar 15, 2022
DRILLING METHOD:
CONTRACTOR: Canadian Environmental Drilling

INCLINATION: -90° AZIMUTH: ---

FR/FX-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	COLOUR % RETURN / FLUSH	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.3	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY K, cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)	WELL INSTALLATION AND WATER LEVELS
		ASPHALT		56.33												
11		Highly weathered, grey, horizontal bedding, open joints, clay infillng **SHALE**		10.67 / 56.02	1										2 / 4 / 6	16.2
		45° inclinded joints and vertical joints		10.98	2											10.3
12				54.50												
				12.50 / 54.20	3											
13		**END OF BOREHOLE**		12.80												
		Notes: 1. This log is to be read with the subject report and project number as presented above. 2. Interpretation assistance by AECOM is required for projects excluding the above mentioned project. 3. No abnormal odour or staining was observed unless otherwise indicated. 4. The groundwater was observed at the depth of 4.27 mbgs in the open hole. 5. The monitoring well was installed upon the completion of drilling.														
14																
15																
16																
17																
18																
19																
20																

DEPTH SCALE
1 : 50

AECOM

LOGGED: BK
CHECKED: TA

PROJECT: DYT3 - Ottawa
LOCATION: 2625 Sheffield Rd
COORDINATES: N 5028091.4; E 452590.1
DATUM: Geodetic
AECOM PROJECT #: 60634622
CLIENT: Amazon Logistics

RECORD OF BOREHOLE: DCPT-1

SHEET 1 OF 1

START DATE: Mar 14, 2022
END DATE: Mar 14, 2022
BORING METHOD: 50.8 mm diameter CPT
CONTRACTOR: Canadian Environmental Drilling

PENETRATION TEST HAMMER, 64kg; DROP, 760mm
SAMPLER HAMMER, 64kg; DROP, 760mm

DEPTH SCALE (METRES)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: N VALUE	Dynamic Cone Penetration Testing (blows/0.3m) 20 40 60 80 / 100 200 300 400	SHEAR STRENGTH Cu, kPa (nat V. + Q ●, rem V. ⊕ U △) 20 40 60 80 / WATER CONTENT PERCENT Wp w Wl 10 20 30 40	ADDITIONAL LAB. TESTING & GRAIN SIZE DISTRIBUTION (%)	WELL INSTALLATION AND WATER LEVELS
		PAVEMENT		67.00						GR SA SI CL	
0	Dynamic Cone Penetration Testing 50.8 mm diameter CPT	**ASPHALT:** 50 mm thick									
1								150			
2											
3											
4											▽ 2022.03.14
5											
6											
7											
8											
9								215			
10		**END OF BOREHOLE**		9.75							
11		Notes:									
12		1. This log is to be read with the subject report and project number as presented above.									
13		2. Interpretation assistance by AECOM is required for projects excluding the above mentioned project.									
14		3. No abnormal odour or staining was observed unless otherwise indicated.									
15		4. The groundwater was obeserved at the depth of 4.27 mbgs in the open hole.									

(LOG TO BE READ IN CONJUNCTION WITH REPORT)

DEPTH SCALE
1 : 75

AECOM

LOGGED: BK
CHECKED: TA

AECOM_BH_001 60634622 - DYT3 OTTAWA 2022_04_12.GPJ GAL-MISS.GDT 22-10-11

PROJECT: DYT3 - Ottawa
LOCATION: 2625 Sheffield Rd
COORDINATES: N 5028025.2; E 452766.4
DATUM: Geodetic
AECOM PROJECT #: 60634622
CLIENT: Amazon Logistics

RECORD OF BOREHOLE: DCPT-2

SHEET 1 OF 1

START DATE: Mar 14, 2022
END DATE: Mar 14, 2022
BORING METHOD: 50.8 mm diameter CPT
CONTRACTOR: Canadian Environmental Drilling

PENETRATION TEST HAMMER, 64kg; DROP, 760mm
SAMPLER HAMMER, 64kg; DROP, 760mm

DEPTH SCALE (METRES)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER / TYPE / N VALUE	Dynamic Cone Penetration Testing (blows/0.3m)	SHEAR STRENGTH Cu, kPa (nat V. - + Q - ●, rem V. - ⊕ U - △) / WATER CONTENT PERCENT (Wp, w, Wl)	ADDITIONAL LAB. TESTING & GRAIN SIZE DISTRIBUTION (%)	WELL INSTALLATION AND WATER LEVELS
		PAVEMENT		67.50		20 40 60 80 / 100 200 300 400	20 40 60 80 / Wp w Wl 10 20 30 40	GR SA SI CL	
0	Dynamic Cone Penetration Testing 50.8 mm diameter CPT	**ASPHALT:** 40 mm thick							
1									
2									
3									
4									▽ 2022.03.14
5									
6									
7									
8									
9									
10						117 / 200			
11		**END OF BOREHOLE**		10.67					
12		Notes: 1. This log is to be read with the subject report and project number as presented above. 2. Interpretation assistance by AECOM is required for projects excluding the above mentioned project. 3. No abnormal odour or staining was observed unless otherwise indicated. 4. The groundwater was observed at the depth of 4.57 mbgs in the open hole.							
13									
14									
15									

(LOG TO BE READ IN CONJUNCTION WITH REPORT)

DEPTH SCALE
1 : 75

AECOM

LOGGED: BK
CHECKED: TA

AECOM_BH_001 60634622 - DYT3 OTTAWA 2022_04_12.GPJ GAL-MISS.GDT 22-10-11

Appendix B Laboratory Results

AECOM CANADA LTD.

MOISTURE CONTENT DETERMINATION

CLIENT	AECOM	DATE	March 28, 2022
PROJECT NUMBER	60634622	TESTED BY	SAM/DHARMIK
PROJECT NAME	DYT3	REVIEWED BY	Ramana M
LOCATION	2625 Sheffield Rd, Ottawa, ON		

				Observations			Formula		
Borehole Name	Sample Id	Depth (feet)	Can Id	Weight of Empty Can (g) W_1	Weight of Wet Soil + Can (g) W_2	Weight of Dry Soil + Can (g) W_3	Weight of Water (g) $W_w = (W_2-W_3)$	Weight of Dry soil (g) $W_s = (W_3-W_1)$	Moisture Content (%) $w = (W_w/W_s)*100$
S1MW	SS1		114	13.40	71.64	66.49	5.15	53.09	9.70
	SS2		174	13.66	83.21	78.18	5.03	64.52	7.80
	SS3		87	13.68	64.32	52.02	12.30	38.34	32.08
	SS4		148	13.47	58.60	46.23	12.37	32.76	37.76
	SS6		111	13.58	83.02	64.70	18.32	51.12	35.84
	SS7		105	13.85	95.34	87.63	7.71	73.78	10.45
	SS8		63	13.49	81.09	74.80	6.29	61.31	10.26
	SS9		132	13.72	69.74	62.13	7.61	48.41	15.72
S2MW	SS1		82	13.47	72.24	70.18	2.06	56.71	3.63
	SS2		161	13.48	86.74	75.35	11.39	61.87	18.41
	SS3		173	13.45	82.40	69.36	13.04	55.91	23.32
	SS4		165	13.71	64.42	47.84	16.58	34.13	48.58
	SS5		134	13.69	74.97	53.78	21.19	40.09	52.86
	SS6		181	13.60	91.34	62.39	28.95	48.79	59.34
	SS8		144	13.66	102.50	84.24	18.26	70.58	25.87
S1MW	TW1-1(TOP)	78'	56	13.56	39.96	32.26	7.70	18.70	41.18
	TW1-2	78'	106	13.51	75.01	70.41	4.60	56.90	8.08
S2MW	TW2(TOP)		116	13.74	111.35	95.93	15.42	82.19	18.76
	SS9		168	13.62	94.40	86.68	7.72	73.06	10.57

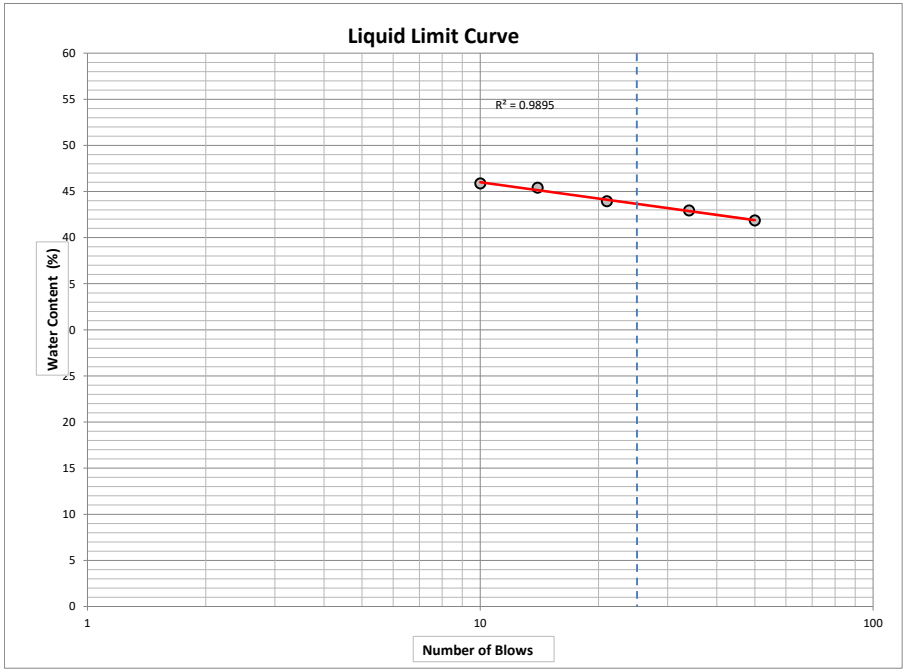
Total Samples	19

AECOM CANADA LTD.

DETERMINATION OF LIQUID LIMIT

Client	AECOM	Project Number	60634662		Date	April 3, 2022	
Project Name	Sheffield Rd				Tested By	Ian P	
Location	Ottawa				Reviewed By	Ramana M	
Borehole Number	S1/MW	Sample Id	SS7	Depth (feet)	20-22	Lab Number	202204003S

Description	Formula	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6
Container Number		134	175	146	149	136	
Weight of Empty Container (g) W_1		13.69	13.68	13.77	13.64	13.83	
Weight of Container + Wet Soil (g) W_2		19.70	21.64	21.68	20.73	22.64	
Weight of Container + Dry Soil(g) W_3		17.81	19.21	19.21	18.60	20.04	
Weight of Water (g) W_w	$W_w = W_2 - W_3$	1.89	2.43	2.47	2.13	2.60	
Weight of Dry Soil (g) W_s	$W_s = W_3 - W_1$	4.12	5.53	5.44	4.96	6.21	
Water Content (%)	$w = (W_w / W_s) * 100$	45.87	43.94	45.40	42.94	41.87	
Number of Blows		10	21	14	34	50	
Liquid Limit (%) From Graph		43.7					



AECOM CANADA LTD.

DETERMINATION OF PLASTIC LIMIT

Client	AECOM	Project Number	60634662		Date	April 3, 2022	
Project Name	Sheffield Rd				Tested By	Ian P	
Location	Ottawa				Reviewed By	Ramana M	
Borehole Number	S1/MW	Sample Id	SS7	Depth (feet)	20-22	Lab Number	202204003S

Description	Formula	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6
Container Number		156	132	64			
Weight of Empty Container (g) W_1		13.41	13.70	13.48			
Weight of Container + Wet Soil (g) W_2		14.34	14.98	14.63			
Weight of Container + Dry Soil(g) W_3		14.14	14.70	14.38			
Weight of Water (g) W_w	$W_w = W_2 - W_3$	0.20	0.28	0.25			
Weight of Dry Soil (g) W_s	$W_s = W_3 - W_1$	0.73	1.00	0.90			
Plastic Limit (%)	$w = (W_w / W_s) * 100$	27.40	28.00	27.78			
Average Plastic Limit (%) w_P		27.73					

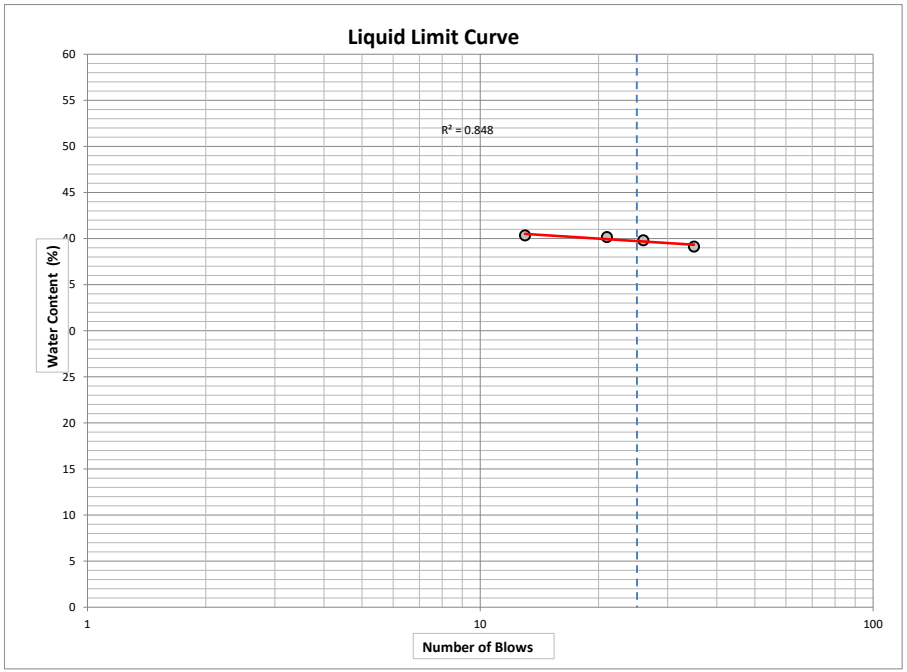
Result Summary	
Liquid Limit (%)	44
Plastic Limit (%)	28
Plasticity Index (%)	16
Sample status	Plastic

AECOM CANADA LTD.

DETERMINATION OF LIQUID LIMIT

Client	AECOM	Project Number	60634662		Date	April 3, 2022	
Project Name	Sheffield Rd				Tested By		
Location	Ottawa				Reviewed By	Ramana M	
Borehole Number	S2/MW	Sample Id	SS5	Depth (feet)	10-12	Lab Number	202204005S

Description	Formula	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6
Container Number		283	229	33	223		
Weight of Empty Container (g) W_1		12.40	12.40	12.00	12.50		
Weight of Container + Wet Soil (g) W_2		20.40	22.00	22.50	22.90		
Weight of Container + Dry Soil(g) W_3		18.10	19.30	19.51	19.92		
Weight of Water (g) W_w	$W_w = W_2 - W_3$	2.30	2.70	2.99	2.98		
Weight of Dry Soil (g) W_s	$W_s = W_3 - W_1$	5.70	6.90	7.51	7.42		
Water Content (%)	$w = (W_w / W_s) * 100$	40.35	39.13	39.81	40.16		
Number of Blows		13	35	26	21		
Liquid Limit (%) From Graph		39.7					



AECOM CANADA LTD.

DETERMINATION OF PLASTIC LIMIT

Client	AECOM	Project Number	60634662		Date	April 3, 2022	
Project Name	Sheffield Rd				Tested By	0	
Location	Ottawa				Reviewed By	Ramana M	
Borehole Number	S2/MW	Sample Id	SS5	Depth (feet)	10-12	Lab Number	202204005S

Description	Formula	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6
Container Number		196	255	22			
Weight of Empty Container (g) W_1		12.4	12.50	12.00			
Weight of Container + Wet Soil (g) W_2		19.6	19.30	20.30			
Weight of Container + Dry Soil(g) W_3		18.3	18.00	19.00			
Weight of Water (g) W_w	$W_w = W_2 - W_3$	1.30	1.30	1.30			
Weight of Dry Soil (g) W_s	$W_s = W_3 - W_1$	5.90	5.50	7.00			
Plastic Limit (%)	$w = (W_w / W_s) * 100$	22.03	23.64	18.57			
Average Plastic Limit (%) w_P		21.41					

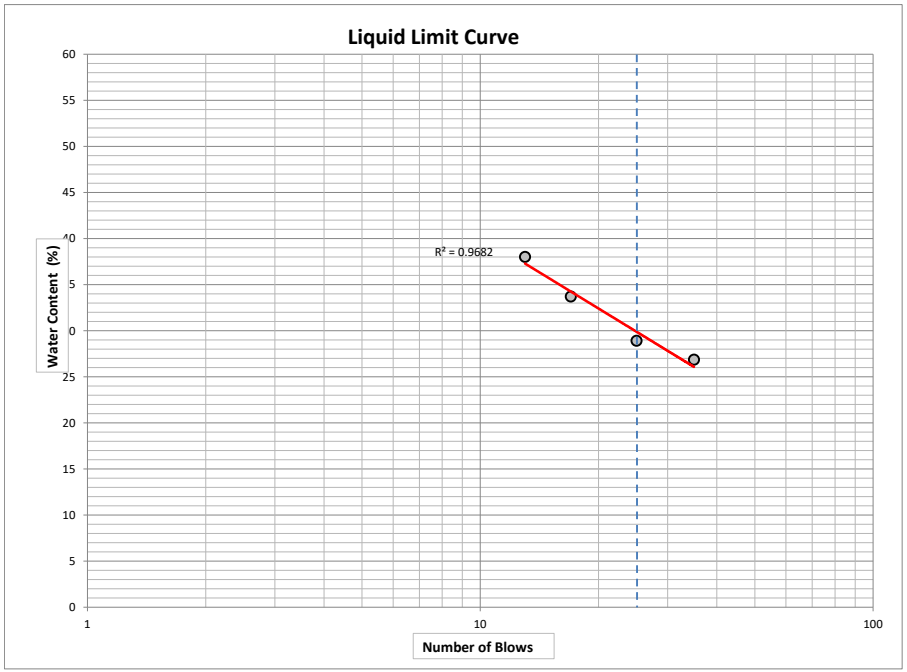
Result Summary	
Liquid Limit (%)	40
Plastic Limit (%)	21
Plasticity Index (%)	19
Sample status	Plastic

AECOM CANADA LTD.

DETERMINATION OF LIQUID LIMIT

Client	AECOM	Project Number	60634662		Date	April 3, 2022	
Project Name	Sheffield Rd				Tested By		
Location	Ottawa				Reviewed By	Ramana M	
Borehole Number	S2/MW	Sample Id	TW1/SS1	Depth (feet)		Lab Number	202204006S

Description	Formula	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6
Container Number		284	278	40	251		
Weight of Empty Container (g) W_1		12.41	12.40	12.00	12.40		
Weight of Container + Wet Soil (g) W_2		22.80	23.10	23.90	23.80		
Weight of Container + Dry Soil(g) W_3		20.60	20.70	20.90	20.66		
Weight of Water (g) W_w	$W_w = W_2 - W_3$	2.20	2.40	3.00	3.14		
Weight of Dry Soil (g) W_s	$W_s = W_3 - W_1$	8.19	8.30	8.90	8.26		
Water Content (%)	$w = (W_w / W_s) * 100$	26.86	28.92	33.71	38.01		
Number of Blows		35	25	17	13		
Liquid Limit (%) From Graph		29.9					



AECOM CANADA LTD.

DETERMINATION OF PLASTIC LIMIT

Client	AECOM	Project Number	60634662		Date	April 3, 2022	
Project Name	Sheffield Rd				Tested By	0	
Location	Ottawa				Reviewed By	Ramana M	
Borehole Number	S2/MW	Sample Id	TW1/SS1	Depth (feet)	0	Lab Number	202204006S

Description	Formula	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6
Container Number		214	18	293			
Weight of Empty Container (g) W_1		12.4	11.90	12.40			
Weight of Container + Wet Soil (g) W_2		20.4	18.90	20.00			
Weight of Container + Dry Soil(g) W_3		19.12	17.78	18.79			
Weight of Water (g) W_w	$W_w = W_2 - W_3$	1.28	1.12	1.21			
Weight of Dry Soil (g) W_s	$W_s = W_3 - W_1$	6.72	5.88	6.39			
Plastic Limit (%)	$w = (W_w / W_s) * 100$	19.05	19.05	18.94			
Average Plastic Limit (%) w_P		19.01					

Result Summary	
Liquid Limit (%)	30
Plastic Limit (%)	19
Plasticity Index (%)	11
Sample status	Plastic

AECOM CANADA LTD.

Client	AECOM	**Borehole No**	S1/MW	**Lab No**	202204001S
Project Number	60634622	**Sample ID**	SS2	**Date**	April 1, 2022
Project Name	Sheffield Rd			**Depth (Feet)**	2.5-5
Location	Ottawa			**Tested by**	SAM
Soil Classification	Silty Sand, some gravel (SM)			**Reviewed by**	Ramana M

Total Sample Mass (A) g	134.8	**% Coarse Aggregate (D)**	17.7	**% Fine Aggregate (E)**	82.3

COARSE AGGREGATE

Sieve (mm)	Individual Mass Retained (g)	Cumultive Mass Retained (g) [X]	Coarse Aggegate Portion Only		% Passing (Total Sample
			% Retained	% Passing	
106				100.0	100.0
75.0				100.0	100.0
63.0				100.0	100.0
53.0				100.0	100.0
37.5				100.0	100.0
26.5				100.0	100.0
22.4				100.0	100.0
19.0				100.0	100.0
16.0				100.0	100.0
13.2	3.8	3.8	15.7	84.3	97.2
9.5	8.7	12.4	52.0	48.0	90.8
6.7	7.1	19.5	81.6	18.4	85.5
4.75	4.4	23.9	100.0		82.3
Pan	109.9	Pan + [B]	Mass Passing 4.75 mm (g) [C = A-B]		110.9

FINE AGGREGATE

Sample Mass before washing (g) [F]	109.9	Mass passing 75 µm sieve by washing (g)	32.77
Sample Mass after washing (g)	77.13	Mass passing 75 µm sieve by sieving (g)	0.65

Sieve (mm)	Cumultive Mass Retained (g) [Y]	Fine Aggregate Portion Only		% Passing (Total Sample
		% Retained	% Passing	
4.75			100.0	82.27
2.36	13.7	12.5	87.5	72.01
1.18	33.33	30.3	69.7	57.32
0.600	50.56	46.0	54.0	44.42
0.425	57.17	52.0	48.0	39.47
0.300	63.19	57.5	42.5	34.97
0.150	71.02	64.6	35.4	29.11
0.075	76.48	69.6	30.4	25.02
Pan	0.65	Total Mass passing 75 µm sieve (g)	33.42	

Calculations:

D = (B/A) * 100
E= (C/A) * 100

Coarse Aggregate Portion:
% Retained =(X/B) * 100
% Passing = ((B-X) /B) * 100

Fine Aggregate Portion:
% Retained =(Y/F) * 100
% Passing = ((F-Y) /F) * 100

Total Mass Calculations

% Retained on Coarse Aggregate Sieves = (X/A) * 100

% Retained on Fine Aggregate Sieves = (Y/F) * E + % Ret. 4.75

% Passing Coarse Aggregate Sieves = ((A -X)/A)) * 100

% Passing on Fine Aggregate Sieves = ((F - Y)/F) * E

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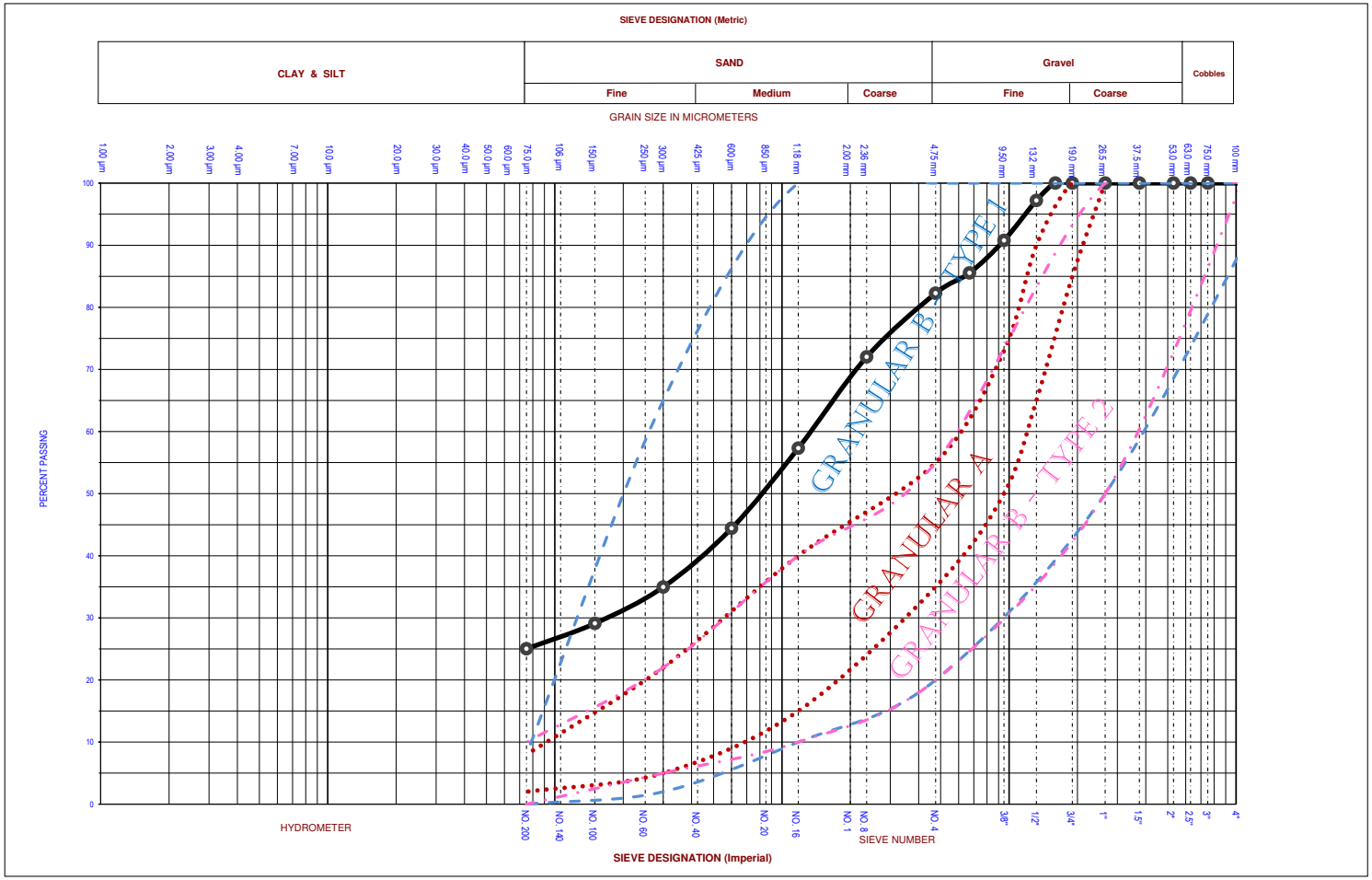

GRAIN SIZE DISTRIBUTION CURVE (SIEVE AND HYDROMETER ANALYSIS)

AECOM CANADA LTD. 83 Galaxy Blvd, Unit 6 Toronto, Ontario			Client		AECOM			Date	April 1, 2022		Project Number		60634622		
			Borehole No / Sample Id		S1/MW SS2			Depth (feet)	2.5-5		Lab No		202204001S		
			Project Name		Sheffield Rd						Project Location		Ottawa		
			Soil Classification		Silty Sand, some gravel (SM)						Figure No:				
Gravel(%)	18	Sand(%)	57	Fines(%)	25	D_{60} (mm)	1.395	D_{30} (mm)	0.173	D_{10} (mm)	N/A	C_U	N/A	C_c	N/A

AECOM CANADA LTD.

Client	AECOM	**Borehole No**	S2/MW	**Lab No**	202204004S
Project Number	60634622	**Sample ID**	SS2	**Date**	April 1, 2022
Project Name	Sheffield Rd			**Depth (Feet)**	2.5-5
Location	Ottawa			**Tested by**	SAM
Soil Classification	Silty Sand, trace gravel (SM)			**Reviewed by**	

Total Sample Mass (A) g	475.5	**% Coarse Aggregate (D)**	10.9	**% Fine Aggregate (E)**	89.1

COARSE AGGREGATE

Sieve (mm)	Individual Mass Retained (g)	Cumultive Mass Retained (g) [X]	Coarse Aggegate Portion Only		% Passing (Total Sample
			% Retained	% Passing	
106				100.0	100.0
75.0				100.0	100.0
63.0				100.0	100.0
53.0				100.0	100.0
37.5				100.0	100.0
26.5				100.0	100.0
22.4				100.0	100.0
19.0				100.0	100.0
16.0	5.9	5.9	11.3	88.7	98.8
13.2	9.1	14.9	28.8	71.2	96.9
9.5	12.4	27.4	52.9	47.1	94.2
6.7	10.0	37.4	72.1	27.9	92.1
4.75	14.4	51.8	100.0		89.1
Pan	423.1	Pan + [B]	Mass Passing 4.75 mm (g) [C = A-B]		423.72

FINE AGGREGATE

Sample Mass before washing (g) [F]	210.5	Mass passing 75 µm sieve by washing (g)	53
Sample Mass after washing (g)	157.5	Mass passing 75 µm sieve by sieving (g)	8.8

Sieve (mm)	Cumultive Mass Retained (g) [Y]	Fine Aggregate Portion Only		% Passing (Total Sample
		% Retained	% Passing	
4.75			100.0	89.11
2.36	8.09	3.8	96.2	85.69
1.18	16.08	7.6	92.4	82.30
0.600	23.7	11.3	88.7	79.08
0.425	30.03	14.3	85.7	76.40
0.300	42.42	20.2	79.8	71.15
0.150	105.36	50.1	49.9	44.51
0.075	148.7	70.6	29.4	26.16
Pan	8.8	Total Mass passing 75 µm sieve (g)	61.8	

Calculations:

D = (B/A) * 100
E= (C/A) * 100

Coarse Aggregate Portion:
% Retained =(X/B) * 100
% Passing = ((B-X) /B) * 100

Fine Aggregate Portion:
% Retained =(Y/F) * 100
% Passing = ((F-Y) /F) * 100

Total Mass Calculations

% Retained on Coarse Aggregate Sieves = (X/A) * 100

% Retained on Fine Aggregate Sieves = (Y/F) * E + % Ret. 4.75

% Passing Coarse Aggregate Sieves = ((A -X)/A)) * 100

% Passing on Fine Aggregate Sieves = ((F - Y)/F) * E

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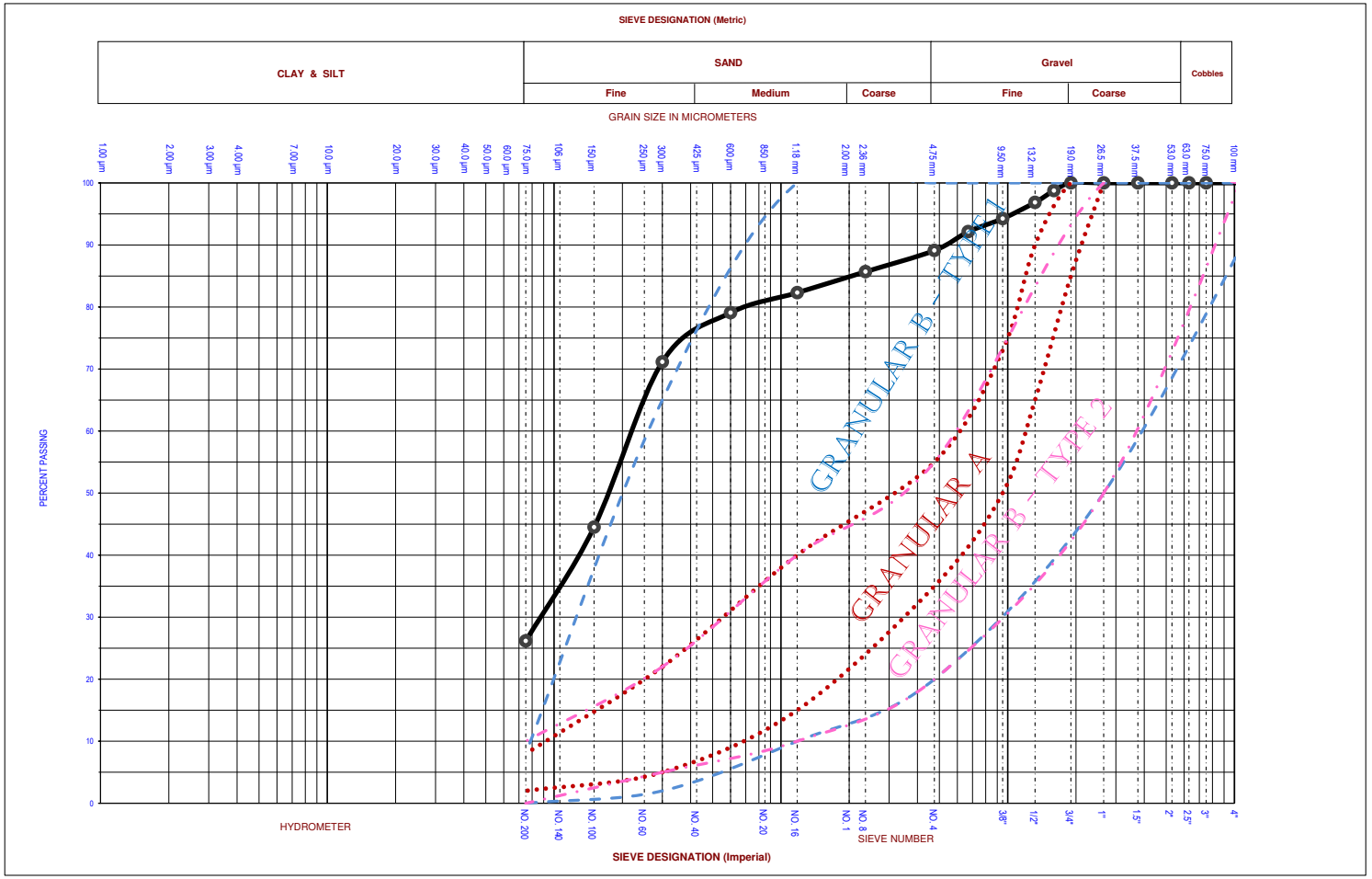

GRAIN SIZE DISTRIBUTION CURVE (SIEVE AND HYDROMETER ANALYSIS)

AECOM CANADA LTD. 83 Galaxy Blvd, Unit 6 Toronto, Ontario			Client		AECOM			Date	April 1, 2022		Project Number		60634622		
			Borehole No / Sample Id		S2/MW	SS2		Depth (feet)	2.5-5		Lab No		202204004S		
			Project Name		Sheffield Rd						Project Location		Ottawa		
			Soil Classification		Silty Sand, trace gravel (SM)						Figure No:				
Gravel(%)	11	Sand(%)	63	Fines(%)	26	D_{60} (mm)	0.237	D_{30} (mm)	0.091	D_{10} (mm)	N/A	C_U	N/A	C_c	N/A

AECOM CANADA LTD.

Hydrometer Analysis

Lab No	202204002S	Borehole No	S1/MW	Tested by	IP/SAM/DHARMIK
Project Name	DYT3	Sample Id	SS4	Reviewed by	Ramana M
Project Number	60634622	Depth (feet)		Date	
Location	OTTAWA	Soil Classification	Lean Clay, trace sand (CL)		

Soil Hydrometer Used		
151 H SN#	993585	○
	115105	◉

Soil Information

Liquid Limit	(LL)		
Plasticity Index	(PI)		
Specific Gravity of Soil	(Gs)	2.70	
Specific Gravity of Water	(Gw)	1	
Sg Correction Factor	(α)	0.989	
Total Mass of sample		197.8	g
Soil Particles Greater Than This Are Excluded From Graph		9.50	mm

Hydrometer Details

Volume of Bulb	(V_B)	61.1	cm^3
Length of Bulb	(L_2)	14.44	cm
Length from '1.0' reading to top of Bulb	(Ls)	10.17	cm
Scale Dimension	(hs)	0.27	cm/Div
Cross-sectional Area of Cylinder	(A)	28.3535	cm^2
Meniscus Correction	(Hm)	0.0005	Divisions

Calculation of Dry Soil Mass

Oven Dried Mass	(Wo)	30.48	g
Air Dried Mass	(Wa)	30.55	g
Hygroscopic Corr Factor	(F)	0.998	
Air Dried Mass in Analysis	(Ma)	50	g
Oven Dried Mass in Analysis	(Mo)	49.9	g
% Passing 2.0 mm Sieve	(P10)	99.8	
Sample Represented	(W)	50.0	g

Sieve Analysis of Retained on 2.0 mm Sieve (M2)

Sieve Size (mm)	Cummulative Mass Retained (g)	Mass Passing (g)	% Passing
75.0			
63.0			
53.0			
37.5			
26.5			
19.0			
13.2			
9.5			
4.75	0.0	197.8	100.0
2.0	0.4	197.4	99.8

Sieve Analysis of Hydrometer Material (M7)

Sieve Size (mm)	Comulative Mass Retained (g)	Mass Passing (g)	% Passing
2.00	0.0	49.9	99.8
0.850	0.1	49.8	99.7
0.425	0.2	49.7	99.4
0.25	0.4	49.5	99.1
0.106	0.7	49.2	98.4
0.075	0.8	49.0	98.1
Pass 0.075	0.0		

Percent In Suspension (P) as per Section 14.3 of ASTM D 422

P = [(100000/W) * (Gs/(Gs -Gw))] * (R - Gw) in percent (for Soil Hydrometer 151 H)

Where R = Corrected Hydrometer Reading = Hs - Hc

Hs = Actual Hydrometer Reading
Hc= Composite Correction to be determined as per Section 7 of ASTM D 422

Diameter of Soil Particles (D) as per Section 15 of ASTM D 422

D = SQRT of {[(30*η)/(980*(Gs-Gw)] * (L/T)} in mm

Where η= Viscosity of suspending Medium (Water) in poises
L = Effective Depth = L1+ 0.5*[L_2 - V_B /A)] in cm
L1 = distance from the top of the bulb to Recorded Hydrometer Reading in cm
T = Time in minutes

Date	Time	Elaspsed Time (minutes)	Hs in Divisions	Hc in Divisions	Temp Tc in C	R=Hs-Hc	P in %	L in cm	η in Poise	K	D in mm
1-Jan-00	10:34:00 AM	1.0	1.0335	0.0030	26.1	1.0305	96.9	7.36	8.75559	0.0125568	0.0341
	10:35:00 AM	2.0	1.0330	0.0030	26.1	1.0300	95.3	7.49	8.75559	0.0125568	0.0243
	10:38:00 AM	5.0	1.0320	0.0030	26.1	1.0290	92.2	7.76	8.75559	0.0125568	0.0156
	10:48:00 AM	15.0	1.0310	0.0030	26.0	1.0280	89.0	8.03	8.77493	0.01257066	0.0092
	11:03:00 AM	30.0	1.0300	0.0030	25.9	1.0270	85.8	8.30	8.79435	0.01258456	0.0066
	11:33:00 AM	60.0	1.0280	0.0030	25.8	1.0250	79.4	8.84	8.81384	0.0125985	0.0048
	2:43:00 PM	250.0	1.0235	0.0030	25.4	1.0205	65.1	10.06	8.89259	0.01265465	0.0025
2-Jan-00	10:33:00 AM	1440.0	1.0185	0.0030	20.8	1.0155	49.3	11.41	9.89606	0.01334957	0.0012

L1 cm	Viscosiity C	K (η/(Gs-1)
1.21	-0.522902	5.1503494
1.35	-0.522902	5.1503494
1.62	-0.522902	5.1503494
1.89	-0.520695	5.1617255
2.16	-0.518485	5.1731466
2.70	-0.516271	5.1846127
3.91	-0.507377	5.2309329
5.27	-0.400459	5.821213

Mass Retained on Seive # 10	40.5
Mass Passed Seive # 10	157.3
Jar Number	

Hygroscopic Data		
	Can Id	53
	Empty Can Weight (g)	13.43
	Can+ Air Dried Soil (g)	43.98
	Can + Oven Dried Soil (g)	43.91

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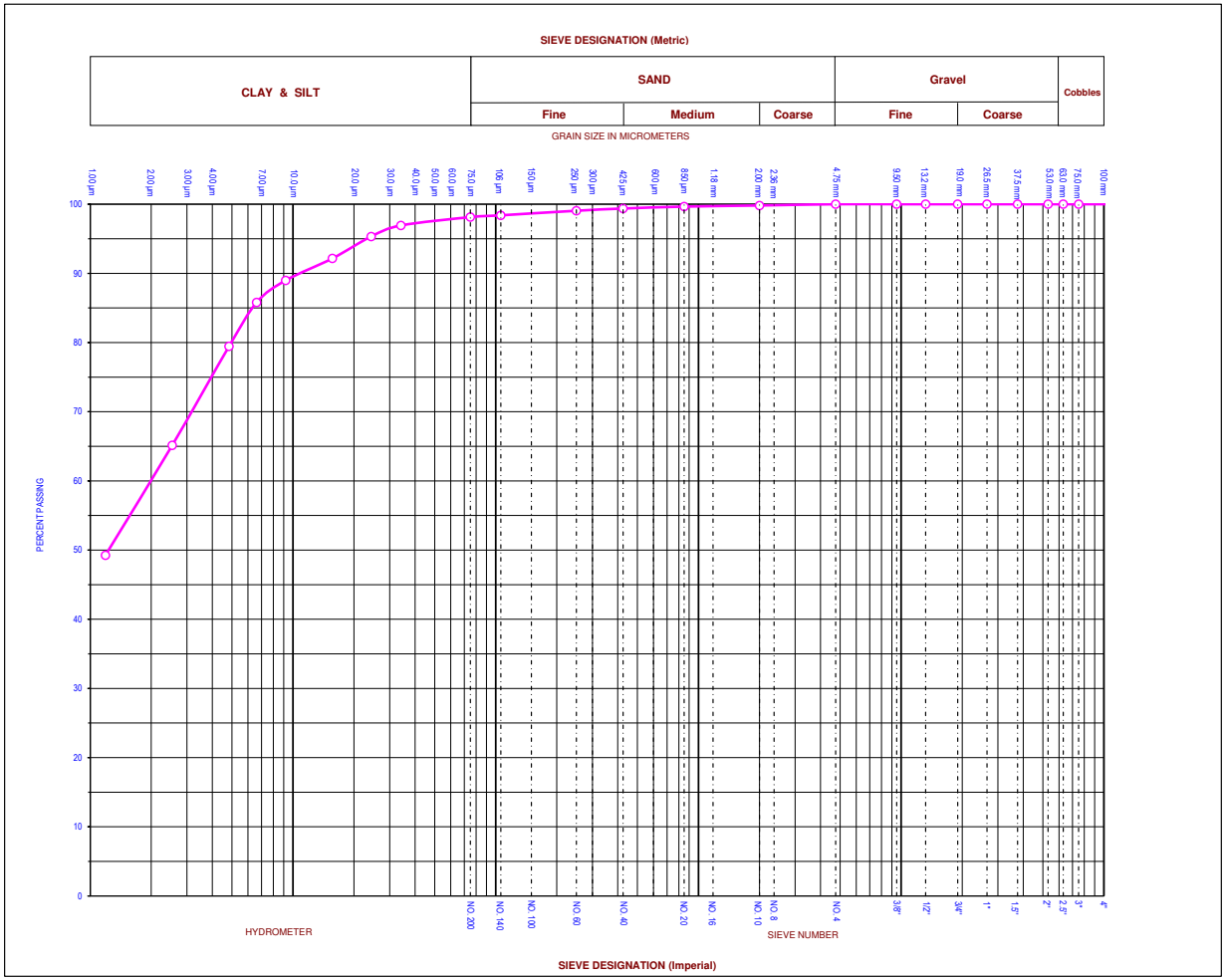

GRAIN SIZE DISTRIBUTION CURVE (SIEVE AND HYDROMETER ANALYSIS)

AECOM CANADA LTD. 83 Galaxy Blvd, Unit 6 Toronto, Ontario	Client	AECOM		Date	January 0, 1900		Project Number	60634622			Gravel (%)	0	
	Sample ID	S1/MW	SS4	Depth (feet)	0		Project Name	DYT3			Sand (%)	2	
	Lab Sample No:	202204002S					Project Location	OTTAWA			Silt (%)	39	
	Soil Classification	Lean Clay, trace sand (CL)									Clay (%)	59	
	Figure No.			D10	N/A	D30	N/A	D60	0.002	Cu	N/A	Cc	N/A

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Hydrometer Analysis

Lab No	202204003S	Borehole No	S1/MW	Tested by	IP/SAM/DHARMIK
Project Name	DYT3	Sample Id	SS7	Reviewed by	Ramana M
Project Number	60634622	Depth (feet)		Date	12-Apr-22
Location	OTTAWA	Soil Classification	Silty Sand, some clay, trace gravel (SM)		

Soil Hydrometer Used		
151 H SN#	993585	◉
	115105	○

Soil Information

Liquid Limit	(LL)		
Plasticity Index	(PI)		
Specific Gravity of Soil	(Gs)	2.70	
Specific Gravity of Water	(Gw)	1	
Sg Correction Factor	(α)	0.989	
Total Mass of sample		511.9	g
Soil Particles Greater Than This Are Excluded From Graph		9.50	mm

Hydrometer Details

Volume of Bulb	(V_B)	63.1	cm^3
Length of Bulb	(L_2)	14.15	cm
Length from '1.0' reading to top of Bulb	(Ls)	10.5	cm
Scale Dimension	(hs)	0.27	cm/Div
Cross-sectional Area of Cylinder	(A)	28.1351	cm^2
Meniscus Correction	(Hm)	0.0005	Divisions

Calculation of Dry Soil Mass

Oven Dried Mass	(Wo)	28.88	g
Air Dried Mass	(Wa)	29.07	g
Hygroscopic Corr Factor	(F)	0.993	
Air Dried Mass in Analysis	(Ma)	50	g
Oven Dried Mass in Analysis	(Mo)	49.7	g
% Passing 2.0 mm Sieve	(P10)	84.6	
Sample Represented	(W)	58.7	g

Sieve Analysis of Retained on 2.0 mm Sieve (M2)

Sieve Size (mm)	Cummulative Mass Retained (g)	Mass Passing (g)	% Passing
75.0			
63.0			
53.0			
37.5			
26.5			
19.0			
13.2			
9.5			
4.75	36.8	475.2	92.8
2.0	79.0	432.9	84.6

Sieve Analysis of Hydrometer Material (M7)

Sieve Size (mm)	Comulative Mass Retained (g)	Mass Passing (g)	% Passing
2.00	0.0	49.7	84.6
0.850	5.3	44.4	75.5
0.425	9.7	40.0	68.1
0.25	13.4	36.3	61.8
0.106	19.6	30.1	51.3
0.075	22.0	27.7	47.1
Pass 0.075	1.2		

Percent In Suspension (P) as per Section 14.3 of ASTM D 422

P = [(100000/W) * (Gs/(Gs -Gw))] * (R - Gw) in percent (for Soil Hydrometer 151 H)

Where R = Corrected Hydrometer Reading = Hs - Hc

Hs = Actual Hydrometer Reading
Hc= Composite Correction to be determined as per Section 7 of ASTM D 422

Diameter of Soil Particles (D) as per Section 15 of ASTM D 422

D = SQRT of {[(30*η)/(980*(Gs-Gw)] * (L/T)} in mm

Where η= Viscosity of suspending Medium (Water) in poises
L = Effective Depth = L1+ 0.5*[L_2 - V_B /A)] in cm
L1 = distance from the top of the bulb to Recorded Hydrometer Reading in cm
T = Time in minutes

Date	Time	Elaspsed Time (minutes)	Hs in Divisions	Hc in Divisions	Temp Tc in C	R=Hs-Hc	P in %	L in cm	η in Poise	K	D in mm
13-Apr-22	10:44:00 AM	1.0	1.0175	0.0030	25.7	1.0145	39.2	11.49	8.83341	0.01261248	0.0427
	10:45:00 AM	2.0	1.0160	0.0030	25.7	1.0130	35.1	11.89	8.83341	0.01261248	0.0308
	10:48:00 AM	5.0	1.0145	0.0030	25.7	1.0115	31.1	12.30	8.83341	0.01261248	0.0198
	10:58:00 AM	15.0	1.0130	0.0030	25.6	1.0100	27.0	12.70	8.85306	0.0126265	0.0116
	11:13:00 AM	30.0	1.0120	0.0030	25.7	1.0090	24.3	12.97	8.83341	0.01261248	0.0083
	11:43:00 AM	60.0	1.0110	0.0030	25.6	1.0080	21.6	13.24	8.85306	0.0126265	0.0059
	2:53:00 PM	250.0	1.0085	0.0030	25.8	1.0055	14.9	13.92	8.81384	0.0125985	0.0030
14-Apr-22	10:43:00 AM	1440.0	1.0080	0.0030	20.7	1.0050	13.5	14.05	9.92007	0.01336576	0.0013

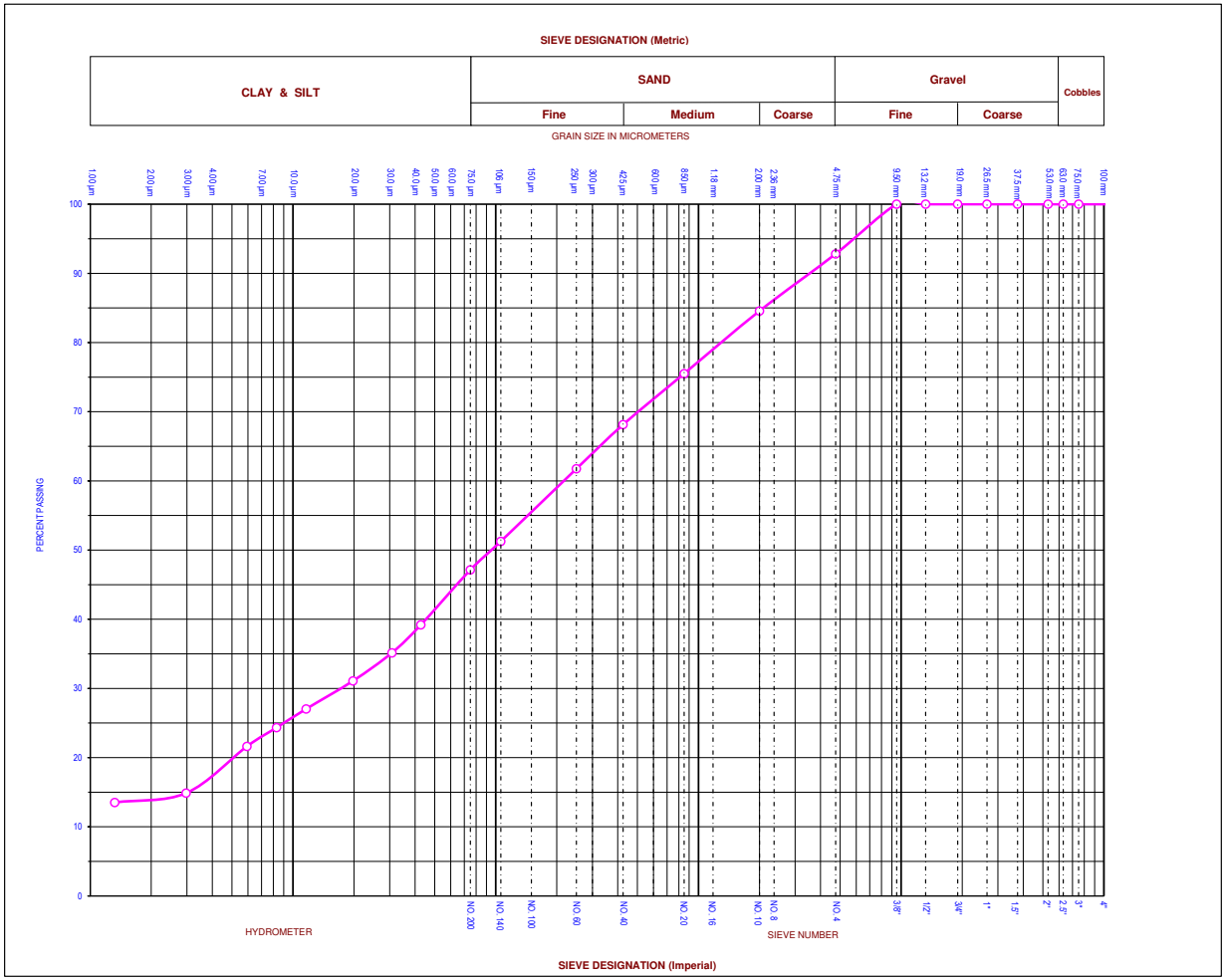
L1 cm	Viscosiity C	K (η/(Gs-1)
5.53	-0.514053	5.1961241
5.94	-0.514053	5.1961241
6.35	-0.514053	5.1961241
6.75	-0.511832	5.2076811
7.02	-0.514053	5.1961241
7.29	-0.511832	5.2076811
7.97	-0.516271	5.1846127
8.10	-0.398036	5.8353345

Mass Retained on Seive # 10	185.3
Mass Passed Seive # 10	326.6
Jar Number	

Hygroscopic Data		
	Can Id	55
	Empty Can Weight (g)	13.33
	Can+ Air Dried Soil (g)	42.40
	Can + Oven Dried Soil (g)	42.21

AECOM Canada Ltd.

UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION CURVE (SIEVE AND HYDROMETER ANALYSIS)

AECOM CANADA LTD. 83 Galaxy Blvd, Unit 6 Toronto, Ontario	Client	AECOM		Date	April 12, 2022		Project Number	60634622		Gravel (%)	7
	Sample ID	S1/MW	SS7	Depth (feet)	0		Project Name	DYT3		Sand (%)	46
	Lab Sample No:	202204003S					Project Location	OTTAWA		Silt (%)	33
	Soil Classification	Silty Sand, some clay, trace gravel (SM)								Clay (%)	14
	Figure No.			D10	N/A	D30	0.018	D60	0.226	Cu	N/A	Cc	N/A

AECOM CANADA LTD.

Hydrometer Analysis

Lab No	202204005S	Borehole No	S2MW	Tested by	IP/SAM/DHARMIK
Project Name	DYT3	Sample Id	SS5	Reviewed by	Ramana M
Project Number	60634622	Depth (feet)	10-12	Date	01-Apr-22
Location	OTTAWA	Soil Classification	Lean Clay, traace sand, trace gravel (CL)		

Soil Hydrometer Used		
151 H SN#	993585	○
	115105	◉

Soil Information

Liquid Limit	(LL)		
Plasticity Index	(PI)		
Specific Gravity of Soil	(Gs)	2.70	
Specific Gravity of Water	(Gw)	1	
Sg Correction Factor	(α)	0.989	
Total Mass of sample		297.4	g
Soil Particles Greater Than This Are Excluded From Graph		9.50	mm

Hydrometer Details

Volume of Bulb	(V_B)	61.1	cm^3
Length of Bulb	(L_2)	14.44	cm
Length from '1.0' reading to top of Bulb	(Ls)	10.17	cm
Scale Dimension	(hs)	0.27	cm/Div
Cross-sectional Area of Cylinder	(A)	28.3535	cm^2
Meniscus Correction	(Hm)	0.0005	Divisions

Calculation of Dry Soil Mass

Oven Dried Mass	(Wo)	22.18	g
Air Dried Mass	(Wa)	22.5	g
Hygroscopic Corr Factor	(F)	0.986	
Air Dried Mass in Analysis	(Ma)	50	g
Oven Dried Mass in Analysis	(Mo)	49.3	g
% Passing 2.0 mm Sieve	(P10)	98.4	
Sample Represented	(W)	50.1	g

Sieve Analysis of Retained on 2.0 mm Sieve (M2)

Sieve Size (mm)	Cummulative Mass Retained (g)	Mass Passing (g)	% Passing
75.0			
63.0			
53.0			
37.5			
26.5			
19.0			
13.2			
9.5			
4.75	2.1	295.4	99.3
2.0	4.8	292.6	98.4

Sieve Analysis of Hydrometer Material (M7)

Sieve Size (mm)	Comulative Mass Retained (g)	Mass Passing (g)	% Passing
2.00	0.0	49.3	98.4
0.850	0.4	48.9	97.6
0.425	0.7	48.6	97.0
0.25	1.2	48.1	96.1
0.106	2.4	46.9	93.6
0.075	4.2	45.1	90.0
Pass 0.075	1.4		

Percent In Suspension (P) as per Section 14.3 of ASTM D 422

P = [(100000/W) * (Gs/(Gs -Gw))] * (R - Gw) in percent (for Soil Hydrometer 151 H)

Where R = Corrected Hydrometer Reading = Hs - Hc

Hs = Actual Hydrometer Reading
Hc= Composite Correction to be determined as per Section 7 of ASTM D 422

Diameter of Soil Particles (D) as per Section 15 of ASTM D 422

D = SQRT of {[(30*η)/(980*(Gs-Gw)] * (L/T)} in mm

Where η= Viscosity of suspending Medium (Water) in poises
L = Effective Depth = L1+ 0.5*[L_2 - V_B /A)] in cm
L1 = distance from the top of the bulb to Recorded Hydrometer Reading in cm
T = Time in minutes

Date	Time	Elaspsed Time (minutes)	Hs in Divisions	Hc in Divisions	Temp Tc in C	R=Hs-Hc	P in %	L in cm	η in Poise	K	D in mm
2-Apr-22	10:55:00 AM	1.0	1.0290	0.0030	26.1	1.0260	82.4	8.57	8.75559	0.0125568	0.0368
	10:56:00 AM	2.0	1.0280	0.0030	26.1	1.0250	79.3	8.84	8.75559	0.0125568	0.0264
	10:59:00 AM	5.0	1.0265	0.0030	26.1	1.0235	74.5	9.25	8.75559	0.0125568	0.0171
	11:09:00 AM	15.0	1.0250	0.0030	26.0	1.0220	69.8	9.65	8.77493	0.01257066	0.0101
	11:24:00 AM	30.0	1.0240	0.0030	25.9	1.0210	66.6	9.92	8.79435	0.01258456	0.0072
	11:54:00 AM	60.0	1.0230	0.0030	25.8	1.0200	63.4	10.19	8.81384	0.0125985	0.0052
	3:04:00 PM	250.0	1.0190	0.0030	25.7	1.0160	50.7	11.27	8.83341	0.01261248	0.0027
3-Apr-22	10:54:00 AM	1440.0	1.0160	0.0030	20.6	1.0130	41.2	12.08	9.94418	0.01338199	0.0012

L1 cm	Viscosiity C	K (η/(Gs-1)
2.43	-0.522902	5.1503494
2.70	-0.522902	5.1503494
3.11	-0.522902	5.1503494
3.51	-0.520695	5.1617255
3.78	-0.518485	5.1731466
4.05	-0.516271	5.1846127
5.13	-0.514053	5.1961241
5.94	-0.395608	5.8495155

Mass Retained on Seive # 10	76.3
Mass Passed Seive # 10	221.1
Jar Number	

Hygroscopic Data		
	Can Id	146
	Empty Can Weight (g)	13.80
	Can+ Air Dried Soil (g)	36.30
	Can + Oven Dried Soil (g)	35.98

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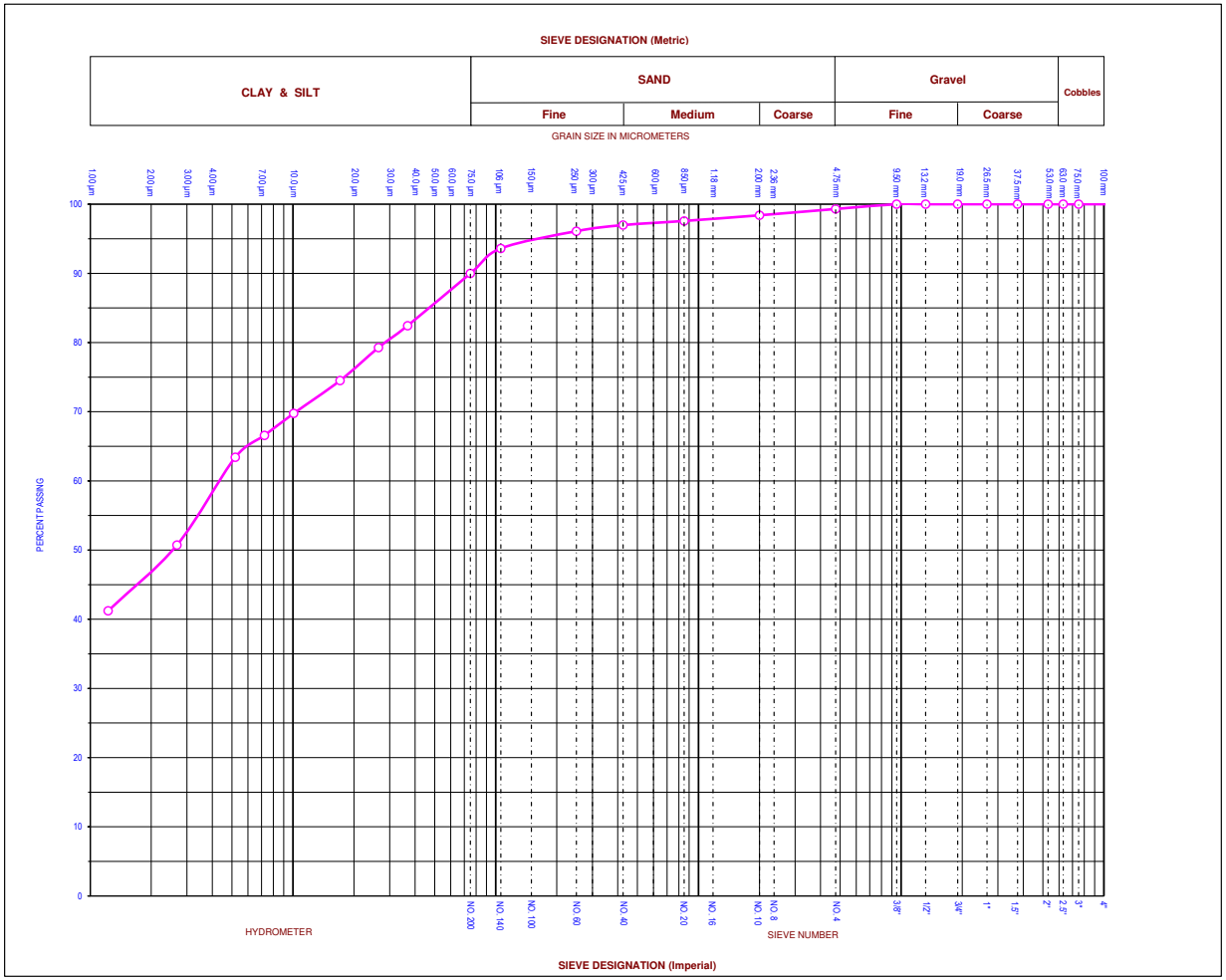


GRAIN SIZE DISTRIBUTION CURVE (SIEVE AND HYDROMETER ANALYSIS)

AECOM CANADA LTD. 83 Galaxy Blvd, Unit 6 Toronto, Ontario	Client	AECOM		Date	April 1, 2022		Project Number	60634622			Gravel (%)	1
	Sample ID	S2MW	SS5	Depth (feet)	10-12		Project Name	DYT3			Sand (%)	9
	Lab Sample No:	202204005S					Project Location	OTTAWA			Silt (%)	44
	Soil Classification	Lean Clay, traace sand, trace gravel (CL)									Clay (%)	46
	Figure No.			D10	N/A	D30	N/A	D60	0.005	Cu	N/A	Cc	N/A

AECOM CANADA LTD.

Hydrometer Analysis

Lab No	202204006S	Borehole No	S2MW	Tested by	IP/SAM/DHARMIK
Project Name	DYT3	Sample Id	TW1 SS1	Reviewed by	Ramana M
Project Number	60634622	Depth (feet)		Date	01-Apr-22
Location	OTTAWA	Soil Classification	Lean Clay, trace sand (CL)		

Soil Hydrometer Used		
151 H SN#	993585	○
	115105	◉

Soil Information

Liquid Limit	(LL)		
Plasticity Index	(PI)		
Specific Gravity of Soil	(Gs)	2.70	
Specific Gravity of Water	(Gw)	1	
Sg Correction Factor	(α)	0.989	
Total Mass of sample		297.2	g
Soil Particles Greater Than This Are Excluded From Graph		9.50	mm

Hydrometer Details

Volume of Bulb	(V_B)	61.1	cm^3
Length of Bulb	(L_2)	14.44	cm
Length from '1.0' reading to top of Bulb	(Ls)	10.17	cm
Scale Dimension	(hs)	0.27	cm/Div
Cross-sectional Area of Cylinder	(A)	28.3535	cm^2
Meniscus Correction	(Hm)	0.0005	Divisions

Calculation of Dry Soil Mass

Oven Dried Mass	(Wo)	18.58	g
Air Dried Mass	(Wa)	18.7	g
Hygroscopic Corr Factor	(F)	0.994	
Air Dried Mass in Analysis	(Ma)	50	g
Oven Dried Mass in Analysis	(Mo)	49.7	g
% Passing 2.0 mm Sieve	(P10)	100.0	
Sample Represented	(W)	49.7	g

Sieve Analysis of Retained on 2.0 mm Sieve (M2)

Sieve Size (mm)	Cummulative Mass Retained (g)	Mass Passing (g)	% Passing
75.0			
63.0			
53.0			
37.5			
26.5			
19.0			
13.2			
9.5			
4.75	0.0	297.2	100.0
2.0	0.0	297.2	100.0

Sieve Analysis of Hydrometer Material (M7)

Sieve Size (mm)	Comulative Mass Retained (g)	Mass Passing (g)	% Passing
2.00	0.0	49.7	100.0
0.850	0.1	49.6	99.9
0.425	0.1	49.6	99.8
0.25	0.1	49.5	99.7
0.106	0.2	49.5	99.6
0.075	0.3	49.4	99.5
Pass 0.075	0.0		

Percent In Suspension (P) as per Section 14.3 of ASTM D 422

P = [(100000/W) * (Gs/(Gs -Gw))] * (R - Gw) in percent (for Soil Hydrometer 151 H)

Where R = Corrected Hydrometer Reading = Hs - Hc

Hs = Actual Hydrometer Reading
Hc= Composite Correction to be determined as per Section 7 of ASTM D 422

Diameter of Soil Particles (D) as per Section 15 of ASTM D 422

D = SQRT of {[(30*η)/(980*(Gs-Gw)] * (L/T)} in mm

Where η= Viscosity of suspending Medium (Water) in poises
L = Effective Depth = L1+ 0.5*[L_2 - V_B /A)] in cm
L1 = distance from the top of the bulb to Recorded Hydrometer Reading in cm
T = Time in minutes

Date	Time	Elaspsed Time (minutes)	Hs in Divisions	Hc in Divisions	Temp Tc in C	R=Hs-Hc	P in %	L in cm	η in Poise	K	D in mm
2-Apr-22	11:30:00 AM	1.0	1.0330	0.0030	21.9	1.0300	95.9	7.49	9.63853	0.01317473	0.0361
	11:31:00 AM	2.0	1.0325	0.0030	21.9	1.0295	94.3	7.63	9.63853	0.01317473	0.0257
	11:34:00 AM	5.0	1.0320	0.0030	21.9	1.0290	92.7	7.76	9.63853	0.01317473	0.0164
	11:44:00 AM	15.0	1.0305	0.0030	21.9	1.0275	87.9	8.17	9.63853	0.01317473	0.0097
	11:59:00 AM	30.0	1.0290	0.0030	21.8	1.0260	83.1	8.57	9.66145	0.01319039	0.0071
	12:29:00 PM	60.0	1.0250	0.0030	21.8	1.0220	70.3	9.65	9.66145	0.01319039	0.0053
	3:39:00 PM	250.0	1.0190	0.0030	21.7	1.0160	51.2	11.27	9.68448	0.01320609	0.0028
3-Apr-22	11:29:00 AM	1440.0	1.0140	0.0030	20.1	1.0110	35.2	12.62	10.06625	0.01346388	0.0013

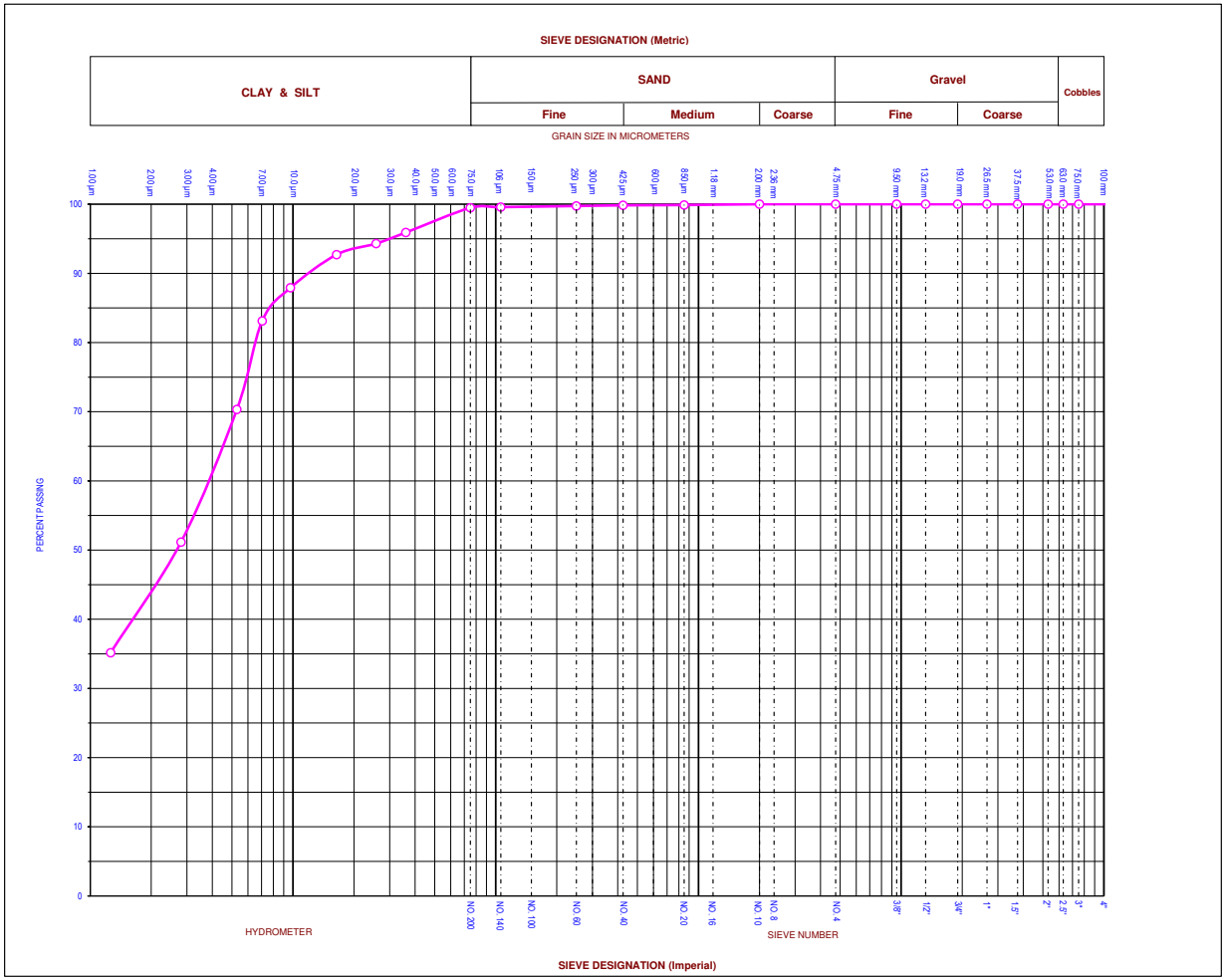
L1 cm	Viscosiity C	K (η/(Gs-1)
1.35	-0.426827	5.6697227
1.49	-0.426827	5.6697227
1.62	-0.426827	5.6697227
2.03	-0.426827	5.6697227
2.43	-0.424451	5.6832087
3.51	-0.424451	5.6832087
5.13	-0.422071	5.696751
6.48	-0.383407	5.9213247

Mass Retained on Seive # 10	0
Mass Passed Seive # 10	297.2
Jar Number	

Hygroscopic Data		
	Can Id	100
	Empty Can Weight (g)	13.60
	Can+ Air Dried Soil (g)	32.30
	Can + Oven Dried Soil (g)	32.18

AECOM Canada Ltd.

UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION CURVE (SIEVE AND HYDROMETER ANALYSIS)

AECOM CANADA LTD. 83 Galaxy Blvd, Unit 6 Toronto, Ontario	Client	AECOM		Date	April 1, 2022		Project Number	60634622			Gravel (%)	0
	Sample ID	S2MW	TW1 SS1	Depth (feet)	0		Project Name	DYT3			Sand (%)	1
	Lab Sample No:	202204006S					Project Location	OTTAWA			Silt (%)	56
	Soil Classification	Lean Clay, trace sand (CL)									Clay (%)	43
	Figure No.			D10	N/A	D30	N/A	D60	0.004	Cu	N/A	Cc	N/A

AECOM CANADA LTD.

AECOM

DETERMINATION OF UNIT WEIGHT - ASTM D7263

Project Number	60634622	**Date Tested**	29-Mar-22	**Tested by**			
Project Name	DYT3	**Location**	2625 Sheffield Rd, Ottawa, ON	**Checked by**	Ramana M		

Water Content

Test Info	**Lab Number**		**202204007S**							
	Borehole Name		**S1-MW**							
	Sample ID		**TW1**							
	Depth		**78'(Bottom 20cm)**							
	Trial		**A**	**B**	**A**	**B**	**A**	**B**	**A**	**B**
	Tare ID		190	192						
Mass in Grams	**Tare Wt**		13.50	13.60						
	Tare + Wet Soil		51.40	45.60						
	Tare + Dry Soil		43.90	39.19						
	Water	M_w	7.50	6.41						
	Dry Soil	M_d	30.40	25.59						
Water Content %		w	24.67	25.05						
Average %			24.86							

Weight- Volume Relations

Temp of water (C)			20	20						
Density of Water			1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Mass in Grams	**Wet Soil**	M_t	147.32	169.82						
	Soil + Wax in Air		162.27	179.80						
	Wax		14.95	9.98						
	Wet Soil + Wax in water		73.79	85.63						
	Dry Soil[A]	M_d	118.17	135.80						
Specific Gravity of Soil (assumed)		G_S	2.72	2.72						
Volume in CC	Wet Soil + Wax[B]		88.48	94.17						
	Wax		16.46	10.99						
	Wet Soil	V	72.02	83.18						
	Dry Soil = M_d / G_s	V_S	43.52	50.02						
KN/cum	Wet Unit Weight = (M_t/V)x9.81	γ_m	20.07	20.03						
	Average Wet Unit Weight		**20.05**							
	Dry Unit Weight = (M_d/V)x9.81	γ_d	16.10	16.02						
	Average Dry Unit Weight		**16.06**							
Void Ratio = $(V-V_S)/V_S$		e	0.65	0.66						
Porosity % = $[(V-V_S)/V]x100$		n	39.56	39.87						
Degree of Saturation = $[V_w/(V-V_s)]$ x100		S	100.00	100.00						

DETERMINATION OF SPECIFIC GRAVITY OF SOIL SOLIDS

Client	**AECOM**	**Project Number**	**60634622**		**Date**	**4-Apr-22**	
Project Name	**DYT3**				**Done By**	**Ian P**	
Location	**Ottawa**				**Reviewed By**	**Ramana M**	
Borehole Number	**S2/MW TW1**	**Sample Id**	**SS7**	**Depth (feet)**		**Lab#**	**202204006S**

Description	Formula	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6
Weight of Empty Density Bottle (g) W_1		89.32	87.44	89.18			
Weight of Density Bottle + Dry Soil (g) W_2		109.43	109.54	109.92			
Weight of Dry Soil W_s (g)	$W_0 = W_2 - W_1$	20.11	22.1	20.74			
Weight of Density Bottle + Water (g) W_4		338.35	337.11	338.42			
Weight of Density Bottle + Soil + Water (g) W_3		351.24	351.28	351.72			
Weight of Water Displaced (g) W_4	$W_5 = \{(W_0 + W_4) - W_3\}$	7.22	7.93	7.44			
Specific Gravity of Soil Solids	$G_s = (W_0) / (W_5)$	2.785	2.787	2.788			
Average Specific Gravity at room temperature (G_T)		2.787					

Description	Formula	Data
Room Temperature T ^{0}C		21.5
Standard Temperature for Reporting Specific Gravity		20
Relative Density of Water at Room Temperature γ_T		0.997913
Relative Density of Water at Standard Temperature γ_{20}		0.998234
Corrected Specific Gravity (G_{20})	$G_{20} = G_T * (\gamma_T / \gamma_{20})$	2.786

k 0.999677931

One-Dimension Consolidation Test as per ASTM D2435-11

Lab Number	202204006S			Date of Testing	30-Mar-22
Project Num	60634622	Client	AECOM	Tested by	Ian / Dharmik/ Sam
Project Nam	DYT3 Ottawa			Reviewed by	Ramana M
Project Locat	2625 Sheffield Road, Ottawa, Ontario				
Sample Id	BHS2/MW TW 1 (SS7)			Depth (feet)	20-22

Grain Size Analysis Results					
Gravel %	Sand %	Silt %	Clay %	Soil Type	
0	1	56	43	**Lean Clay**	
Atterberg's Limits			**Other Results**		
LL %	PL %	PI %	SG	***Y kN/m^3	***Υ_d kN/m^3
30	19	11	2.787	1.947	1.486

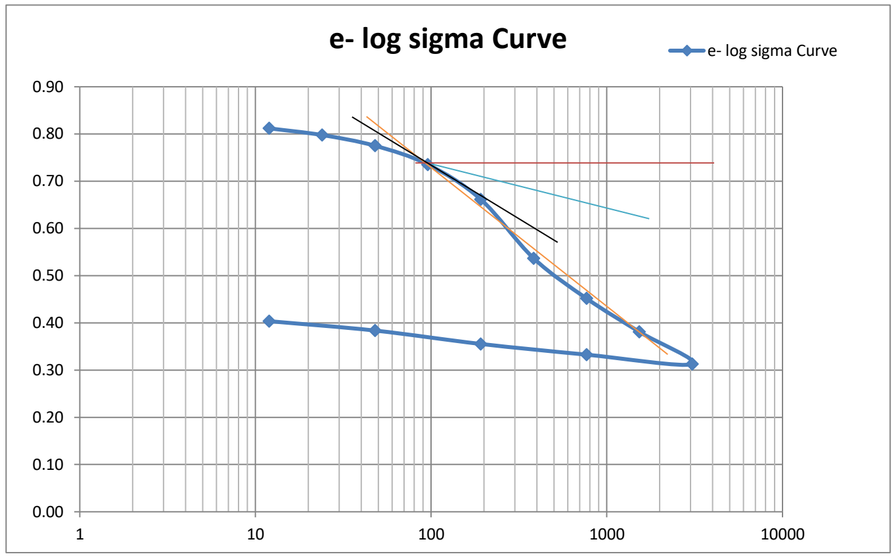
Note: ** Assumed Values *** Before Testing

CONSOLIDATION TEST SUMMARY

Initial Height of Specimen H_0 (mm)			1.91	Height of Solids H_s (cm)		0.896
Load Increment	Axial Stress σ_a (lb/ft^2))	Axial Stress σ_a (kPa)	Corrected Deformation ΔH (cm)	Specimen Height H (cm)	Axial Strain ε_a (%)	Void Ratio e
1	Seating Load		0.0000	1.9100	0	1.13
2	125	11.97	0.2870	1.6230	15.0272251	0.81
3	250	23.94	0.2997	1.6103	15.6921466	0.80
4	500	47.88	0.3200	1.5900	16.7560209	0.78
5	1000	95.76	0.3556	1.5544	18.617801	0.74
6	2000	191.52	0.4216	1.4884	22.0753927	0.66
7	4000	383.04	0.5334	1.3766	27.9267016	0.54
8	8000	766.08	0.6096	1.3004	31.9162304	0.45
9	16000	1532.16	0.6731	1.2369	35.2408377	0.38
10	32000	3064.32	0.7341	1.1759	38.4324607	0.31
11	8000	766.08	-0.7163	1.1937	-37.5015707	0.33
12	2000	191.52	-0.6960	1.2140	-36.4376963	0.36
13	500	47.88	-0.6706	1.2394	-35.1078534	0.38
14	125	11.97	-0.6528	1.2572	-34.1769634	0.40

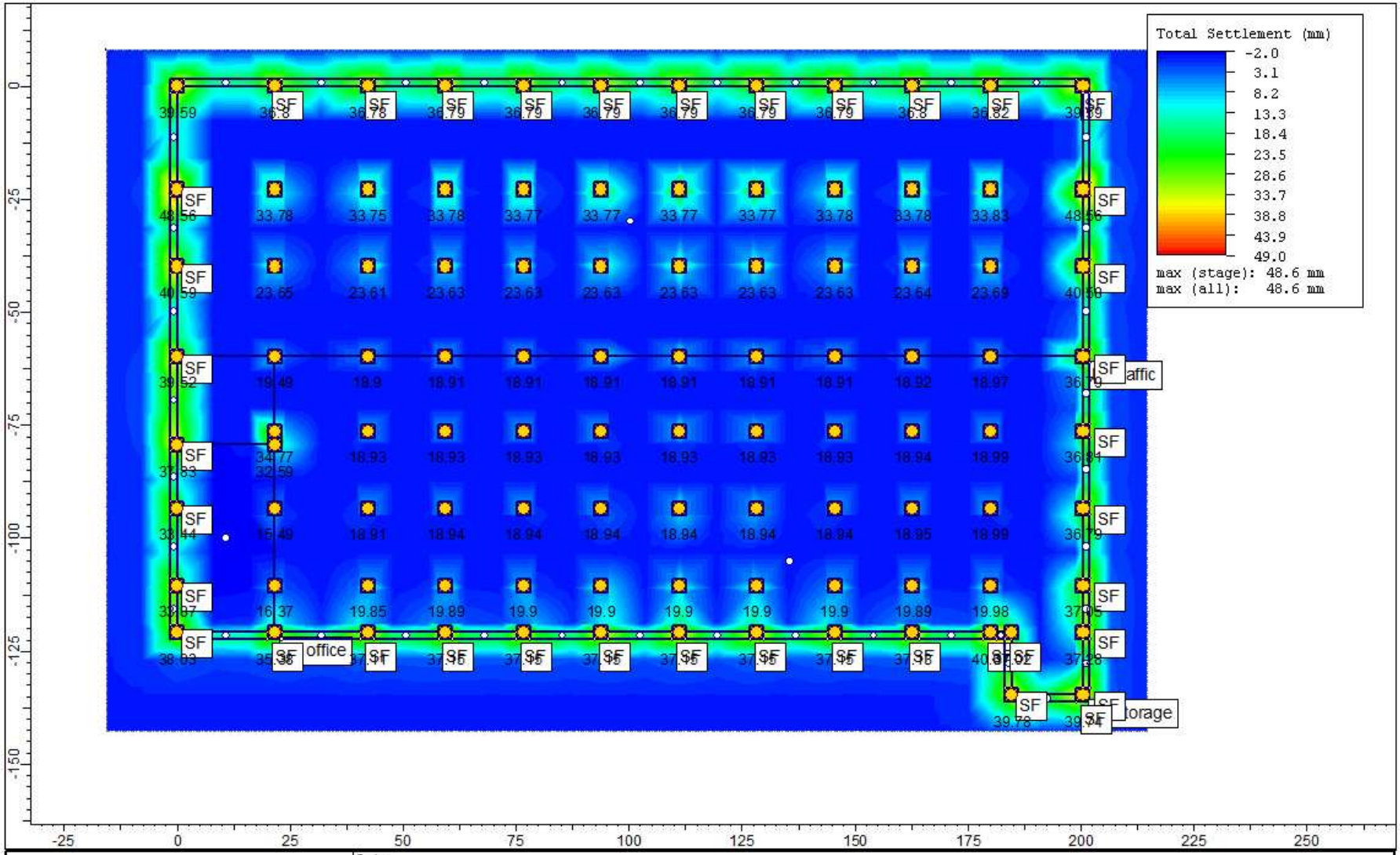
Void Ratio e	Axial Stress σ_a (kPa)	Log of Axial Stress σ_a (kPa)
1.13	0	#NUM!
0.81	11.97	1.078094
0.80	23.94	1.379124
0.78	47.88	1.680154
0.74	95.76	1.981184
0.66	191.52	2.282214
0.54	383.04	2.583244
0.45	766.08	2.884274
0.38	1532.16	3.185304
0.31	3064.32	3.486334
0.33	766.08	2.884274
0.36	191.52	2.282214
0.38	47.88	1.680154
0.40	11.97	1.078094

Determination of Pre-Consolidation Pressure from e-logσ Curve

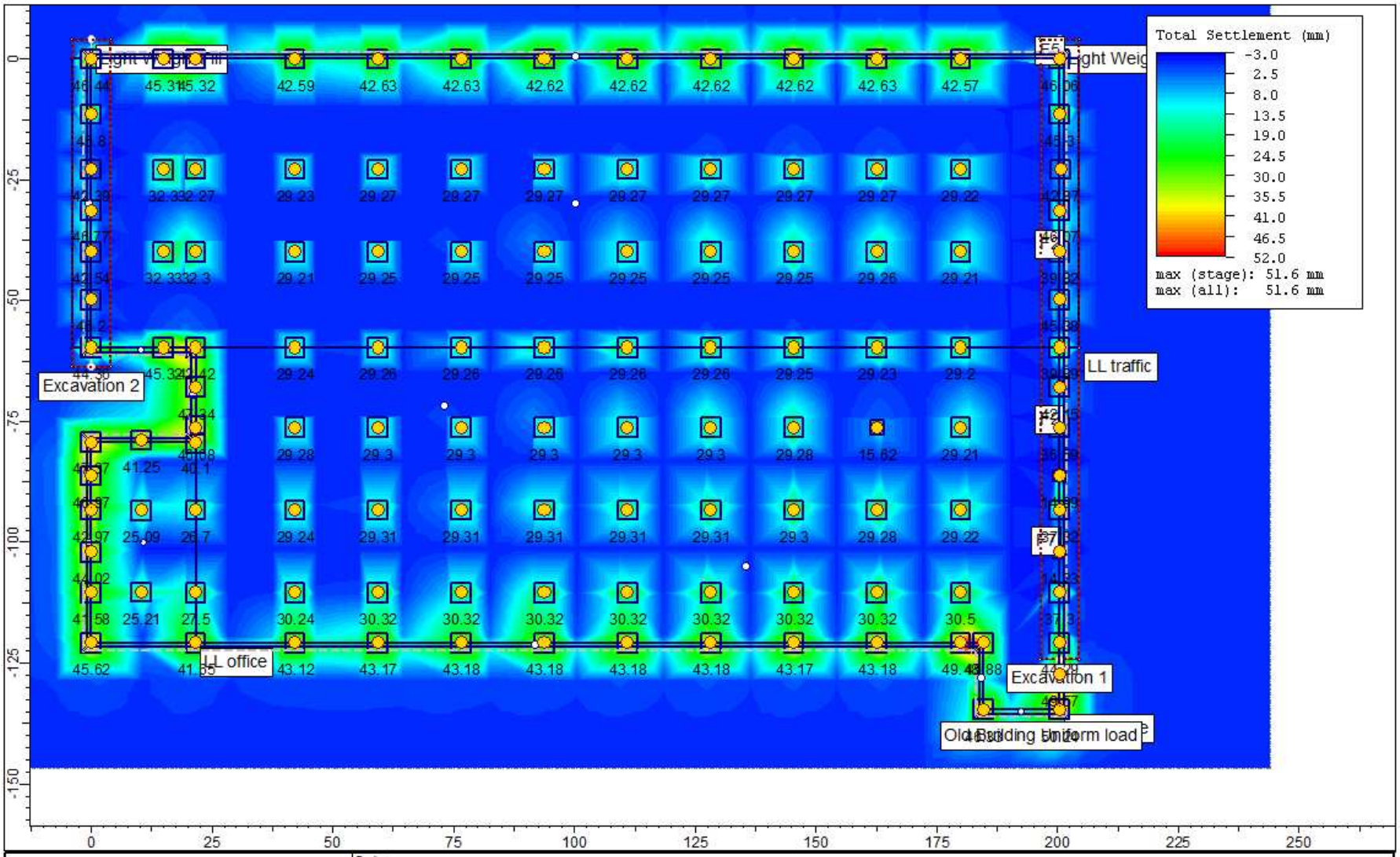


Coefficient of Compressibility C_c	Preconsolidation Pressure p_0 kPa
0.3109	100

Appendix C Settlement Analysis



AECOM	Project	AMZL-DYT3 Settlement Analysis	
	Analysis Description	Total Settlement at 15 Years	
	Drawn By	Jack Yu Guo	Company: AECOM Canada Ltd.
SETTLE3 5.016	Date	2022-04-12, 12:13:31 PM	File Name: Settlement_detailed .s3z



AECOM	Project	AMZL-DYT3 Settlement Analysis	
	Analysis Description	Total Settlement at 15 Years (Lightweight Fill)	
	Drawn By	Jack Yu Guo	Company: AECOM Canada Ltd.
	Date	2022-11-22	File Name: Settlement_detailed_update_SLS.s3z

SETTLE3 5.016